FARM SIZE AND PRODUCTIVITY IN EGYPTIAN AGRICULTURE: AN ANALYSIS OF AGRARIAN STRUCTURE AND TECHNICAL CHANGE

PhD Economics

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ABSTRACT

The inverse relationship between farm size and productivity is widely accepted as a "stylised fact" of agriculture in developing countries, a generalised phenomenon observed in widely differing agro-climatic conditions and agrarian structures. This thesis uses primary fieldwork data to examine the factors which give rise to such a relationship, and the impact of economic and technological change on the inverse relationship in the context of Egyptian agriculture.

The significance of the inverse relationship as a crucial developmental issue cannot be overemphasised. The inverse relationship constitutes a major component of the economic rationale for redistributive land reform, and has obvious importance for policy issues concerning land reorganization.

Part one critically discusses the inverse relationship debate, with particular emphasis on India, as an essential preliminary analysis to the examination of the Egyptian situation. The Indian literature on the inverse relationship is by far the most extensive, and it is within this debate that most of the analytical approaches to the inverse relationship have originated.

The second, core part of the thesis uses fieldwork data from rural Egypt (an extensive 18-village survey conducted by the ILO in 1976 and the author's own intensive 2-village survey conducted in 1990) to support a new political economy approach to understanding the factors behind the inverse relationship and to examine how the inverse relationship breaks down in the dynamic context.

We show that in the static context, the inverse relationship arises from the economic compulsions to which poor peasants are subject within a relatively backward agriculture. Redistribution of land on the basis of the inverse relationship argument therefore, will only deepen and perpetuate these conditions.

Furthermore, in the dynamic context of technological change, the inverse relationship will disappear. The inverse relationship argument for redistributive land reform no longer has any rationale in the context of changing production conditions.

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ACKNOWLEDGEMENTS

My foremost debt of thanks go to my friend, colleague and supervisor, Professor Terry Byres at SOAS, who has been a constant source of advice and inspiration. It was Terry who planted the seeds of this thesis and who has over many years developed the central ideas at the core of my understanding of the inverse relationship, and the analytical framework within which such a study has to be located.

This work also has its origins in my MPhil thesis at Cambridge University and my thanks are also due to John Sender who was my supervisor there, and for his continuing help and advice as a colleague at SOAS. I am greatly indebted to Samir Radwan, Chief of the Rural Employment Policies Branch, Employment and Development Department, International Labour Office, in Geneva, for providing me with the original data on which his joint study with Eddy Lee on the anatomy of rural poverty in Egypt was based. Samir also greatly facilitated my fieldwork in Egypt during the summer of 1990. Many thanks are also due to his colleagues Albert Wagner and Patrick Cornu for preparing the tape files and instructions. I appreciate immensely the enabling help of Ajit Ghose, formerly at the ILO, and Ruchira Chatterji, formerly at SPS, Cambridge University.

I would like to thank Dr Yunis Batriq, Cultural Attache, and Dr Elsaid Elbaz, Agriculture Councillor, at the Egyptian Embassy in London for their advice and letters of introduction to Dr Yusuf Wali, the Egyptian Minister of Agriculture; Dr Hassan Khadr, the Under-Secretary of Agriculture, Agricultural Economics Department; and Dr Mohammed Salim at the Central Agency for Public Mobilisation and Statistics, who authorised and facilitated my fieldwork with letters of introduction to the Agricultural Administrations in Giza and Qena governorates.

I received immensely useful advice from Professor Alan Richards, formerly at the American University in Cairo, Dr Richard Adams at the International Food Policy Research Institute in Washington, and Dr Nicholas Hopkins at AUC who have all had long experience of working in rural Egypt. I would also like to thank Professor Heba Handoussa, head of the Department of Economics and Politics at AUC, and Dr Souraya Turki, head of the Department of Sociology at AUC for providing academic hospitality.

I am indebted to the help, advice, hard work and friendship of the members of my fieldwork team: Dr Amin Girgis of the Statistics and Computing Section of the Giza Agricultural Administration; Sabri al-Shoni, Agricultural Engineer in the Giza Agricultural Administration; and Mohammed Sayyid, agricultural extension worker (for agricultural machinery) in the Qus District Agricultural Unit. Thanks also go to Atef Abu al-Azam, Director of the Statistics Department, Giza Agricultural Administration; Abdel Azim, Director of the Saff District Agricultural Unit;
and especially Hassan Abdel-Fattah Hassan, Director of the Shubak al-Sharqi Cooperative, and Antar Mahdi, Supervisor in the Shubak al-Sharqi Cooperative for their time and help. In Qena, my thanks go to Faruq Aref, Director of the Qena Agricultural Administration; M. Makram, Director of the Statistics Section in Qena Agricultural Administration; Murtada Abd al-Naim, head of Public Relations in Qena Agricultural Administration; and Abdel Aziz Arabi, Director of the Qus District Agricultural Unit. I owe especial thanks to Abd Ali Majr, head of the Agriculture Unit and Director of the Higaza Cooperative; Rabia Nur, Agricultural Supervisor in Higaza Cooperative; and Abu al-Fadl of the Village Bank in Higaza. Above all, I thank the farmers of Shubak al-Sharqi and Higaza who welcomed me into their homes and gave me their time and information.

I would also like to thank Mohammed Zeidan at the Agricultural Museum in Cairo, and Ahmed Rammah at the Agricultural Research Centre, for their advice and help; and the library staff at AUC and the USAID depository in Cairo for their kind and efficient help.

Finally, this thesis is dedicated to my family: Nada, Souraya and Jihane without whose love, support and patience this work would not have been possible.

INTRODUCTION

The present study: nature and rationale

The inverse relationship between farm size and farm productivity is widely accepted as a "stylised fact" of agriculture in developing countries, a generalised phenomenon observed in many countries characterised by widely differing agro-climatic conditions, agrarian structures and cropping patterns. This thesis uses primary fieldwork data to examine both the factors which give rise to such a relationship, and the impact of economic and technological change on the inverse relationship in the context of Egyptian agriculture.

The significance of the inverse relationship as a crucial developmental issue cannot be overemphasised. It is important not only in terms of the debate surrounding economies/diseconomies of scale, but because land ownership in backward agriculture is practically synonymous with control of labour, wealth, and social and political power. The inverse relationship constitutes a major component of the economic rationale for redistributive land reform, and has obvious importance for policy issues such as cooperative and other forms of land reorganization, involving discussion of factors such as market imperfections and the institutional framework of traditional agriculture.

This thesis is in two parts. Part one, comprising the first six chapters, critically discusses the inverse relationship debate, with particular emphasis on India. The Indian literature on the inverse relationship is by far the most extensive, and it is within this debate that most of the analytical approaches to the inverse relationship have originated, even if only embryonically. These chapters are more than simply a review of the literature. Both the treatment of the Indian literature in Chapters I to V, and that of Berry and Cline (which surveys a wider range of empirical material) in Chapter VI are intended as contributions in their own right and as an essential preliminary analysis to the examination of the Egyptian situation.

The second, core part of the thesis uses fieldwork data from rural Egypt (both an extensive 18-village survey conducted by the ILO in 1976 and the author's own intensive 2-village survey conducted in 1990) to support a new political economy approach to understanding the factors behind the inverse relationship and to examine how the inverse relationship breaks down in the dynamic context.

Chapter I discusses the nature and extent of the evidence for an inverse relationship in the agrarian sector of developing countries, and the suggested policy implications of such a relationship. We are not attempting here a comprehensive treatment of the range of evidence; rather a statement which captures the widespread existence of such a relationship, in order to set the context for the core part of the thesis, relating to Egypt. We concentrate here on the Indian debate as it has been the by far the most intensive and prolonged.

We demonstrate that the suggested policy implications are heavily dependent on a number of unconvincing assumptions. They are also dependent on a particular theoretical perspective on the inverse relationship. Nevertheless, these implications of the inverse relationship, accepted at face value and without critical examination of its nature or causal factors, are subject to severe qualifications. Any positive impact may be severely constrained by efficiency considerations relating to minimum feasible farm size, input availability, dynamic general equilibrium effects on saving, investment and employment, and the nature of technical and social change in agriculture. After examining the causal explanations for the inverse relationship and placing it in the context of agrarian transition in later chapters, however, we shall see that the inverse relationship rationale for redistributive land reform disappears.

Chapter II clarifies the issues involved with a detailed examination of the major conceptual, statistical and methodological problems associated with the inverse relationship debate. Neither the existence of the inverse relationship, nor its implications, have gone unchallenged. Indeed, Amartya Sen, who is regarded as the prime mover of the debate, was one of the first to admit that the inverse relationship was by no means a well established fact and had not been proven beyond the legitimate doubts of exacting statisticians.

The necessity for care in interpreting the inverse relationship findings is imposed by a number of important conceptual, statistical and methodological problems associated with the data. Classification by farm-size implies that the characteristics of a farm depend predominantly on its belonging to a certain size-group. Size of farm however is a very general variable and to treat it as the only significant parameter would be a mistake. Other significant problems include the level of aggregation of the data, and the use of OLS regression techniques on grouped data.

Despite these problems, the inverse relationship has been confirmed in Indian agriculture at the time during which the studies cited in this chapter were conducted, and its statistical validity has been adequately established by an analysis of the disaggregated data. It is not necessarily, however, a phenomenon that will persist indefinitely. Clearly the inverse relationship is a phenomenon that needs to be explained, and not explained away by "exacting statisticians".

A number of conjoint relationships are revealed by the various studies mentioned, involving other factors of production besides land. These relationships tend to be clustered, suggesting some *a priori* explanations for the inverse relationship along factor-intensity lines. This sets the context for a critical examination of the major theoretical explanations of the inverse relationship in the following four chapters.

Chapter III turns to the theoretical debate with a critique of those explanations of the inverse relationship which attempt to explain the inverse relationship in terms of qualitative factor differences between farm-size categories. It is postulated that small farm-size categories, however they may be defined, utilize qualitatively superior factors of production, either in terms of physical resources such as soil quality and irrigation, or in terms of management, labour, and production technique. The main thrust of such an approach has been to explain why such factors are concentrated on small farms.

We demonstrate in this chapter that the explanations of the inverse relationship based on qualitative factor differences are severely flawed. The various approaches are both theoretically inadequate and their assumptions remain unsupported by the empirical evidence. The essentially untestable hypotheses relating to superior management on small farms rest on an uncritical acceptance of the inverse relationship data, relying on a residual hypothesis tested by weak and unreliable proxy variables without consideration of other factors which a more critical analysis of the data suggests are important.

The alternative hypothesis concerning differentials in land or soil quality between farm sizes rests on conceptual confusion over the meaning of fertility and on the distinction that must be made between the macro and micro levels of aggregation. At best, indirect and imprecise data have been used to support *a priori* reasoning which neglects factors which would tend to undermine the hypothesis.

Chapter IV continues the theoretical critique with an examination of those explanations based on differential factor input intensities between farm size categories, comprising a range of variant cheap labour theories. This approach postulates that small farms apply production inputs, especially land and labour, more intensively in cultivation. The debate has centred around Amartya Sen's model which postulates different behavioural strategies as between farm-size categories. A more explicitly neoclassical variant of this approach will also be discussed.

Clearly, the empirical evidence does on the whole provide support for an explanation of the inverse relationship based on factor intensities, and in particular, a labour-based explanation. The clustering of empirical relationships around cropping intensities and labour input intensities (the latter subsuming capital and irrigation factors) in association with the inverse relationship finding certainly justifies the focus on patterns of labour use.

However, the models presented in this chapter which attempt to explain how the inverse relationship is generated via labour utilisation are theoretically flawed while crucial elements in their underlying assumptions are also subject to empirical refutation. The critical problems arise from the production function methodology employed. Conceptually, these approaches depend on a spurious calculus involving the marginal product of labour and the wage rate. As we will see, the former is an operationally useless concept in agricultural production, while the latter is only one and probably not the most important variable taken into account in determining labour use. The question must encompass a more complex set of market and non-market relations than the suggested behavioural assumptions incorporated in the models allow.

These essentially static choice-theoretic frameworks have proven to be seriously defective. This would suggest that the framework of analysis is inappropriate. There is clearly a need to go beyond farm size as the relevant stratifying variable to examine the underlying relations and forces of production.

Chapter V turns to an examination of the inverse relationship in the context of agrarian transition, and attempts to transcend the limitations of the debate. We present a new approach to explaining the existence of an inverse relationship within a political economy perspective, and show how in the dynamic context, the inverse relationship breaks down.

We propose an alternative class-based approach to understanding the inverse relationship. This class-based approach proceeds from the proposition that the peasant farm is embedded in the socio-economic context of an emerging capitalist agriculture in which however, non-capitalist forms of surplus appropriation are still prevalent. Where capitalist farming is emerging out of a semi-feudal agriculture, the coexistence of both the modes shapes the labour market, while the characteristics of the labour market itself influence the form and process of transition.

The class-based approach attempts to locate farm size within a class matrix. The fundamental determinants of factor-use intensities are the nexus of property rights and tenurial conditions that shape market characteristics, resource endowments, and the nature and extent of market participation by different peasant strata. Within the process of peasant differentiation, poor peasants end up with smaller and smaller below-subsistence plots of land, and are forced to intensify cropping intensity and labour input in order to achieve subsistence levels of income. This stratum of poor peasants may also be characterised by compulsive market involvement or "forced commerce". Exploitative relations of production and exchange, with landlords, merchants and moneylenders extracting surplus via high rents, usury and price wedges, either singly or conjointly, compel poor peasants to achieve higher than average yields, market a high proportion of high-value cash crops, and sell labour off-farm in order to pay off cash and debt obligations as well as reach subsistence income.

In those areas where we find an inverse relationship, it is the case that all farm sizes have access to a more or less similar technology. Large and small farms use the same set of production inputs, and the small farms achieve higher output per acre via higher cropping intensity and higher application of labour effort per acre. With the introduction of a new technology which favours large farms due to its associated economies of scale, the so-called advantage which the small farms have with respect to labour input intensity, may be matched or more than matched by the new advantages which large farms have with respect to technology. In this situation, we might expect the inverse relationship to break down and eventually disappear, and with it part of the case for redistributive land reform.

Chapter VI rounds off the first part of the thesis with a critique of what is regarded by many authors as the definitive theoretical and empirical study of the inverse relationship: that of Berry and Cline. This chapter too, is not presented merely in terms of a review of the literature. The rigorous statistical treatment of the Berry and Cline data, which has been so influential, is offered as a contribution to the debate in its own right.

We devote a chapter to this study for three reasons. The first is because it allows a more general treatment of the inverse relationship result than we have attempted so far. Secondly, it displays serious methodological shortcomings which need to be addressed. And finally, such a chapter constitutes a useful bridge into the second part of the thesis, which relates to a country other than India: Egypt.

The main policy conclusion presented by Berry and Cline, of an equalising distribution of land towards the small farm sector, is both crude and simplistic, and requires a number of unrealistic assumptions to hold. They are further rendered baseless by inadequate theoretical and empirical support. The aggregate nature of most of the empirical evidence leads to an inevitable confusion between the macro and micro level inverse relationships which are of entirely different import. This applies particularly to the cross-country data, but also to most of the individual country case studies. Certainly, such data is an inadequate basis for testing the hypotheses concerning market imperfections.

The theoretical framework chosen by the authors, that of differential factor prices and imperfect markets, is both logically flawed and not supported by the evidence. Further, where it does have some validity, however inadequate, it actually undermines its own purpose. The so-called market imperfections adduced would seem more appropriate to explaining why the inverse relationship might be expected to disappear in the long-run rather than explaining the existence of an inverse relationship.

Chapter VII turns to the core part of the thesis with a critical survey of the inverse relationship debate in the Egyptian context. We examine the nature and range of evidence for an inverse relationship between farm size and productivity in the Egyptian countryside. In contrast with the extensive Indian literature on the inverse relationship is the rather meagre resonance that the debate has had in Egypt. This relative paucity, however, has not prevented calls by several writers for redistributive land reform in the Egyptian countryside. The Egyptian evidence ranges from simple assertion, by invoking the authority of Berry and Cline, to full-scale field studies.

The studies examined in this chapter present apparently strong, but contradictory evidence on the relationship between farm size and productivity, with some contributors supporting the existence of an inverse relationship while others vehemently deny its existence. However, all the participants in the Egyptian debate reveal crucial conceptual and methodological flaws in their analyses, echoing many of the errors and misconceptions we have examined in the previous six chapters. It is important to consider these in some detail since they are flaws which recur wherever the inverse relationship has been examined and discussed. We draw heavily on the critical analysis of the debate surrounding the inverse relationship which we have discussed thoroughly in the previous six chapters.

Nevertheless, these inconclusive and partial results do suggest that the inverse relationship may be an important phenomenon in rural Egypt, although not in the way conceived of by the authors looked at in this chapter.

Chapter VIII identifies the central features of the political economy of the Egyptian countryside, as a necessary prelude to discussion of the fieldwork data. We consider some of the central features of the political economy of the Egyptian countryside, which have been identified by other researchers and which are central to our own analysis. In other words, we here survey the evidence with respect to the mechanisms and institutions which have been central to rich peasant dominance in contemporary Egypt. This is an important prelude to the treatment of the ILO data and the author's study villages in the following chapters. As we shall see, the influences identified in this chapter were crucial in the study villages, both with respect to the causal factors behind the inverse relationship and to its disappearance.

We shall see that despite significant land reform measures, important elements of semi-feudal agriculture remain strong: sharecropping tenancy, personalised oral contracts, and an indebted poor peasantry. Access to land and resources lies through the patronage of the rich peasants and those landlords who managed to evade land reform legislation. This is the environment, the matrix of exploitative relationships, in which the inverse relationship flourishes.

Our hypothesis is that in the early stages of transition, institutional biases act strongly in favour of the larger farmers. Several studies show that the main beneficiaries of the land reform legislation, and subsequently, the cooperative and rural credit system in Egypt were the rich farmers. The control of the latter by the rich peasantry, those owning over ten feddans of land, ensured their dominance with respect to the diffusion of the new technology. While at an earlier stage, intrinsic advantages of scale are not unimportant, these become increasingly significant over time, enabling the large farmers to maintain relatively high investment and growth rates. In this two stage process, the first impact of agrarian transition is the weakening and disappearance of the inverse relationship. Later, when scale advantages operate for a substantial length of time the relation turns significantly positive.

Chapter IX employs an extensive ILO data set covering 18 villages in 6 regions of Egypt to show a more complex and heterogeneous pattern of the relationship between farm size and productivity. We subject the data used by Radwan and Lee in their 1986 study to much closer examination, in order to discover the nature and extent of the inverse relationship in the Egyptian countryside, and its relationship to technological change. This will provide a stronger empirical support for our hypotheses. Then, in the following chapter, we can explore, at the more disaggregated level of individual villages, just why such an inverse relationship exists, where it exists, and how it is changing.

Analysis of the data at a more disaggregated level produces results at variance with widely held views on the size-productivity relation. We find in the Egyptian rural sector striking parallels with the process of agrarian transition in India, with regard to the technological factors. The heterogeneous pattern of technological change in Egyptian agriculture is mirrored by the pattern of occurrence of an inverse relationship between farm size and productivity. Where technical change in agriculture is at a relatively undeveloped stage, we appear to have evidence of a significant inverse relationship. In those regions where technical change is relatively more advanced, the inverse relationship is absent. We can advance the hypothesis, on the basis of the evidence in previous chapters, that technical change in these latter regions has led to the breakdown of a previously existent inverse relationship.

Finally in Chapter X, intensive village fieldwork data from 1990, collected by the author, is used to provide support for the political economy approach to explaining the inverse relationship and its breakdown in the Egyptian context. In order to test the various hypotheses associated with the inverse relationship, two village surveys were carried out in the summer of 1990. On the basis of the results from the ILO data, a village (Higaza al-Qibli) was chosen from Qena governorate which was expected to show a positive relationship between farm size and productivity. A second village (Shubak al-Sharqi) was chosen from Giza governorate which was expected to shed light on the inverse relationship.

Land reform in Shubak has created a situation in which relatively little social differentiation and elite land accumulation has occurred. Thus, land reform has actually had the effect of slowing down capital accumulation, inhibiting saving and investment. Shubak is characterised by small scattered land possessions prohibiting the application of modern technology and leading to the fragile formation of capitalism. Land fragmentation has weakened the ability of large farmers to adopt new agricultural methods, slowing down the intensification of capital utilization. Significant elements of semi-feudal agriculture remain to provide the compulsions driving poor farmers to intensify land and labour use, thus generating an inverse relationship.

The village is dominated by middle and rich peasant farms which have not developed into capitalist farmers. These farms are not fully commercialised and operate with essentially the same techniques of production as the poor farmers with less than three feddans of land. Clearly, the evidence from Shubak shows us that the larger farmers are not qualitatively different from smaller farmers, but only quantitatively differentiated.

In contradistinction, Higaza clearly falls into a capitalist path category. This village has a relatively greater concentration of land, a larger area and population, and higher levels of new technology use, particularly mechanization. The cooperative system was dominated by the rich peasants allowing the large farms to accumulate land and other means of production such as machinery. Thus, Higaza has exhibited a different outcome with increased social differentiation and the potential disappearance of the small farmer rather than his survival.

Higaza has also benefited from development efforts in the form of loans for machinery and other modern inputs because of its integration into an industrialised agriculture dominated by sugar capital. The mode of production has changed because capital has penetrated the village and changed the system of production instead of being merely externally imposed via market relations. The middle and rich peasant family farms have given way to capitalist enterprises organized by the family, but based on wage labour and capitalist accumulation, manifested in the intensive use of machine inputs.

The 'traverse' from Giza to Qena, representing a development of the forces of production both determines and is determined by the development of the relations of production. In particular, rich peasants, either as proto- or fully-developed capitalist farmers monopolise productive resources and dominate access to the new technology through their control of the cooperative and rural credit systems. The utilization of this new technology accelerates rich peasant accumulation and deepens the process of social differentiation. The productivity advantages thus gained lead to a reversal in the size-productivity relationship characteristic of a relatively backward agriculture.

In conclusion, we show through both theoretical critique and empirical analysis, that in the static context, the inverse relationship is not the product of superior efficiency on the part of small farms nor is it due to better quality land on the small farms, but arises from the desperate struggle of poor peasants for survival on below-subsistence plots of land in a relatively backward agriculture, and the matrix of exploitative relations within which they operate. Redistribution of land on the basis of the inverse relation argument therefore, far from alleviating poverty and creating employment opportunities, will only deepen and perpetuate extreme levels of exploitation and poverty. Furthermore, in the dynamic context of the development of the forces of production, in the shape of Green Revolution technology, the inverse relationship is likely to disappear. The inverse relationship argument for redistributive land reform no longer has any rationale in the context of changing production conditions.

CHAPTER I

The range of evidence for an inverse relationship and its apparent policy implications.

Introduction

The empirical evidence for the existence of an inverse relationship between farm size and farm productivity[1] is both historically and geographically widespread, ranging from pre-revolutionary Russia and China to contemporary poor countries in Asia, Africa and Latin America. Indeed, the inverse relationship is widely regarded as a "stylised fact" of traditional agriculture [*Bardhan, 1973: 1370*], a generalised phenomenon observed in many developing countries characterised by widely different agro-climatic conditions, agrarian structures and cropping patterns [*Cornia, 1985: 514-5; Ghose, 1979: 27*]. Section 1.1 presents a brief survey of the range of empirical evidence for such an inverse relationship. Clearly, we are not attempting a comprehensive treatment of the range of evidence; rather a statement which captures the widespread existence of such a relationship, in order to set the context for the core part of the thesis, relating to Egypt.

The significance of the inverse relationship as a crucial developmental issue cannot be overemphasised. It is important not only in terms of the debate surrounding economies/diseconomies of scale, but because land ownership in backward agriculture is practically synonymous with control of labour, wealth, and social and political power [*Bachman & Christensen, 1967: 263*]. Such a relationship has obvious importance for policy issues such as land ceilings and redistribution, as well as cooperative and other forms of land reorganization, involving discussion of factors such as market imperfections and the institutional framework of traditional agriculture [*Bardhan, 1973: 1371*]. We will consider some apparent policy implications in section 1.2. Section 1.3 engages critically with the assumptions behind such policy implications, and attempts to qualify their validity.

1.1 The range of evidence, with an emphasis on India

The modern debate surrounding the inverse relationship begins with the Indian Farm Management Studies (FMS) of the mid-1950s. This comprises a large theoretical and empirical literature which came into being due to the existence of a large body of data in the Farm Management Studies of the 1950s.[2] However, there are a number of important precursors of the Indian evidence and a range of other notable references from other countries. An inverse relationship can clearly be seen in data for both pre-revolutionary Russia and China. Roy [*1979: 1*] notes that the relative productive superiority of large farms versus small farms lay at the core of the controversy between Lenin and the Narodniki (the latter position later supported by Chayanov and the Organization of Production School). This is the case in as much as the identification of large farms as capitalist and smallholdings as peasant family farms is made. Interestingly, however, while the zemstvo data do support the existence of an inverse relation, neither Lenin nor Chayanov mention its existence in Russia.[3]

While the earlier Russian debate on the relative efficiency of small farms and large farms stressed the historical perspective in the transition to capitalist agriculture, the more recent debate emphasises microeconomic analysis. Bauer, in his 1948 study of the rubber industry in Malaya, the Netherlands East Indies and Sarawak makes the following observation: "In the choice of planting density the rational course is not the same for estates and for smallholdings. The latter incur no cash wage costs, being operated by the owner and his family, occasionally assisted by outside labour paid on a share basis. The smallholders attempt to maximise the gross yield per surface unit. On their densely planted holdings the trees are of smaller girth and the yield per tree lower than on the estates, but the yield per surface unit is higher. In Malaya and NEI normal, unrestricted yields on smallholdings are about 475-500 lb. per mature acre, against some 400 lb. on seedling estates" [*1946: 131*].[4] This is corroborated by Bevan in his 1962 study of rubber smallholdings in the coastal area of Selangar, Malaya, who finds slightly larger yields per acre on the smaller farms [*Bachman & Christensen, 1967: 247*].[5]

Cornia's study of fifteen developing countries found that output per acre systematically declines with increasing farm size in all countries except Bangladesh and Peru [*1985: 517-523*][6]. We cite Cornia's evidence in full in Table 1 in Appendix A in order to show the precise basis for the statement. Evidence exists also for the following countries: Poland[7], Iran[8], Indonesia[9], Pakistan[10], Argentina, Chile, Guatemala[11], Korea[12], Sri Lanka[13], Thailand[14], Mexico[15], Brazil[16], Kenya[17], Philippines, Colombia, Malaysia, Egypt, and others[18]. In Chapter VI, we critically examine what is regarded by some writers as the major empirical contribution to the debate over the inverse relation, that of Berry and Cline [*1979*], in the light of the observations and discussion in Chapters I to V.

Central to the modern Indian debate on farm size and productivity is the 17-volume Farm Management Studies (FMS) data collected by the Directorate of Economics and Statistics and the Research Programmes Committee over three years: 1954-5, 1955-6 and 1956-7. The FMS data covered 2,962 farms in six typical regions of India: Punjab, West Bengal, Bombay, Uttar Pradesh, Madras and Madhya Pradesh.[19] The studies adopted a multi-stage stratified random sampling procedure with villages as the primary unit and operational holding as the ultimate unit. Within each state, two contiguous districts were selected to represent typical soil-crop complexes and major cropping patterns. Each district was divided into two fairly homogeneous zones and 16 villages were selected at random with a probability proportional to respective populations engaged in cultivation (in each district, 10 villages were studied under the intensive cost-accounting method and ten by the sample survey method, with four of these studied by both alternative methods: thus, 16 villages per district).[20] Selection of operational holdings was carried out by size ranking within each village, and holdings were selected with equal probability from one of five equal size groups. Altogether, 1,096 farms (37% of holdings) were studied by the cost-accounting method. Information was collected concerning village area, population, livestock, soil type, climatic conditions, land utilization, demographic characteristics, operating costs, maintenance of livestock, purchase/sale of output, and yields, with all variables measured in annual flows and values measured in 1954-5 rupees.[21]

The Indian debate proper begins with Sen's seminal 1962 article in the Economic Weekly [*Sen, 1962*]. There he notes the following observations: "I: When family labour employed in agriculture is given an 'imputed value' in terms of the ruling wage rate, much of Indian agriculture seems unremunerative...II: By and large, the 'profitability' of agriculture increases with the size of holding, 'profitability' being measured by the surplus (or deficit) of output over costs including the imputed value of labour...III: By and large, productivity per acre decreases with the size of holding." Sen further notes that this latter trend holds in most areas for value-added too. We cite the statistical basis for Sen's argument in Table 2, Appendix A.

In the Indian context, precursors to Sen include Charan Singh,[22] Raj Krishna[23] and E.J. Long[24]. Long concludes that the data "clearly calls into question the supposition in much land reform discussion that large farms are more 'efficient' than small farms" [*1961: 118*]. Bachman and Christensen take this further, citing Mann who finds generally higher output per acre on small family farms than on the large cooperative farms in Punjab [*1967: 245*].[25]

Khusro [*1964*] and Bharadwaj [*1974a*] carry out more detailed studies using OLS regression techniques on the grouped FMS data. Table 3 in Appendix A [*from Bharadwaj, 1974a: 92*] lists the OLS regression coefficients for yields per acre on farm size for the entire data set.[26] While all regression coefficients are negative, not all are statistically significant. Khusro [*1964: 59*] finds no exception to an inverse relation in all seven states.[27] Khusro concludes: "It is this consistently recurring phenomenon of declining slopes in all seven States without exception that lends itself to the generalization that in Indian farming of the 1950s gross output per acre declines with an increase in farm size" [*1964: 54*]. Khusro then averages these results for all India: "the sceptical reader who refuses to accept this average as valid for the country or for the States in question can think of it as an average for the farms studied in the FMS survey" [*1964: 60, fn. 6*].[28] The constant generation and analysis of data since then continues to confirm the finding of an inverse relationship.[29]

Let us conclude this section with a statement that encapsulates the pervasiveness of the inverse relationship phenomenon by one of the principal contributors to the debate: " A striking feature of the agricultural systems of virtually all poor countries is that yields per acre rise as average farm size declines. That is, the smaller the farm, the greater the average productivity of land. Conversely, the larger the farm, the greater the average productivity of labour. Since land is usually the factor in most acute shortage, the farms with the highest yields per acre are normally the most efficient. Even in countries where the average farm is very small, such as in India, it has been demonstrated that those farms which are smaller than average are economically the most efficient" [*Griffin, 1974: 228*].[30]

1.2 Some apparent policy implications

The apparent implications of such a relationship constitute a major component of the economic rationale for redistributive land reform and a small farm bias in agricultural development strategy.

The inverse relationship between farm size and productivity has fundamental significance for economic policy, particularly the choice between small peasant family farms, large capitalist farms, and large cooperatives [*Chattopadhyay & Rudra, 1976: A115*]. An apparent implication is that a land reform which results in smaller units of management in agriculture would both reduce inequality and increase total output [*Griffin, 1974: 228*]. Cornia [*1985: 532*] writes: "Because of the demonstrated superiority of small vis-a-vis large farming, land redistribution would have, if thoroughly implemented, immediate beneficial effects in terms of output growth, enhanced income distribution and, as a result, of alleviation of rural poverty. It would also bring about a resource use more in line with the factor endowment of developing countries by increasing labour absorption...while forestalling premature labour-displacing mechanization."

In Paglin's view, citing the Japanese experience, large farms constitute a source of unexploited land resources that could be used to expand output and provide additional employment [*1965: 829*]. While Ghose [*1979: 39*] claims that the inverse relation demonstrates the static superiority of small-scale over large-scale production, Griffin takes the argument further: "It is also possible to argue...that in certain circumstances an agrarian reform would lead to an acceleration in the rate of growth of output, i.e. to cumulative gains" [*1974: 228*].

In India, the alleged relationship apparently strengthened the case of those arguing in favour of the small farm, as against those advocating the relaxation of ceiling laws. In particular, a section of opinion which, at one time backed the idea of cooperatives for overcoming diseconomies of scale of small farms, found it easier to accept the failure of the cooperative movement in the light of the observed finding that small farms were not so inefficient [*Rudra, 1968a: 1041*]. Chattopadhyay and Rudra [*1976: A115*] write: "Many erstwhile supporters of the cooperative movement have now turned into supporters of peasant farming, drawing consolation from the thought that large-scale farming is not after all necessary for dynamism in agriculture."

Dorner [*1974: 119*] stresses the productive and labour-absorptive capacity inherent in a small-farm system in providing more employment, a more equitable distribution of income (at least in the early stages of development), and a more relevant demand structure for the growing manufacturing sector. Lipton agrees that secondary demand for labour-intensive non-farm commodities, and therefore rural non-farm growth,[31] is relatively greater where land is more equally distributed. He also claims that land redistribution also redistributes the supply of and demand for credit and labour [*1993b: 649*].

For Lipton, the validity of the "really rather pervasive" [*1993b: 650*] inverse relationship at market prices "does make the static case for redistributive land reform" [*1993b: 645*].[32] Lipton [*1993b: 642-3*] argues that land redistribution to the poor can accelerate and equalize the long-run institutional outcomes of factor and product markets, technologies and power structures, but to achieve its aims, land reform requires institutions that render those aims incentive compatible. Reforms also need to be power compatible (allowing small farmers to mobilize politically around labour-intensive small-sale agriculture.

Lipton [*1993b: 653*] mentions three ways of asset enhancement for the poor: classical land reform via ceilings and confiscation; "new wave" decentralised market shifts of land to small farmers to be achieved more by market or tax incentives rather than through ceilings legislation and confiscation (the latter to be done by NGOs or local government rather than the central state; and regional rural development to steer resources to the poor. The primary motivation is to reduce poverty by land transfers to the poor that shift rural income, or power, toward poorer (not necessarily the poorest) rural groups, thereby reducing inequality: "A change is a land reform if and only if it enriches or empowers the rural poor by transferring substantial land rights to them" [*1993b: 644*].

Lipton [*1974: 304*] regards small farms as "superior" because they select both higher labour intensity and produce higher output per acre and output per unit of capital, thereby economising on what poor countries are short of (land and capital), absorbing idle resources (labour), and producing more of what is needed (food). Dorner [*1974: 119*] adds that under conditions of abundant rural labour and continuous population growth, productivity per unit of land will be the most relevant measure for policy purposes for the next several decades.

In view of these factor endowments, agriculture and the rural sector appear to offer the potential for generating livelihoods while increasing social returns to scarce capital resources, provided more labour-intensive policies and growth paths are followed [*Lipton and Lipton, 1993: 1523*]. In the South African context, Lipton writes that the prospects for more labour-intensive, small-scale farming are critically dependent on whether South Africa successfully reorients its research capacity toward resolving the technical problems involved in such farming: "Experience elsewhere suggests that it is important, early in a transition, to design a smallholder-responsive research and technology strategy, to ensure its stable domestic financing" [*1993: 1535*]. The technology available to black smallholders needs to be transformed by research and geared to the creation of productive work rather than to labour-replacing mechanization [*1993: 1523*].[33]

The further claim is made that small-scale farming can be modern, scientific and profitable [*Lipton & Lipton, 1993: 1524*], and that land-saving technologies can usually be applied equally well and efficiently on small farms [*Dorner, 1974: 119*]. Thus, labour-intensity in modern agriculture does not mean drudgery and backward technology: rather it means providing extra physical and human capital to increase productivity (tubewells, HYVs etc.) [*Lipton & Lipton, 1993: 1524-5*]. New farmers must be supplied with support services and infrastructure and should be drawn from those with farming skills [*Lipton & Lipton, 1993: 1527*]. However, while special aid to small farmers (credit, input subsidies etc.) to shift resources to underemployed family labour is necessary, unless land is redistributed then land/capital ratios fall and hence capital efficiency [*Lipton, 1974: 279-80*].

Berry and Cline [*1979*] argue that the finding of systematically higher land productivity and comparable levels of total factor productivity on small farms as opposed to large farms suggests "that the expansion of the small-farm subsector of agriculture may be a more effective way of increasing both employment and output than pro-large-farm strategies and thus warrants serious consideration in almost all developing countries" [*1979: 4*]. In LDCs, small farms are likely to have higher total factor productivity, and so are the optimal size for output maximization, as well as for labour absorption and income distribution [*1979: 16*].

Given that small farms generate higher land productivity and total social factor productivity (the authors do admit an extremely important caveat to this statement: "except in the very smallest farms in some countries" [*1979: 128*]), the authors propose the redistribution of land to the small farmers who apply labour more intensively, and the improvement of small farm access to credit and new technology. Both strategies will improve equity and increase output levels [*1979: 128*].

With such land redistribution, the authors claim that: "The optimal postreform farm size, in the absence of technical returns to scale, will be merely the total agricultural area divided by the total number of families in the agricultural labour force (after adjusting for land quality). That is, since total factor productivity falls as farm size rises in the relevant range, the most productive agrarian structure will be that composed of the smallest farms possible, consistent with full allocation of the available land and labour force, i.e., total area divided by the total number of farm families" [*1979: 18*]. They add in a footnote: "An equal distribution of available land among the entire rural labour force on a family farm basis will generally result in parcels significantly larger than the smallest prereform farms" [*1979: 226, fn. 23*]. Berry and Cline then reason: "If the equal distribution of all available land among all families implies a labour/land ratio equal to that of the same sized farms in the existing agrarian structure, the land productivity of these latter farms can provide a rough prediction of average land productivity after redistribution..." [*1979: 18*].

Estimates of output gains after land redistribution follow a two-step procedure: first, the average farm size is computed by dividing the available land by the number of families in the rural labour force;[34] secondly, a statistical estimate of output per acre for that farm size is applied to the former result. Chapter five presents [*1979: 132-3, table 5-1*] estimates of the potential gains from such equalizing land redistribution. Potential output increases range from 10% for Pakistan to 79.5% for north-eastern Brazil, including 19% for India, 23% for the Philippines, 25% for Brazil as a whole, and 28% for Colombia and the Muda river area of Malaysia.

1.3 Some qualifications of the policy implications

The only caveats to the above procedure for calculating output gains given any prominence in Berry and Cline are those arising from price changes following shifts in output mix, and changes in labour input intensities [*1979: 18-9*]. However, the set of assumptions required for this astonishingly simplistic calculation to hold are both numerous and highly unlikely to occur in reality.

The first and most obvious problem with this procedure is that the estimates are not constrained by product mix or land quality. In other words, the total land available which is defined as all land currently being used for agricultural purposes including pasture and woodland, can be converted to arable cultivation. Indeed, even marginal and waste land or land unsuitable for arable purposes can be so converted. Clearly, such a computation is inadmissible; the latter category of land would have to be excluded from the calculation, and the remainder would have to be disaggregated by type or use, between arable and pasture for example. Very different figures are likely to result. Indeed, where such product disaggregation has been carried out, as in Cline [*1970*] for Brazil, the potential output gains from land redistribution have been disappointing. In seven out of twelve regional crop sectors, production changes were either negative or insignificant [*1970: 146-8*].

An equalizing distribution might well lead to an modal farm size significantly greater than the smallest currently existing farm size. However, an important consideration here is the question of minimum feasible size of farm. None of the foregoing calculations take into account the possibility of there being a minimum efficient scale or of there being a floor determined by subsistence income. In terms of the inverse relationship evidence, the optimal size of farm would be around one acre [*Sen, 1962*]. But when other criteria are considered, relating to viability, we find that the level of the floor rises considerably. One criterion might be that of minimum income. That is, the farm should be able to provide an adequate level of income for a peasant family - a subsistence income. This may turn out to be significantly larger than the optimal size based on the inverse relationship phenomenon (output maximization). Other criteria might involve employment absorption: that is, the farm should be able to gainfully employ the working members of the average rural family; or technology absorption: that is, the minimum farm size should be such as to make efficient use of draught animals or machines. Consideration of these criteria may significantly raise the minimum feasible size of holding.

In a famous exercise, Khusro [*1973*] estimates the average size of the minimum feasible holding in India, in terms of minimum income unit, or the "size of farm below which its output is too small to maintain the family at whatever is considered to be a reasonable standard of living" [*1973: 38*], at about fifteen acres [*1973: 67*]. Likewise, the minimum work unit, or the size of farm below which family manpower cannot be fully employed, is estimated at 7.5 acres, the dividing line between adequate and inadequate family labour absorption [*1973: 60*]. Finally, the minimum plough unit, or size of farm below which the farm becomes too small to absorb effectively the services of a pair of bullocks, is estimated conservatively at an average for all-India of 7.5 acres [*1973: 52*].

Note here, we have a clear conflict between the various criteria, in particular that based on the inverse relationship, on the one hand, and those based on subsistence requirements or resource use on the other. Thus, the concept of viability sets a limit to redistributive land reform.[35]

To draw on the inverse relationship to justify redistributive land reform, the general equilibrium effects also need to be considered: landless labourers have normally been excluded from access to redistributed land, and if land reform is implemented at the expense of large farms, then the landless may be worse off due to a fall in employment opportunities. Lipton admits that land reform must allow for the effects on the growing majority of the poor who depend, not on farming, but on farm labour and rural non-farm activity [*1993b: 643*]. These kinds of considerations lead Lipton to accept some differential in size as justified, and he suggests a 5:1 ceiling to livelihood size ratio [*1974: 285*].

Even if the inverse relationship is empirically valid because small farms use more inputs per acre,[36] land redistribution without ensuring the availability of extra inputs may not produce the expected results [*Bardhan, 1973: 1371*]. Estimates of output gains after redistribution of land assume that the required inputs exist and that no losses occur due to the process of redistribution. The process of land redistribution itself may involve extra costs in terms of cadastral survey, boundary marking and the provision of access to plots, as well as the potential for the disruptive effects of land reform to reduce output.

Such estimates do not take into account the extra investment costs of providing irrigation to unirrigated land, or of providing extra inputs (seeds, fertilizers, pesticides etc.). Smallholder farming is not a cheap option. It requires investment in both production and infrastructure [*Lipton & Lipton, 1993: 1525*]. Lipton remarks that in the African context, irrigation is the key component of a smallholder-oriented policy, but irrigation in Sub-Saharan Africa has typically involved construction costs 5-10 times higher per hectare irrigated than in Asia. Fertilizer use in SSA is low partly because it is seldom economic without irrigation, or with crop mixes heavily geared towards tubers, roots and coarse grains [*1993: 1535-6*].

The estimates further assume that the current input-output characteristics on existing farms of the "optimal" size would also characterise farms of that size after land reform. This question is not only related to the availability and distribution of production inputs, but also to the whole area of motivation governing labour effort. If incomes were to rise on the small farms, this may relax the subsistence income or debt obligations constraint and allow small farmers to relax labour effort with a lower application of labour per acre, and hence lower output per acre.[37] In such circumstances, while on-farm family consumption might increase, the supply of marketed surplus may well fall with serious consequences for economic activity outside agriculture.

One area dismissed rather cursorily by Berry and Cline is the question of the possible dynamic losses of redistributive land reform affecting negatively the rate of saving and capital accumulation, and the adoption of new technology. Yet the supposed static productivity advantages of small farms may seem inconsequential if a small-farm system cannot generate sufficient investments and the necessary increases in agricultural output. The authors however doubt the existence of any possible dynamic losses arising from land distribution because 1) there appears to be no evidence for higher agricultural growth rates in countries with higher than average farm size, and 2) there is evidence in Green Revolution areas that small farmers adopt the new technology rapidly [*1979: 134-5*].

The first point is quite irrelevant. Average farm size provides no indication of the distribution of farm size or the weight of large farms in that distribution. What needs to be compared is the relative output growth rates of a group of large capitalist farms with a group of small peasant farms in one country. Berry and Cline cite evidence of simulation experiments with rural savings data for Brazil and India by Cline and Bhalla[38] which indicate that income redistribution would have only a limited impact on rural savings rates and total savings [*1979: 28*]. However, as Sen [*1964*] and Bharadwaj [*1974a*] have shown, the vast bulk of small farms in India are highly indebted deficit farms. It is therefore most likely that any post-reform average or marginal rate of rural saving would be very low. Indeed, as we shall see below, Bhalla disposes of this annoying problem of deficit farms by excluding them from his analysis (this reduces his NCAER sample by over 50%).

The second assertion is also highly dubious. The authors assert that small farmers adopt the Green Revolution technology very soon after the large farmers, thus re-establishing an inverse relationship in the form of an S-curve [*1979: 28*]. They claim that the association of mechanization with the adoption of new technology is erroneous, simply just another manifestation of factor market imperfections, and that the existence of the latter imply the need to channel new inputs towards the small farms [*1979: 27-8*].

Lipton [*1993b: 645*] claims that evidence since the mid-1970s increasingly suggests that the dynamics of the Green Revolution do not undermine the inverse relationship: smallness of farms, with or without reform, does not significantly impede adoption of, or success with, improved cereal varieties or related inputs [*Lipton & Longhurst, 1989*]. Even after the Green Revolution process, "a big majority of empirical work in developing countries supports the unadjusted IR, or UIR: a 'meaningful' inverse relationship of gross annual output-per-hectare at market prices to farm size in hectares" [*Lipton, 1993b: 645*].[39] Later, as smaller-scale farmers adopt the new technology, the advantage of labour-intensity, as manifested in the inverse relationship, reasserts itself, and their yields per hectare once again outpace those of the larger farmers [*Lipton & Lipton, 1993: 1526*].

However, the empirical evidence would appear not to substantiate this assertion. Patnaik [*1987: 120-5*] has demonstrated that although some farms in all size groups have adopted the new technology, those small farms are in fact, in terms of scale and hired labour use, rich farms.[40] It is the rich farms who both adopt the new technology thus reaping the initial benefits and who maintain that advantage. The evidence in chapter V shows clearly that the inverse relation has broken down in those Green Revolution areas as large farmers adopt both the new technology and mechanize. Indeed, Berry and Cline do admit that large farms are able to capture economies of scale with the introduction of mechanized technology [*1979: 138*].

Even if small farmers are more productive than large, small farm systems or regions need not be. Efficient and persistent large farms are not illusions either [*Lipton, 1993b: 648*]. The persistence of efficient large farms shows that they too are endogenous, incentive-compatible institutions which fulfil economic functions with economies of scale or which fulfil political economy functions [*Lipton, 1993b: 643*]. Thus, even those convinced by the inverse relationship are not necessarily against land pooling in cooperatives, or for land redistribution, because of the associated finding that large farms show larger profits, thus generating higher savings, investment and innovation in the long run [*Bardhan, 1973: 1371*]. Sen and Rudra [*1980: 394*], while rejecting the inverse relationship as a basis for small-scale peasant farming, also reject the development of capitalist farming which would further impoverish the poor peasant, and support expansion of the cooperative system: the superior ability of large cooperative farms to marshall labour and non-labour resources may be important, allowing large farms to produce more output per acre than small farms.

Finally, there are important political constraints to redistributive land reform. A rural power structure dominated by landlords or rich peasants may simply undermine land reform legislation through evasion and avoidance. However, Lipton's view that "avoidance can sometimes help reform [as] threats of ceilings can induce substantial sales to poorer farmers" [*1993b: 645*] or that such a process can be implemented "if the rich farmers see their interests in such a process and/or are too weak to stop it" [*1993b: 653*] would, faced with the evidence, appear to be wishful thinking of Daedalus-like proportions.[41]

Summary and conclusions

This chapter has critically surveyed the range and nature of the evidence for an inverse relationship between farm size and land productivity. We have seen in this chapter that the evidence for an inverse relationship between farm size and land productivity is both geographically widespread and historically pervasive. Empirical support for the finding has been heavily documented for the contemporary developing regions of Africa, Asia and Latin America, as well as for earlier periods in Europe, Japan, and North America. This weight of evidence, however, has not gone unchallenged, and in Chapter II, we go on to examine the major conceptual, methodological and statistical problems which have been raised in the inverse relationship literature.

The contemorary significance of the inverse relation as a crucial developmental issue cannot be overemphasised. Such a relationship has obvious importance for policy issues. The apparent implications of such a relationship constitute a major component of the economic rationale for redistributive land reform and a small farm bias in agricultural development strategy. This it is claimed will have a positive impact on output, income, employment absorption, and poverty alleviation.

The suggested policy implications are however heavily dependent on a number of unconvincing assumptions. They are also dependent on a particular theoretical perspective on the inverse relationship which will be examined in Chapter IV. Nevertheless, Section 1.3 has shown that these implications of the inverse relationship, accepted at face value without critical examination of its nature or causal factors, are subject to severe qualifications. Any positive impact may be severely constrained by efficiency considerations relating to minimum feasible farm size, input availability, dynamic general equilibrium effects on saving, investment and employment, and the nature of technical and social change in agriculture. Further, the next five chapters attempt to show that, after examining the causal explanations for the inverse relationship and placing it in the context of agrarian transition, the inverse relationship rationale for redistributive land reform disappears.

Notes to Chapter I

1. This relationship is hereinafter referred to throughout this study simply as the inverse relation or inverse relationship. Other inverse relationships between key economic variables associated with the current debate are specified in full. While the inverse relation has been introduced as one between farm size and farm productivity, the latter component usually refers to land productivity. Given the overwhelming importance of land as the major factor input in the agriculture of poor countries however, this may be justified.

2. The Indian debate on the inverse relation has been by far the most extensive. It began in the pages of the Economic Weekly (later Economic and Political Weekly) with Sen's 1962 article. It continued over the years with Mazumdar 1963, Sen 1964, Agarwala 1964, Khusro 1964, Mazumdar 1965, Paglin 1965, A.P. Rao 1967, C.H.H. Rao 1967 and 1968, Rudra 1968a and 1968b, C.H.H. Rao 1972, Bhattacharya and Saini 1972, Patnaik 1972, Rudra 1973, Bharadwaj 1974a, Chandra 1974, Chattopadhyay and Rudra 1976 and 1977, Chadha 1978, Sen and Rudra 1980, Barbier 1984. Other major contributions are Sen 1966, C.H.H. Rao 1966, Bhagwati and Chakravarty 1969, Saini 1972, Bharadwaj 1974b, Bhalla 1979, Saini 1979, Roy 1981, Carter 1984, Patnaik 1987, Bhalla 1988, Bhalla and Roy 1988. See Ellis 1988 for a useful survey.

3. Chayanov cites evidence for an inverse relation for Switzerland and Czechoslovakia, but ignores the Russian zemstvo data. Byres in an unpublished manuscript suggests that for Chayanov to admit any widespread existence of an inverse relationship in Russia would be to undermine his premise that 90% of Russian farms were pure family labour farms, given his assertion that large farms are capitalist. Byres also suggests that Lenin, on the other hand, who asserts the global superiority of capitalist farms, ignores the possibility of an inverse relationship in Russia as this would tend to undermine his thesis that capitalist agrarian transition was nearing completion. These propositions will be argued in detail in a forthcoming book.

For the Russian debate on the relative superiority of large and small farms, see V.I. Lenin: *New economic developments in peasant life (on V.Y. Postnikov's 'Peasant farming in South Russia')* pp. 13-73, volume I, Collected Works; *The development of capitalism in Russia*, chapters I-IV, volume III, Collected Works; *Capitalism in agriculture (reply to Bulgakov)*, pp. 109-59, volume IV, Collected Works; *The agrarian question and the critics of Marx*, pp. 107-222, volume V, Collected Works; and for the USA, *New data on the laws governing the development of capitalism in agriculture*, pp. 17-102, volume XXII, Collected Works; and A.V. Chayanov: *The Theory of Peasant Economy*, edited by D. Thorner, B. Kerblay and R.E.F. Smith, Homewood, Illinois (Irwin, 1966). See also K. Kautsky: *The Agrarian Question*, volume I, translated by P. Burgess, London (Zwan Publications, 1988).

The Russian zemstvo data can be seen in U. Patnaik: *Neo-populism and Marxism: The Chayanovian view of the agrarian question and its fundamental fallacy*, Journal of Peasant Studies, vol.6 no.4 (July 1979) table I, p.382. This data was calculated by M. Harrison in *'A.V. Chayanov and the study of the Russian peasantry'* (mimeo, Cambridge 1972) from Byudzhety Kresty'an Starobel'skogo Uezda by Chayanov, Kharkov 1915. This shows the value of output (in Roubles) per desyatina (1 des.= 2.7 acres) decreasing from 1166.0 on 0-0.009 des. farms to 46.2 on farms over 15.01 des. for a sample of 101 peasant farms in Starobels'ky Uyezd, 1910. See also M. Harrison in Journal of Peasant Studies, January 1977, table 4. p.141 citing figures by G.A. Kushchenko, published in 1916.

For China, see J. Lossing Buck, *Chinese Farm Economy*, University of Chicago Press, Chicago, 1930, and *Land Utilization in China*, 1937. In his first book [p.134] Buck admits that there is something of an inverse relationship in North China, which he attributes to better soil quality. In the second book, he simply asserts [p.273] that there is no inverse relationship in China. In fact, inspection of the disaggregated data in *Land Utilization. Statistics* (the statistical volume accompanying the second book) shows clear evidence of an inverse relationship. See Byres, unpublished manuscript.

4. Bauer's compact statement, with its focus on rational choice and yield maximization by family labour incurring no cash wage costs, may suggest that Sen [*1962*] has derived more inspiration

from Bauer than he acknowledges.

5. However, Bevan also finds higher incomes on the large farms, with labour used more effectively: the number of trees tapped per hour increases from 56 on the small farms to 108 on the large farms.

6. Cornia uses FAO Farm Management and Production Economics Service data for 1973-79 which covers 3,167 farms in 18 countries. Note however that all farms with less than $10 capital or less than 0.1 ha of land or with labour input less than 10 man-days have been deleted. Further, three countries were dropped due to incomplete or insufficient data. Very small and very large farms have been excluded. He makes the curious and wrong proposition that: "The variability of the sample is thus smaller than that of the universe; the conclusions about farm size, resource use and land productivity drawn on the basis of the sample are therefore likely to hold true a fortiori for the universe" [*1985: 517*]. The 15 countries covered comprise: Barbados, Mexico, Peru, Ethiopia, Nigeria, Tanzania, Uganda, Syria, Sudan, Bangladesh, Burma, India, Nepal, Korea, and Thailand. See Taslim, [*1989*], for evidence of the inverse relationship in Bangladesh.

7. Pohorille [*1964*] finds evidence for the inverse relation in pre-war Poland: "Labour productivity is unquestionably higher on the landed estates than on the peasant farms. The yield per acre, however, is higher in the latter owing to the use of more labour, especially in stock-breeding". Cited in [*Sen, 1966: 442*] from Pohorille, *Development and Rural Overpopulation: Lessons from Polish Experience*, in ILO, *Problems of Employment in Economic Development*, Geneva, 1964.

8. The 1960 Census for Iran shows crop yields higher on the small farms, although there is no monotonic decrease [*Bachman & Christensen, 1967: 246*-7].

9. Penny and Zulkifli find value added per acre (after deducting capital expenses) higher on the small farms than on the large states [cited in *Bachman & Christensen, 1967: 245*]. See D.H. Penny & M. Zulkifli *Estates and small-holdings: an economic comparison*, Journal of Farm Economics, vol. 45, pp. 1017-21, December, 1963. Griffin [*1974: 44*] also cites a survey of 58 owner-operated sawah (flood irrigated) farms in Subang district of west Java, where the wet season padi yield index declines from 100 on the smallest size class to 78 on the largest [*source: Agroeconomic survey, Analis usaha tani padi sawah dan tatniaga beras ditiga kabupaten di Djawa barat, 1971*].

10. Pakistan Institute of Development Economics, 1969-70 and follow-up survey in 1974 of Phulpur and Thakurgaon thanas in the districts of Mymensingh and Dinajpur [cited in *Hossain, 1977: 297*].

11. Comite Interamericano de Desarrollo Agricola, *Monografias Sobre Algunos Aspectos de la Tenencia de la Tierra y el Desarrollo Rural en America Latina*, Organizacion de los estados Americanos, Washington, 1970, p.34. See [*Berry & Cline, 1979: 203*].

12. Bank of Korea, Research Department, Economic Statistics Year Book 1960, p.278 [cited in *Berry & Cline, 1979: 203*].

13. Cited in [*Griffin, 1974: 39*]. Table 2.9 shows paddy yields in Sri Lanka fall from 36.4 bushels per acre on farms less than 20 perches (1 acre = 40 perches) and 37.3 on farms of 21-40 perches to 33 bushels on farms of 161-320 perches and 33.7 on farms over 320 perches [*source: 3,000 farm survey (1966-7) conducted by Central Bank of Ceylon, Survey on Cost of Production of Paddy, 1969*].

14. See [*Griffin, 1974: 42*]. A graph shows rice yields in central Thailand declining from 306 kg/rai (1 acre = 2.5 rais) on farms of 2-6 rais to 194 kg/rai on farms greater than 140 rais [*source: G.A. Marzouk, Economic Development and Policies: Case Study of Thailand, Rotterdam University Press, 1972*]. Note that on page 41, Griffin states that since HYVs are short-stemmed plants and this area is subject to annual flooding, the green revolution has made no impact in this region - a fact that is of major significance as we shall see.

15. See [*Griffin, 1974: 97*]. Table 4.2 shows relative average land productivity in 1960 on small private farms (minifundia) less than 5 ha at 2.6, while that on the large private farms over 5 ha was only 0.88 [*source: S. Eckstein, El marco macroeconomica del problema agrario mexicana, CIDA, January 1969*].

16. See W.R. Cline *Economic Consequences of a Land Reform in Brazil* (Amsterdam: North-Holland Publishing Co., 1970).

17. Studies of resettlement schemes in Kenya demonstrate that smallholders, working more intensively with family labour make more profitable use of land previously cultivated by large farms [H.W. von Haugwitz *Some experience with smallholder settlement in Kenya*, Afrika-Studien. no. 72, Munich: Weltforum Verlag for ILO-Institut fur Wirtschaftforschung 1972]. The increase in productiivity ranges between 15-90% [cited in Deininger & Binswanger, *Are large farms more efficient then small ones? Government intervention, large scale agriculture, and resettlement in Kenya, South Africa and Zimbabwe*, World Bank Policy Working Paper, Washington DC, forthcoming]. See also D. Hunt, *The impending crisis in Kenya: the case for land reform*, Aldershot UK: Gower Press, 1984.

18. These latter case studies are all included in the survey by Berry & Cline [*1979*]. In Chapter VI we discuss the evidence for each country in detail. See also Barraclough & Domike, *Agrarian structure in seven Latin American countries*, in Land Economics, vol. XLII, no. 4, November 1966, for evidence for Argentina, Brazil, Colombia, Chile, Ecuador, Guatemala, and Peru. Dorner

[*1972*] also cites evidence for India, Brazil, Colombia, Mexico, Japan, Guatemala, Taiwan, Philippines, Chile, Denmark and Hungary [*Dorner, 1972: 119-25*].

19. Coverage of Madhya Pradesh began in 1956-7. The Indian Farm Management Studies proceed beyond the 1950s. See *Farm Management in India: A study based on recent investigations*, published by the Directorate of Economics and Statistics, Department of Agriculture, Ministry of Food, Agriculture, Community Development and Co-operation, Government of India (New Delhi: April 1966).

20. The cost-accounting method entailed intensive daily recording of data during the enquiry period (2-3 months), while the sample survey method entailed periodic visits throughout the enquiry period. The former method provided the more accurate information used by Bharadwaj [*1974a*] and Khusro [*1964*]. Khusro adds a seventh state, Andhra Pradesh, for the years 1956-7, 1957-8, and 1958-9.

21. Sahota [*1968*] notes that as data were available on a per acre basis only, production function estimates are constrained to constant returns: q/n=b(l/n)^a1.(k/n)^a2 => q=b.l^a1.k^a2.n^(1-a1-a2).

22. See Byres [*1988: 176-78*]: Charan Singh pre-dates both Sen and the FMS data. In his 1947 book, *Abolition of the Zamindari: Two Alternatives*, Singh cites evidence on the existence of an inverse relationship from Swiss agriculture (this is the Laur data noticed by Chayanov) and from Denmark. Later, in 1959 and 1964, Singh again uses the inverse relationship in his argument against cooperative agriculture, citing evidence from England, Denmark, Norway, Sweden, Switzerland and the USA. Bachman and Christensen note that "large agricultural properties inevitably become a focal point of attack by the economic and social groups attempting to displace the old elite" [*1967: 263*].

23. R. Krishna, *Land reform and development in southern Asia*, in W. Froelich (ed.), *Land Tenure, Industrialization and Social Stability*, Marquette University Press, Milwaukee, 1961. He writes: "Under present conditions, the ratio of output to total input shows no consistent relation to the size of farm. In respect to the ratio of output to paid input, the small farm turns out to be more productive than the large farm, and in respect to output per acre, the small farms appear to be even more productive" [pp. 243-4].

24. Long who acquired data from the Farm Management Centre Reports provides the following composite tabulation (he notes that the state data is not entirely comparable, hence the rather wide size classes) [*Long, 1961: 117*]:

AVERAGE GROSS OUTPUT PER ACRE BY SIZE OF FARM (rupees per acre)

0-4.9 acres	240 Rs
5-9.9	213
10-19.9	171

over 20	103

Long points out that the above data have the defect that some of the inverse relationship finding is caused by "the fact that the areas of lower productivity per acre tend to be characterised by larger farm units" [*1961: 117*]. The data are recombined by state (which are regarded as relatively homogeneous) to obtain the following table [*1961: 118*]:

	MP	WB	UP	Pun	Or	AP	Bom	Mad	ave
smallest size group	87	239	292	201	161	433	117	209	219
2nd smallest group	88	217	267	186	141	352	82	171	188
2nd largest group	84	229	227	173	150	369	51	75	170
largest size group	93	169	232	143	126	380	53	75	159

Long [*1961: 118*] also provides evidence for 225 farms in 3 villages in Bihar (supplied by P. Ray, Principal, HD Jain College, Arrah, Bihar, LSE thesis):

[*1961: 119, table II*]:
GROSS OUTPUT PER ACRE 1955-56

	village A	villB	villC	average
	n=92	n=100	n=33	n=225
0-4.9	206	384	315	302
5-9.9	193	337	306	279
10-14.9	178	329	308	272
> 15	173	331	278	261

Long also provides evidence for the USA. He finds gross value productivity per acre (above variable costs) inversely related to farm size in Wisconsin in 1950. See E.J. Long & K.H. Parsons 'How Family Labor Affects Wisconsin Farming', *Wisconsin Research Bulletin*, no. 167, May 1950, and also E.J. Long, 'Return to Scale in Family Farming: Is the Case Over-stated?, *Journal of Political Economy*, December 1949. Long also mentions a 1911 study of Tompkins County, New York state, [by G.F. Warren & K.C. Livermore, *An Agricultural Survey, Township of Ithaca, Tompkin County, New York*, Cornell Memoirs, no.295, Ithaca, NY: Cornell University Press, 1911] which shows an inverse relationship between value productivity per acre and farm size.

25. See H.S. Mann, *Cooperative farming and family farming in the Punjab: a comparative study*, PhD dissertation, Ohio State University, 1962. Mann further claims that in those cases where large cooperatives were more productive than small family farms, this was due to superior irrigation facilities.

26. We cite the Bharadwaj data in full in Appendix A as they usefully summarise the findings from the entire Indian FMS data set in the form of OLS regression equations. Bharadwaj fits a log-linear regression for each district for all three years: $\log Y = \log a + b \log X$ where Y = yield per net acre (yield is gross value of output) and X = <u>average</u> size of operational holding for

the relevant size group. The use of grouped and averaged data is further discussed in Chapter II.

27. While the regression coefficients are all negative, only three regressions (out of 21) are statistically significant: Bombay, Madras, and Punjab. See Table 1B in [*Khusro, 1964: 55*-7] for the full regression results.

28. Just how meaningless and misleading such averages are is discussed in Chapter II.

29. See note 2 above which includes the major contributions to this extensive empirical support for an inverse relationship in the Indian context.

30. Citing Lau & Yotopoulos [*1971*] and Paglin [*1965*].

31. Lipton [*1993b: 645*] citing Vyas [*1979*].

32. Lipton [*1993b: 651*] claims that price distortions favouring large farms mean that the inverse relation is strong at shadow prices, but suppressed at market prices, and even at effective prices including transactions costs. Correcting such distortions therefore helps to get land into smaller holdings. See also de Janvry & Sadoulet [*1989*] and Binswanger & Elgin [*1988*].

33. Binswanger and Deininger [*1993: 1465*] proceed beyond this to say that land reform involving mechanized commercial farming systems requires that such farms be subdivided and resettled, because the efficiency of family farms is associated with the use of family labour, and too few families reside on highly mechanized farms to work these farms efficiently, if land is redistributed exclusively to the residential labour force.

34. In determining the number of family parcels it is assumed that each family has 2.5 workers [*Berry & Cline, 1979: 130*]. Land available is defined as total farm area in the 1960 FAO World Census of Agriculture.

35. In Javanese conditions, for example, equal redistribution of land would leave no livelihood holdings at all, and the output effects of bringing 1/4 acre farms up to 1/2 acre were found to be disappointing [*Lipton, 1974: 283*]. And in the Egyptian case, three acres is considered as being the minimum feasible size of farm on the income criterion, according to informal interviews with farmers during fieldwork in 1990.

36. A crucial distinction needs to be made here between purchased and on-farm-supplied inputs. See later in chapters II and IV for the importance of this distinction.

37. See Dharm Narain, *Distribution of the Marketed Surplus of Agricultural Produce by Size-Level of Holding in India, 1950-51*, Asia Publishing House, Bombay, 1961.

38. W.R. Cline, *Interrelationships between agricultural strategy and rural income distribution*, Food Research Institute Studies, vol. 12, no. 2, 1973, and S. Bhalla, *An analysis of savings in rural India*, mimeo, Washington DC, 1975, using NCAER data.

39. Lipton refers to supporting studies reviewed in Lipton [*1993*] and Binswanger et al. [*1993*]. The unadjusted inverse relationship remains meaningful, though weakened, if land measured in efficiency hectares is used, allowing for the fact that small farms operate higher quality land: "Economic logic-but little evidence-suggests that the UIR is strengthened if (a) size is measured in hectares per household member or worker (reflecting the IR's basis in access to family labour-per-hectare at low transactions costs); (b) only farms with similar nonland, non-unskilled-labour inputs per hectare are compared, or else their costs are deducted from value of gross output; (c) gross output (and inputs) are measured at shadow prices, especially if socially weighted" [*Lipton, 1993b: 645*].

He goes on to write that a properly adjusted inverse relationship (AIR) would measure per hectare gross output minus costs other than land and unskilled labour, all at shadow prices, as a function of efficiency hectares per person. This AIR would, in most cases, show that if farmland were more equally distributed in terms of efficiency hectares per person it would produce more annual output, net of appropriate costs. It is presumably efficiency hectares per person, not land per household that a poverty reducing reform seeks to get to poor people. Moreover, it is appropriately shadow-priced and netted output, not gross output at market prices, from land that is maximized by an optimal distribution of operated land: "Therefore the AIR makes an even stronger case than does the UIR for getting owned (and therefore operated) land from largeholdings to private smallholders" [*Lipton, 1993b: 645*].

40. We return to this question of farm size versus farm scale in the next chapter where we discuss conceptual problems relating to the inverse relationship debate, and in Chapter V where we move on to a political economy approach to the inverse relationship in the dynamic context.

41. See T.J. Byres, *Of Neo-Populist Pipe Dreams: Daedulus in the Third World and the Myth of Urban Bias*, Journal of Peasant Studies, vol. 6, no. 2, January, 1979.

CHAPTER II

Conceptual, statistical, and methodological problems

Introduction

Neither the existence of the inverse relationship, nor its implications, have gone unchallenged. Indeed, Sen was one of the first to admit that the inverse relation was by no means a well established fact and had not been proven "beyond the legitimate doubts of exacting statisticians due to the fact that average data can be misleading" [*1964a: 323*].

Barraclough [*1967: 266*], after noting that the CIDA studies in Latin America corroborate the finding of an inverse relationship, warns: "great care must be taken in interpreting these data. When comparisons are made for relatively homogeneous areas limited to the same types of farming and tenure conditions these inter-farm differences often diminish and in some cases even disappear."[1]

The aim of this chapter is to demonstrate the necessity for care in interpreting the inverse relationship findings, imposed by a number of important conceptual, statistical and methodological problems associated with the data. In section 2.1, we highlight a crucial conceptual distinction introduced into the debate by

Utsa Patnaik, between different measures of farm size based on acreage and economic scale. Patnaik argues that use of the latter measure, if valid, would undermine the inverse relationship findings.

Sections 2.2 to 2.4 cover the methodological doubts raised by the contributions of a number of "exacting statisticians". In section 2.2, we examine the crucial distinction that needs to be made between aggregated and disaggregated levels of analysis. The nature and causal direction of the inverse relationship evidence is very different at these two levels of analysis. Consideration of this distinction will allow us to specify correctly the nature of the problem. Section 2.3 introduces the methodological critique by Ashok Rudra who argued that the inverse relationship was merely a statistical illusion generated by the use of too highly aggregated and group averaged data. He also criticises the use of OLS regression techniques, rather than rank correlation analysis, in estimating the strength of the inverse relationship. These matters are resolved and the inverse relationship finding vindicated in section 2.4, where the relation is confirmed, to Rudra's satisfaction, as a valid empirical phenomenon in India, but not in the way conceived of in the earlier studies.

Finally, section 2.5 examines a number of conjoint relationships revealed by the various studies mentioned, involving other factors of production besides land. These relationships tend to be clustered, suggesting some *a priori* explanations for the inverse relaitonship along factor-intensity lines. This sets the context for a critical examination of the major theoretical explanations of the inverse relationship in the following four chapters.

2.1 Utsa Patnaik and Scale Grouping Rather than Size Grouping[2]

A notable conceptual problem with respect to the inverse relationship has been introduced into the debate by Utsa Patnaik [*1972: 1613-24*]. She argues forcefully that, if instead of taking acreage as the measure of farm size (size grouping) we take either annual value of gross output per farm or the value of tangible capital stock (scale grouping), we then get (may get), in certain circumstances, "diametrically opposite results".[3] Note the conditionality flagged in this statement by the inclusion of the phrase "in certain circumstances" and the use of "may" in parentheses.

On the second measure of size (the scale grouping) output per acre rises (may rise) sharply with increasing scale of production. It may be the case, she says that "an intensive application of capital on the smaller holding results in its being larger [than a holding of higher acreage] on every economic index except acreage" [*1972: 1614*].

The reason for this is, she argues, that holdings of "varying levels of intensity, i.e. with varying production techniques and even varying organisation" [*1972: 1617*] are lumped together within the same size category. So it is, then, she argues, that the size grouping approach blurs (may blur) certain distinctions: between intensively and extensively cultivated holdings; and between different categories within the peasantry, so obscuring the extent of differentiation [*1972: 1615*]. It is possible to identify, say, a rich peasant with 80 acres and a rich peasant with just 8 acres [*1972: 1614*].

If all of this is so, then the outcome is as follows, with the inverse relationship emerging on the size grouping, and certain crucial aspects concealed, which are clear on the scale grouping: "When grouped by size, a small number of high-productivity holdings of small size, lumped with similar sized but low productivity extensively run holdings (which constitute the majority), raises the average yield for the small size group as a whole; while the large extensive farms, lumped with similar sized but much more intensive high-productivity capitalist farms, lower the average yield for the large-size group as a whole...Not only with respect to yield, but also as regards all inputs, capital intensity and labour productivity, we find the same striking differences in the results of grouping by size and by scale respectively" [*1972: 1620*].

Patnaik is making a very important point. It is, indeed, the case that "when we are studying a process of agricultural change...it becomes especially important to analyse the available data according to scale of production" [*1972: 1621*]. Two holdings of the same size may well differ in their class status. A holding may be smaller in size but larger as an economic unit [*1972: 1614*]. But note how she formulates the argument: "What we are saying is that in the past, the set of rich peasants and the set of farms above 20 acres in UP probably had a very large number of common elements: while at present owing to the changes taking place in use of techniques and intensification of production the intersection of the two sets is getting smaller. Therefore the identification of the properties of one set with those of the other is now less justifiable and may be downright misleading" [*1972: 1624*].

Observe the difference stressed between the past (a static situation) and the present (a dynamic one): in the Indian case, between the pre-"new technology" situation and the period when that "new technology" had begun to spread and have an impact. That differentiation has a certain plausibility.

The validity of her argument surely relates to circumstances of change. One might argue, even on her logic, that in the relatively static situation of the 1950s, when the inverse relationship was first established in the FMS studies size was a useful measure, encompassing "sets with a very large number of common elements"; while in the 1970s (when she was writing and when the "new technology" was beginning to spread) her logic began to take on significance. She stresses: "If techniques were absolutely uniform for all holdings then of course no problem of distinguishing between size and scale would arise. However techniques are far from uniform...The possibility of adopting new, usually much more capital intensive techniques exists [by the 1970s] for the farms with an investible surplus" [*1972: 1615*].

This is the crucial point. We would wish to argue that techniques were tending to uniformity in the 1950s (certainly, they tended to uniformity to a far greater extent then than in the 1970s); and so size is then a useful stratifying variable: an acceptable index of economic status (class position). And where techniques of production have been only partially transformed, farm size may still be the relevant stratifying variable. Great care must be taken by the researcher to avoid grouping farms with different systems of production together. Methods used later in the analysis of the fieldwork data, in the Egyptian context (Chapter X), include computation of rank correlation coefficients between the set of farm sizes and the set of farm scales of production, and the computation of diagnostic statistics to identify outliers in the data set. The exclusion or separate treatment of these cases of course require theoretical and empirical support.

One further issue of crucial significance that needs to be flagged at this point, as it relates closely to the question of agrarian change, is the actual breakdown and disappearance of the inverse relationship in the context of the "new technology". This widely documented phenomenon [see *Chadha, 1978; Roy, 1979; Khan, 1979; Dyer, 1990*] will be discussed in detail in Chapter V. Suffice it to state here that abundant evidence from India and

Pakistan shows that following the introduction of the Green Revolution technology, the inverse relationship has disappeared, markedly so in those areas where the new technology has penetrated most deeply.

This, of course, is a very different phenomenon from that described by Patnaik. The latter approach generates a statistical breakdown of the inverse relationship by switching from an area definition of farm size to a scale measure (warranted by the possibility that a sub-group of holdings of small size have secured important productivity advantages through intensive application of capital, thus increasing their economic scale). The former approach, however, posits that it is the larger farms, due to their greater surpluses and access to and control over capital, which capture the productivity gains from the new technology, thereby structurally reversing the direction of the size-productivity relationship, despite the continued intensive application of family labour on the small farms.

2.2 Aggregated and disaggregated levels of analysis: a 'natural' inverse relationship at the macro level

The statement by Barraclough in the introduction above, raises the crucial distinction that needs to be made between aggregated and disaggregated levels of analysis. At highly aggregated levels of analysis, whether at the cross-country [see *Cornia, 1985*], national or regional level, a relatively high degree of land heterogeneity is to be expected. Those areas with better than average soil quality, in particular, water availability, and hence higher than average natural land productivity, are historically likely to have attracted greater population settlement. Higher population density will, given limited land resources, lead to small average farm size over long time periods. Contrariwise for areas of relatively poor agricultural land where population settlement is likely to be less dense and average farm size larger. Hence, at this "macro" level, an inverse correlation between land productivity (as measured by output per acre) and farm size is to be expected.

Note that this type of natural inverse relationship at the "macro" level is fundamentally different from the inverse relation at the centre of this study. At the aggregate level, the direction of causality runs from land productivity (itself caused by better soil quality) to small average farm size. However, at the micro level (village level for example) the causality is postulated to run in the opposite direction: specific factors associated with smaller than average farm size are producing higher than average farm productivity.[4] Roy [*1979: 5, tables 1.1-2*] notes data from Kalra for Indian states which shows the "macro" relation. Moving from the macro to micro scale, the direction of causation is reversed: "while exogenous factors are assumed to cause the inverse relation at the macro level, endogenous factors are assumed to cause the same inverse relation at the micro level." So the inverse relationship at the "macro" level is caused by diversity in natural conditions.

There are two further dimensions to the problem of aggregation. There is the related problem of aggregation over villages leading to a spurious inverse relationship. Even if no inverse relationship existed within villages, but there were different soil fertilities between villages, and high fertility villages had smaller average farm size, then an inverse relation would be shown by data aggregated over the villages. Alternatively, if fertility (average land productivity) was the same over villages, and the inverse relationship holds in each village, but villages have different size-ranges, then such a relationship could be eliminated [*Chattopadhyay & Rudra, 1976: A110*]. Rudra [*1968b*] implies that the inverse relationship does not exist within any particular village, but arises as a spurious relationship when data for different villages are aggregated[5].

Furthermore, there is the problem of grouped averages. Most of the analysis of the FMS data was carried out using size class averages for the principal variables, farm size and output per acre. Grouped data may generate an aggregation bias when the in-group variance is in fact greater than the between-group variance. Thus, farm level data which show no overall relationship between farm size and output per acre, may when grouped into size classes show a spurious inverse relation. Barbier [*1974*] shows that the overall relation is very sensitive to size-class boundaries.

2.3 Rudra on aggregation and functional form

Rudra [*1968a: 1041*] suspects the process of aggregation is responsible for what he calls the "spurious correlation" of the FMS data. He writes: "the farm management data do not permit of the generalised conclusions that have been drawn, the inferences having been made without adequate examination of the tables themselves" [*1968b: A-33*]. Nevertheless Rudra still uses grouped data to reject the *prima facie* arguments of the FMS data and Sen [*Chattopadhyay & Rudra, 1976: A-110*].

Rudra [*1968a*] uses data for 20 villages (1,198 farms) including 6 used by Rao[6], in Punjab, Haryana and western UP, all surveyed by the Agro-Economic Research Centre at Delhi University. He carried out F tests for one-way analysis of variance.[7] Only two villages had significant F statistics (at the 5% level): Bahantuas Bandhu and Matiana. Bahantuas showed increasing yield per acre with farm size up to 20 acres while no systematic pattern was revealed in Matiana [*Rudra, 1968a: 1043*]. Rudra concludes: "neither case substantiates the hypothesis of yield per acre decreasing as farm size increases" [*1968a: 1044*].[8]

In the same study, Rudra criticizes the use of simple linear regressions and log-linear regressions in the foregoing studies which imply certain assumptions about the nature of the relationship being tested [*1968a: 1041*]. None of the studies on the inverse relationship gives any justification for assuming a linear relation, whether log-transformed or not. This criticism also has some significance for the reliability of t tests [*Roy, 1979: 27*]. The validity of t tests are dependent on the validity of the underlying regression relations. Rudra writes [*1968a: 1043*]: "There may be many reasons to expect some sort of association (between yield per acre and farm size), but none whatsoever for any linear relation." Scatter plots reveal the absence of any systematic relationship between the two variables. Rudra regards rank correlation tests as superior as they assume no specific functional relation between output per acre and farm size [*Chattopadhyay & Rudra, 1976: A-107*].[9]

In a later study, Rudra presents data on rank correlation coefficients between farm size and yield per hectare <u>for individual crops</u> [*1968b: A-35, table 1*]: producing 4 statistically significant negative coefficients (3 at the 5% level and 1 at 7%) and 1 positive out of 20 crop correlations in 12 districts. Note, however, that there is a clear distinction to be drawn between physical yields of individual crops and total crop production in value terms (this reflects the importance of cropping intensity and crop pattern). Unlike the inverse relationship in value terms, little evidence has been produced for an inverse relationship in terms of the physical yields of individual crops.

Output per acre is a crude measure of productivity to only one input. An alternative measure of efficiency is cost per unit of output, but difficulties arise from the fact that much output is retained for self-consumption and many of the inputs are own-produced. This means imputing costs and these depend on rather hazy opportunity costs. Rao and other writers have used net farm income per acre (defined as gross income minus the value of seeds, manures, fertilizers, irrigation charges, bullock feed and depreciation on fixed capital) [*1963: 2042-3*]. Khusro [*1964: 52-3*] claims that farmers are interested in minimising paid-out costs, not "retained" costs, but this raises a difficulty if paid-out cost ratios differ with farm size. If large farms have higher paid-out cost/output ratios than small farms, then this introduces a bias against large farm productivity.

Rank correlation coefficients for yield per hectare for individual crops against farm size,[10] appear to provide no evidence for an inverse relationship: the coefficients are mostly insignificant, and those that are significant are positive [*Chattopadhyay & Rudra, 1976: A105-7, table 1*]. The sign and significance vary with the type of crop. Chattopadhyay and Rudra "have no hesitation in drawing the conclusion that output per hectare decreasing with farm size certainly does not hold true for individual crops" [*1976: A110*].

Rudra also presents rank correlation coefficients between farm size and indicators of farm business as a whole for 17 districts. Here Rudra uses net yields and output in value terms and finds an inverse relation in 15 of the cases, 9 of them significant [*Rudra, 1968b: A-37, table II*]. Among the non-significant coefficients there is still a preponderance of negative coefficients (not a random distribution of negative and positive as would be expected): this possibly results according to Rudra from the often marked declining tendency over the range of smaller farm sizes (but not over the large farms) [*1968b: A-38*]. Important as this is, it is no basis for generalising over the whole country. Rudra challenges the universal validity of the inverse relationship, but does not reject that validity in all circumstances: in some places, at certain times, and for certain size ranges the inverse relationship holds [*Chattopadhyay & Rudra, 1976: A-104*].

The preponderance of negative correlation coefficients only means that the negative relation must be significant for some of the cases in the polled data, but certainly not significant in all cases. A significant inverse relationship between farm size and productivity does not necessarily mean it holds over the whole range of values of the independent variable: thus, it is important to check the data visually. Rudra notes that the inverse relationship over the entire range may be true for Orissa, Tamil Nadu, Assam, Uttar Pradesh, and Madhya Pradesh, but in most cases it is expected to hold over the range of small farms only [*Chattopadhyay & Rudra, 1976: A109*].

2.4 The inverse relation vindicated

While Rudra is correct to assert the need to disaggregate the data, the divergence between his results and those of the FMS would persist even with disaggregation. Rudra's concept of yield per acre is biased toward eliminating the inverse relationship. Yields have been calculated as gross value of output per gross cultivated area [*Rudra, 1968a: 1041*]. Gross cultivated area or gross cropped area includes farm size plus those parts of the operated area multi-cropped.[11]

However, factors such as double (or multiple) cropping and the percentage of land cultivated reflect the economics of farming. They are not exogenous factors affecting the economics of farming. A farmer who cultivates land more intensively via double cropping and raising the percentage of land cultivated may be argued to be using land more efficiently [*Rao, 1968: 1413*]. Rudra's procedure however, obscures cropping intensity differentials between farm size groups which may be of critical significance. Moreover, it is important to establish why land is cultivated more intensively. Rudra's procedure corrects for the efficiency of land use by using gross cropped area.[12]

Hanumantha Rao notes that if an inverse relationship exists between cropping intensity (the ratio of gross cropped area to net cropped area or farm size) and farm size, then Rudra's results are not surprising. If however such a relation does not exist for Rudra's villages then possibly no inverse relation exists. "The relevant question in this case is...whether these five [*sic*] villages are to be regarded as more typical of Indian farming than those studied by the FMS in different parts of the country" [*Rao, 1968: 1413-4*].[13]

Nevertheless, much of Rudra's criticism of the earlier FMS studies has a great deal of validity. However, other writers sought to answer the criticisms by using disaggregated data for individual farm households at the village level.

Saini [*1971*] analyzes disaggregated FMS data for 25 data sets in 9 States.[14] His data [*1971: A-79, table 1*] show 22 out of 25 coefficients less than unity, and 18 significantly less than unity at the 5% level (see Table 4, Appendix A). Three cases show coefficients greater than unity, but not statistically significant. Saini concludes: "Thus, by and large, the inverse relationship between farm size and productivity is a confirmed phenomenon in Indian agriculture and its statistical validity is adequately established by an analysis of the disaggregated data" [*1971: A81-2*]. Note however that this study still pools data over several villages, a defect he was to rectify in the following study.[15]

In this later study, Bhattacharya and Saini [*1972: A63*] examine disaggregated FMS data for individual farms, separately for each sample village. The data relate to Punjab (Ferozepur) 1955-6, 1956-7, 1967-8 and 1968-9 and to Uttar Pradesh (Muzaffarnagar) for the same years plus 1966-7. Scatter diagrams did not reveal any significant non-linearities, but nevertheless Kendall rank correlation coefficients were computed [*1972: A63*]. Table 5 in Appendix A [*from 1972: A65-66*] shows the regression results and rank correlation coefficients.[16]

Muzaffarnagar showed a significant inverse relationship for all years in that such a correlation is observed within most of the sample villages and does not arise from aggregation over villages. An inverse relation was unclear for the Ferozepur region. There is little evidence of a time trend. The writers claim that this indicates that the Green Revolution has not affected the inverse relationship in either region, but regressions using gross cropped area do show a shift from negative to positive correlation over time in Muzaffarnagar and from zero to positive in Ferozepur [*1972: A71*].[17]

The general conclusion after the spilling of much ink is that the inverse relationship between farm size and productivity has been confirmed as a valid empirical phenomenon in India, but not in the way conceived of in the earlier studies. Rudra and Sen in a joint paper [*1980: 393*] conclude: "While...the inverse relation is more frequently confirmed than rejected, it would be a mistake to take it to be an empirical generalisation for Indian agriculture as a whole." The inverse relationship findings in the Indian FMS, then, are not entirely conclusive. Moreover, some exceptions and complications are introduced by considering other factors besides land [*Sen, 1964b: 441*]. But those findings do suggest a persistent phenomenon that needs to be explained.

2.5 Conjoint relationships: clustered factors and some *a priori* explanations

A wide range of relationships between farm size and other important factors are revealed by the various studies mentioned above that may throw some light on the theoretical understanding of this phenomenon presented in chapters III to VI. We note, however, an absence in these early findings concerning, for example, the relationship between tenancy and size, or rent burden and size, or interest burden and size etc.: i.e. on property relations.

The major findings of the FMS studies and the wider debate which followed can be summarised as follows:[18]

1) An inverse relationship between output per net cropped acre for the total value of crop production and farm size exists for most regions of India, and for a wide range of other countries

2) That inverse relationship appears to be weakened when gross cropped area is used as the land measure in the productivity calculation.

3) No inverse relationship is evident between the physical yield per acre of individual crops and farm size. Indeed, in most cases, physical yields of individual crops appear to be constant or even increasing across farm size.

4) There is a strong inverse relationship between cropping intensity and farm size, where the cropping intensity index represents the ratio of gross cropped area to net cropped area.

5) A further inverse relationship is evident between units of labour input per acre and farm size. As farm size increases, less human labour input is applied per acre.

6) A related phenomenon is the declining ratio of family labour to total labour as farm size increases. The ratio of hired labour input to total labour increases with farm size.

7) Along with increasing labour input intensity on the smaller farms, is a higher intensity of application of capital inputs (including animal labour power, seeds, fertilizers, and farm buildings).

8) This latter association does not apply to purchased intermediate inputs which tend to increase proportionately or more than proportionately with farm size.

9) An inverse relationship has also been noticed between the percentage of cultivated area irrigated and farm size.

Below, we discuss each relationship individually, but it is already fairly obvious that these findings are closely interdependent. All the studies mentioned above in Chapter I and in this chapter find these relationships clustered, suggesting a priori explanations for the inverse relationship.

Paglin [*1965: 818*] suggests that differences in labour and material inputs per acre explain a large proportion of the variance in productivity between farm size. On small farms, land-saving techniques imply capital and labour substitution for land. Small farms use more bullock labour, fertiliser and irrigation inputs per acre as well as more family labour - all related to higher cropping intensity [*1965: 821*]. Rao [*1968: 1413*] points out that previous studies at the village level confirm that the inverse relationship between farm size and productivity in the FMS data arises from a corresponding inverse relation between size and cropping intensity, input intensity and the percentage of farm area irrigated.

Rudra's study of 20 villages revealed an inverse relationship between cropping intensity and farm size in 11 out of 16 cases (9 at the 1% level). Eleven villages (5 significant at the 1% level) show negative coefficients with regard to the relation between percentage area irrigated and farm size (but with one significant positive result in Allepey, Kerala) [*1968b: A37-8*]. Investment per hectare shows a declining tendency in 9 out of 12 cases, and there were 13 significantly negative coefficients out of 17 for total input per hectare. The later study by Chattopadhyay and Rudra [*1976: A-111*] showed cropping intensity and labour input intensity varying inversely with farm size in all states and over all size classes (except Madhya Pradesh and Assam). The incidence of irrigation varied inversely with size in many states.[19] Total input per hectare (material costs and labour using imputed costs) varied inversely with farm size in all states, but application of material inputs alone per hectare shows a decreasing tendency only in some cases.

Ghose suggests that higher output per acre is attained on small farms due to higher labour intensity and the intensive application of other inputs. The variation in output per acre correlates significantly with the variation in the application of manures and fertilizers and irrigation levels. These results held for all farms and for all types of farms (tenanted and owner-operated, as well as family labour-based and wage labour-based) taken separately [*1979: 38-40*].

All 15 cases in Cornia's cross-country study [*1985: 524-5, table 3*] show a significant inverse relation between productivity and farm size, and 9 out of 15 show an associated inverse relation between cropping intensity and size. Both labour and capital inputs per unit land area show a significant inverse relation with size. Sanyal's study of the NSS 16th round data in India [*1969: 1345-6*] finds cropping intensity falling sharply as size increases. The number of attached farm workers and percentage area irrigated both decline with size.

As was mentioned above, there is a clear distinction to be drawn between the physical yields of individual crops and total crop production in value terms. While evidence for the inverse relationship in terms of the total value of crop production is strong, most of the data sets show clearly that there is no systematic relationship between farm size and the physical yields of individual crops. Indeed, where a relationship does appear, this tends to reveal a pattern of increasing physical crop yields with farm size. This dual finding can only be resolved when the importance of cropping intensity and crop mix patterns is fully recognised.

Small farms increase output per acre through the adoption of multiple cropping techniques and crop diversification towards high value products. Hossain regards the former as the most significant factor behind land productivity given the relative homogeneity in crop mix between farms [*1977: 315*]. However, there are some problems with cropping intensity alone as an index of land utilization: neither the values of individual crops nor the duration of production cycles enter into the calculation of cropping intensity (simply the ratio of gross cropped area to net cropped area or farm size). A crop with a relatively long production cycle would have a low index of cropping intensity, but may have high land use. Similarly, a high value crop (such as sugarcane) may have low cropping intensity given a twelve month production cycle [*Roy, 1979: 37*].

Higher land use and cropping intensities imply a more intensive application of other inputs, particularly labour. Bharadwaj [*1974a: 19*] notes on the basis of FMS data that while family size varies positively with size of holding, the number of earners per acre declines with increasing size. Regressing total labour days per acre on average size of holding for total crop production, there was a significant inverse relation. Therefore, the higher cropping intensity and choice of labour intensive crops are associated very strongly with greater labour use per acre on small farms in terms of total crop production.

While physical yields show no systematic variation across farm size, the small farms show higher labour intensity even for individual crops. Chattopadhyay and Rudra note a preponderance of significant negative signs among the relevant coefficients [*1976: A105-7*]: "Smaller farms in almost all areas seem to devote a greater amount of labour per hectare of land not only for cultivating more crops on the same land, but even for looking after a single crop. *However, this greater amount of labour does not result in higher production*. Presumably, the larger farms while devoting less labour, apply capital and other inputs at a higher rate so as to obtain the same amount of production or more than the smaller farms" [*1976: A111*]. Data from the Japan Farm Household survey in 1960 show that while individual crop yields are higher on the large farms, cropping intensity is higher on the small farms and the latter use much more labour per cho [*Bachman & Christensen, 1967: 247*].

Ghose [*1979: 34, table 3*] finds that labour input intensity (for both net and gross cropped area) varies inversely with size for all farms taken together and for types of farms. This holds even when output per acre varies directly with size. The inverse relationship between farm size and labour input per acre thus exists independently of production relations. Paglin, however, notes that even though labour intensity varies over farm size, total labour input as a proportion of total costs is relatively constant over size [*1965: 821*].

A related finding found by Sen [*1962: 245*] in nearly all areas covered by the FMS, was that the proportion of family labour to hired labour falls with the size of farms. The Uttar Pradesh study for 1954-5 (p.37) comments: "the contribution of family labour to the total farm labour is the highest in the lower size groups" [*Sen, 1962: 55, table 4.10*]. This table also shows that the proportion of family labour falls monotonically with increase in size.[20] While small farms have higher family labour per acre, this is not so for wage labour. However, total family labour applied per acre increases as size falls, so despite falling wage labour, total labour per acre rises [*Sen, 1962: 245, fn. 2*].

Cornia [*1985: 518*] concludes that the higher proportion of hired labour on the large farms confirms "the hypothesis that, on average, large farms adopt a capitalistic mode of production based on wage-labour, while small farms tend to make a larger use of on-farm family labour."[21] However, Paglin [*1965: 824*] notes that small farms themselves use significant amounts of hired labour although less than the large size classes. Ghose [*1979: 30*] confirms this for Hooghly: the proportion of wage labour-based farms increases with size, but even small size-classes contain a significant proportion of wage labour farms. Ferozepur shows a clearer pattern, but still there are large peasant farms.

Taslim's study of 300 rural households in Bangladesh [*1989: 57*] produces strong evidence to support the general finding that the smaller the farm size, the greater the number of family workers per unit of land. He also finds that the greater the number of family labourers per unit of land, the greater the ratio of family labour to total labour input on the farm. He does notice some difference between small and large farms though: the correlation between family labour and hired labour is negative on the small farms, but positive on the large farms. Also the correlation between family labour inputs per acre and total labour inputs per acre is negative on the small farms, and positive on the large farms (but not significant) [*1989: 64*].[22] This would suggest that family labour and hired labour are substitutes on the small farms, but complementary on the large farm sizes. The ability of large farms to employ wage labour is constrained by the availability of family labour, essential for supervision.

The significantly higher labour intensity of production on small farms appears to entail more intensive use of other inputs. The FMS Studies note a persistent tendency to raise the quantum of inputs per acre, especially in the smaller holdings and irrigated holdings so that output per acre increases, but no explanation is given as to why input per acre falls as size increases (the Uttar Pradesh study mentions indivisibility of bullocks, but this doesn't explain the increased use of other inputs) [*Sen, 1962: 245*]. The increased application of other inputs per acre may partly reflect the complementarity between labour and other inputs. This may also explain the greater investment per acre on smaller farms with such investment undertaken by direct application of family labour. In Madhya Pradesh, Uttar Pradesh, and Punjab, small farms also work with more material inputs per labour unit than the large farms [*Paglin, 1965: 821*]. Cornia [*1985: 524*] notes that capital per hectare declines as farm size increases and capital per worker is higher on the large farms for 9 out of 15 countries. Note however that there is no correction made for uncultivated land in any of the cases.

The cost of bullocks and implements as a proportion of the value of gross output are found to decline with the increase in farm size in all the regions studied [*Rao, 1965*]. This appears to be the result of indivisibilities (especially farm buildings and animals). Within Indian agriculture, bullock power is important not only in crop production, but also for transport, social status, and economic security. Regressing total bullock-labour days per acre on average size of holding, Bharadwaj [*1974: 109, table F1*] found a significantly negative relation for total crop production. Thus for total crop production, bullock labour and human labour appear to be complementary. The FMS data for Punjab shows bullock cost increases with size due to the fact that small farmers maintain lower quality animals [*Rao, 1963: 2042*].

Sanyal [*1969: 1346, table 3*] finds that the proportion of cultivated area under chemical fertilizers increases up to 2.5 acres but falls thereafter. There is, however, evidence to the contrary: showing that the application of purchased inputs per acre rises as size of farm increases.[23] Rao [*1968b: 93*] observes that "even though the application of labour may be higher among smaller farms, they may lag behind the larger ones in regard to the application of technologically new inputs such as fertilizers, improved seeds and insecticides etc. owing to their low investible surplus". Bharadwaj [*1974a: 38*] notes that other inputs reveal no systematic relation with size. The seed rate per acre tends to vary more with sowing methods, climatic factors, and levels of irrigation than with size. Manures and fertilizers account for only a small part of expenditure and are not much used on the smaller size-holdings in any case.

Finally, is the perhaps surprising finding that small farm sizes have a higher proportion of cultivated area irrigated. Irrigation increases productivity per acre by permitting more intensive application of other inputs. The FMS studies show that irrigated holdings do have higher use of human and bullock labour, and total inputs, than unirrigated holdings. Hanumantha Rao [*1966: 3-4*] finds that correcting for irrigation by including the proportion of area irrigated as a regressor, results in a less marked inverse relationship between size and productivity. A.P. Rao [*1967: 1990*], controlling for current fallow and irrigation ratios, finds that expenditure on seed, fertilizer and manure per acre and cropping intensity remained constant over all farm sizes on both net and gross cropped area measures. We shall examine this finding more closely in the next chapter.

Summary and conclusions

Neither the statistical evidence for the inverse relationship, nor its apparent policy implications, have been generally accepted. This chapter has examined the principal conceptual and methodological problems associated with the data. Classification by farm-size implies that the characteristics of a farm depend predominantly on its belonging to a certain size-group. Size of farm however is a very general variable and to treat it as the only significant parameter would be a mistake.

Despite these problems, the inverse relationship has been confirmed in Indian agriculture at the time during which these studies were conducted, and its statistical validity is adequately established by an analysis of the disaggregated data. It is not necessarily, however, a phenomenon that will persist indefinitely. Clearly the inverse relationship is a phenomenon that needs to be explained, and not explained away by "exacting statisticians". These latter however did perform the useful function of questioning the FMS data critically. It would be a mistake to regard the inverse relationship as an empirical generalisation for Indian agriculture as a whole, however.

A wide range of relationships between farm size and other important factors are revealed in section 2.5 that may throw some light on the theoretical understanding of this phenomenon. This range of clustered relationships suggests a possible labour-based explanation for the inverse relationship which will be discussed in Chapter IV.

Further limitations of the FMS data include an over-emphasis on technical relations, input-output data, and only cursory information on tenancy and variation of tenurial terms and conditions across farms. The concentration on size of holding and technical relations on individual farms neglects information on property relations and underplays other aspects such as tenurial status, farm investment size, scale of output, rent burden, and non-price factors. An important point raised is whether productivity differentials will persist over time making small farms historically viable or whether they are based on a specific conjuncture of factors and are subject to change. The FMS years of reference are prior to the Green Revolution. Thus possibly production conditions have changed, both in technological and property aspects in certain regions.

This would suggest that the framework of analysis is inappropriate - a return to the examination of the inverse relationship in the context of agrarian transition would perhaps be more profitable. We must go deeper than the size of holding categories to the underlying social relations of production. The next two chapters examine the main theoretical approaches to the inverse relationship and in Chapter V, we attempt to transcend the limitations of the debate.

Notes to Chapter II

1. Citing H. Morales Jara, *Productividad presente y potencial en 96 predios de la provincia de O'Higgins y su relacion con el tamano de las propriedades* (tesis de Ing. Agron., Universidad de Chile, 1964; J.O. Bray, *La intensidad del uso de la tierra en relacion con el tamano de los predios en el Valle central de Chile* (Santiago, Universidad Catolica de Chile, 1960); A. Corvalan Morales & R. Parra Herrera, *Introduccion a la determinacion de areas agricolas homogeneas en Chile: Aconcagua-Chile*, (tesis de Ing. Agron., Universidad de Chile 1963).

2. The argument in this section has been developed by T.J. Byres in an unpublished manuscript.

3. In adopting such an approach, Patnaik is following Lenin's treatment in *New Data on the Laws Governing the Development of Capitalism in Agriculture*, which relates to the USA and the apparent inverse relationship found there in the US Census data on agriculture of 1910-11. See Volume 22 of *Collected Works* (Moscow, 1964), pp. 58-71. One needs to take a position on whether or not Lenin was correct with respect to US agriculture at that time. He probably was. He, of course, himself used size, quite happily, as a stratifying variable in *Development of Capitalism in Russia*. But while Lenin may well have been correct with respect to the US in 1910-11, the same may not have been true of India in the mid-1950s; although it may have begun to have validity in parts of India by the 1970s.

It is interesting that Patnaik's reasons for so questioning the inverse relationship - i.e. in relation to arguments about cooperative agriculture etc. - seem to be similar to Rudra's (whom she quotes with apparent favour [*1972: 1615*). But her approach is, of course very different to his. She also wishes to oppose the populist arguments about small farms being more efficient etc. [*1972: 1613*].

4. Note however that Roy [*1979*] does attempt to show that the direction of causality at the "macro" level is indeed operative at the micro level. We will discuss this land-based approach to understanding the inverse relationship in chapter II.

5. Bhattacharya and Saini [1972: A-72] note that intercept terms vary significantly between villages due to soil fertility and other factors. Indeed, the variation in intercepts explains a higher proportion of variation in productivity than net or gross cropped area.

6. Rao [*1967: 1990*] uses data for 6 villages (249 farms) - Matiana, Bhatian and Sochania in Punjab; and Zahidpur, Patti Beharipur and Gatti in Uttar Pradesh, collected by the Agricultural Economics Research Centre, University of Delhi. He finds that wherever there is no significant variation in irrigation ratios across farm size, output per acre is constant: the FMS findings therefore may be attributable to the irrigation factor. He suggests that if the percentage of current fallow increases with farm size then this would help to explain the FMS finding of declining output per acre with farm size. He also makes point that he uses individual farm-level data and not group averages.

7. This tests the ratio of between-group variance to within-group variance.

8. Rudra does admit that the use of modal price in each village to calculate value of output (rather than individually received price) may have ironed out some real differences in productivity to the extent that price differences received by different farmers might reflect quality variations in output [*1968a: 1041*].

9. The hypothesis to be tested is not that f(x) has any particular functional form with a negative coefficient, but that given (x1, y1) and (x2, y2), both x1 > x2 and y1 < y2 hold. Thus the suitability of rank correlation tests [*Rudra, 1968b: A-37*].

10. Note that this is yield per gross cropped hectare. If short season crops have a naturally lower productivity, then this too may imply a bias against finding an inverse relation.

11. "The reason we have not taken farm size as the divisor is that we would like to treat the extent of double cropping, proportion of uncultivated land to cultivated land, etc, as distinct factors affecting the economics of farming and not subsume all of them in the factor 'size of farm'" [*Rudra, 1968a: 1041*]. This procedure however, obscures cropping intensity differentials between farm size groups which may be of critical significance.

In fact, inspection of the FMS tables themselves (in *Farm Management in India. A Study Based on Recent Investigations, Appendix III*), reveals that where the gross cropped measure is used, the inverse relationship disappears.

12. This can be seen from the table below in which two farms of the same size have the same output per gross cropped area, even though farm A has higher output per net cropped area [*Rao, 1968: 1413*]:

	A	B
1) size of holding (acres)	10	10
2) output per farm (Rs)	750	500
3) output per acre (2/1)	75	50
4) % of holding cultivated	100	80
5) % cultivated land double	50	25

	cropped		
6)	gross cropped area (acres)	15	10
7)	output per gross cropped area	50	50

13. Rudra [*1968b: A-38*] answers Rao, but not convincingly. While the FMS studies use both net cropped area and gross cropped area, they are used in different contexts (see note on physical yields of individual crops and total value yields below). Rudra also points out that while higher cropping intensity on small farms is one of the factors leading to higher yields (hence the importance of using net cropped area in yield measurements), there are other reasons for the inverse relation mentioned by the FMS studies: such as higher labour input intensity and higher fertility. Therefore using gross cropped area should not "correct" entirely for efficiency of land use. However, labour input and cropping intensity are highly correlated (see section 1.4 below), and the differential fertility hypothesis is insignificant at the "micro" level.

14. Saini in an earlier study uses disaggregated FMS data for Uttar Pradesh (Meerut and Muzaffarnagar districts) and Punjab (Amritsar and Ferozepur districts) for the years 1955-56 and 1956-57 [this paper is a shorter version of [*Saini, 1969a]*. All land coefficients were significantly below unity indicating a strong inverse relationship [*Saini, 1969b: A-120*].

15. Other disaggregated studies have been carried out by Bardhan [*1973*] and Ghose [*1979*]. Bardhan uses disaggregated FMS data for 915 farms from 7 districts in Punjab (2 samples: 1955-6 and 1967-8), Andhra Pradesh, Orissa, Madhya Pradesh, Tamil Nadu, and Uttar Pradesh. Table 1 shows 7 out of 8 estimates of elasticities of crop output per acre with respect to net sown area have negative coefficients (but only three are significant) [*1973: 1373*].

Ghose uses FMS data: 85 farms from 1955-6, 94 farms from 1956-7, 149 farms from 1971-2, and 148 farms from 1972-3 in Hooghly district, West Bengal; and 100 farms from 1955-6, 100 farms from 1956-7, and 150 farms from 1968-9 in Ferozepur, Punjab. Table 2 [*1979: 32*] shows with all farms considered together, an inverse relationship in 5 out of 7 cases (significant in 3) using net cropped area (1 case significantly positive). Using gross cropped area, the inverse relation was much weaker indicating higher cropping intensity on the smaller farms.

16. There is a problem in that the per village sample size is small (about 10) so that t tests lack power [*1972: A-63*]. However, table 3 [*1972: A-69*] shows that chi-squared values from combined village tests are significant. For each t value, the probability p of Students t with n-2 df falling below the computed value was calculated. The lower tail probability was used with a one-tailed alternative hypothesis, i.e. that the true correlation was negative. Chi-square = -SUM ln pi where pi is the probability for the ith village (df = twice the number of sample villages). The hypothesis of zero correlation is rejected if chi-squared is significant. A similar procedure was carried out for the rank coefficients.

17. See Chapter III for further examination of this phenomenon.

18. See tables in Bharadwaj [*1974a: 91-125, Appendices B-H*]. Given their conciseness, the tables relating to the principal findings listed in the text are reproduced in Tables 6 to 12 in Appendix A.

19. But not in Kerala which showed a significant positive relation. Interestingly, in Uttar Pradesh, this relation was inverse and highly significant in the mid-1950s, but had become positive by the mid-1960s.

20. There was one exception in the Cost Accounting sample, but none in the Survey sample.

21. Note that to identify large farmers as 'capitalist' simply because they employ wage labour is quite unacceptable. This important point is elaborated upon in Chapter V when we discuss a possible class-based explanation of the inverse relationship.

22. The large farms are defined as greater than 6.5 acres in Mymensingh, 3.5 acres in Comilla, and 10 acres in Rajashahi; the small farms are less than 5 acres, 3.5 acres, and 7.5 acres respectively.

23. See Goverment of India, *Studies in the Economics of Farm Management in Uttar Pradesh, Combined Report for 1954-55 to 1956-57*, (Delhi, 1963), p. 104, table 5.15.

CHAPTER III

Explanations of the inverse relationship based on qualitative factor differences

Introduction

In the previous chapters, we have surveyed the nature and extent of the empirical evidence supporting the existence of an inverse relationship between farm size and land productivity. In addition, we saw that the empirical data points to a number of clustered relationships involving factors of production, summarised in Chapter II, section 2.5. That evidence has spawned a vast theoretical literature which has attempted to explain how the inverse relationship arises.

One theoretical approach has already been examined in the previous chapter: that which purports to explain away the inverse relationship as a purely statistical artefact. This takes a variety of forms, some more plausible than others. However, the methodological flaws associated with that approach, broadly, and the weight of evidence produced at a suitably disaggregated level, would appear to confirm the existence of an inverse relationship as a real phenomenon that requires substantive explanation.

Rather than discuss the theoretical debate chronologically (see Rudra and Sen [*1980*] for a summary), it is both convenient and logical to examine the principal theoretical approaches to the inverse relationship under three broad conceptual headings:

1) the first approach, to be examined in this chapter, attempts to explain the inverse relationship in terms of qualitative factor differences between farm-size categories. It is postulated that small farm-size categories, however they may be defined, utilize qualitatively superior factors of production, either in terms of physical resources such as soil quality and irrigation, or in terms of management, labour, and production technique. The main thrust of such an approach has been to explain why such factors are concentrated on small farms.

2) the second, and more substantial approach, to be discussed in Chapter IV, attempts to explain the inverse relationship in terms of differential factor use intensities between farm-size categories. This approach postulates that small farms apply production inputs, especially land and labour, more intensively in cultivation. The debate has centred around Amartya Sen's model which postulates different behavioural strategies as between farm-size categories. A more explicitly neoclassical variant of this approach will also be discussed.

3) the third is a class-based political economy explanation of the inverse relationship. Here, an attempt is made to identify farm size with class location, and to show how the inverse

relationship arises from the interaction of classes. This is discussed in Chapter V.

Note here that the more usual categorisation of theoretical approaches in agrarian political economy, comprising neoclassical, Chayanovian, and Marxist paradigms, runs across the sets of explanations based on qualitative and quantitative factor differences. In this chapter and the next two, we intend to show that the first two approaches, both essentially static in nature, are either inadequate or fundamentally flawed as explanations for the inverse relationship. The third approach will be more fully examined in Chapter V when we move from the static context to the dynamic context of agrarian transition.

In this chapter, we examine the principal contributions to the first approach based on qualitative factor differences. In section 3.1, we discuss an influential set of explanations of the inverse relationship based on the proposition that small farms are characterised by better quality management, labour input, and technique than on the large farms. Section 3.2 critically evaluates those explanations based on differential soil fertility between farm sizes, while section 3.3 examines in greater detail a major contribution by Prannoy Roy to that approach. Related to that question are hypotheses concerning better irrigation on small farms, discussed in section 3.4.

3.1 Management, labour and technique hypotheses

This section examines critically three separate, but as we shall see, inter-related explanations of the inverse relationship based on the proposition that small farms are characterised by better quality management, labour input, and technique than on the large farms.

Given the essentially untestable nature of the concepts of management and labour quality, the researcher is forced to utilize various proxies, and hence this approach tends to be residual in nature. Some form of "diseconomies of large scale" peculiar to agricultural production are normally invoked as giving rise to an inverse relationship. Khusro [*1964: 63, fn. 11*] writes: "with an expansion of farm-size and of all other inputs, might it not be that per acre returns decline owing to a fixity of entrepreneurship (the usual argument for diminishing returns to scale)? Entrepreneurship in underdeveloped farming being what it is, the point where it cannot cope with the expansion of other inputs ought to arrive at a smaller farm-size than in developed farming."

This view is supported by Hanumantha Rao [*1966: 10-11*]: "If one agrees with Sen...that the availability of capital cannot be a bottleneck for larger farms, then the productivity behaviour can be explained only in terms of the management factor and the income-leisure preferences among the larger farms." Among the large farm groups, management may be insufficient to meet the increased needs of supervision and inefficient owing to dissociation of ownership from management and management from work [*Rao, 1963: 2402*].[1]

This argument appears to have two distinct components: the first is a proposition concerning the increase in complexity of organisation that comes with size, and which appears to have inefficiencies inherent in it, compared with the small farm situation; the second is a proposition relating to supervision problems and incentives which seem to become problematic as size increases.

Ellman states the first strand in the managerial diseconomies of scale argument as follows: "the efficient large scale organisation of labour requires efficient planning, administration, and book-keeping work which is unnecessary under peasant farming where each peasant organises his own work for himself" [*1989: 100*]. This argument is frequently made with respect to agriculture, both large scale capitalist farms as well as to collective farms. It is not an argument that one encounters with respect to industrial production. In principle, however, it applies just as much to a comparison between small-scale traditional artisanal units and large-scale modern units which spread management overheads. Yet it is not made in this context.

Clearly, complexity of organisation does increase with size, but why this should necessarily generate insuperable inefficiencies is not so clear. On the contrary, one might argue that the scope provided for division of labour and specialization leads to the possibility of increased efficiency. If the logic of the argument applies to agriculture but not to industry, then identifiable differences must exist between the two, in relation to organisation and the internal problems of planning, administration and accounting. It is sometimes implied that such differences do exist in agriculture's spatial dispersion and the sequential nature of work over the course of the agricultural cycle. But why spatial dispersion is assumed to be a significant factor in agricultural production, and not in modern industrial production is unclear: after all, many modern plants cover vast areas and involve extremely complex management problems. Thus it is not at all self-evident that, simply in terms of organisation, large farms are inefficient. To that extent, the argument, in terms of organisation, is problematic.

Let us suppose however that the argument does have some validity. Its force then may hinge, to a certain extent, upon whether or not technical economies of scale exist. If there are indeed demonstrable potential economies of scale then these may compensate for possible managerial diseconomies. The greater the potential technical economies, the greater the compensation. That is, even if managerial diseconomies of scale could be shown to exist (in the sense that management becomes more difficult and more complex as size increases) that might not matter if technical economies of scale are possible. This implies a possible trade-off between technical economies of scale and managerial diseconomies of scale.

Thus, the argument simply in organisational terms is not wholly convincing, but the second part of the argument concerning incentives does seem, at first sight, to have considerable force. This part of the argument suggests that any economies of scale arising from indivisibilities will be offset by the agency costs of managing wage labour and enforcing effort on the part of the hired workforce. Supervision costs and incentive contracts, it is posited, will have profound implications for the optimal size of farm.

Mellor states the argument as follows: "because of the biological nature of the agricultural production process, operations are spread out in time and space" (the sequential nature of the work over the course of the agricultural cycle and the spatial dispersion of work on a large farm with many workers). "Hence, a big operational unit that relies on a large work force, whether hired labourers or members of a group farm, encounters difficult problems of supervision in seeking to avoid shirking. Owing to the high degree of variability that characterises farming activities, there are numerous 'on-the-spot supervisory decisions' to be made" [*Mellor & Johnston, 1984: 558*].

Mellor [*1966: 368*] argues that the problems associated with a large labour force argue for small farm units where incentives rather than supervision "provoke careful, timely and knowledgable use of labour". This echoes an earlier argument by Joan Robinson [*1964: 1*] who writes: "For the deployment of labour, a rather small scale is required. Workers are spread out over space so that discipline is hard to enforce; an incentive wage system is not easy to arrange or administer; there has to be a great diffusion of managerial responsibility; every field is different, every day is different and quick decisions have to be taken. For getting work out of the workers a peasant farm is hard to beat. Discipline and responsibility are imposed by the pressing incentive to secure the family livelihood."

The final product of labour appears with a considerable time lag after labour effort has been expended: with a large labour force, therefore, it is difficult to identify and reward the contribution of each worker, and it is difficult to assess the quantity or quality of labour effort until the final product appears. Hence the need for direct supervision. The spatial dispersion of work exacerbates such supervision problems. Thus, the farm economy is characterised by peculiar difficulties in supervising farm work, generally leading to powerful managerial diseconomies of scale as the number of workers in a production unit expands [*Nolan, 1988: 41-2*].

Rao also mentions a large farm low aspiration model in which small farmers work their land intensively to earn income, but large farmers are indifferent, being accustomed to traditional consumption patterns and a greater preference for leisure and non-economic pursuits [*1966: 11*].

The obverse of the above approach is that small farms have a productivity advantage which relates to the quality of labour.

This is a hypothesis in terms of qualitative factor difference which relates to incentive structures. It is a classic populist assumption suggested quite often in the literature, but is seldom stated with great clarity. More often, it is implied. Unfortunately, no evidence is presented in support of the proposition; or against which one might test the hypothesis.

Thus, for example, Khusro suggests that a unit of family labour is worth more, qualitatively, than a unit of wage labour. He says: "Now, if it is true, as it probably is, that in agriculture a unit of family labour does more or better work than a unit of hired labour, the product will be larger for the former even if the quantities of labour applied were the same in both cases. In that case, a mere increase in the proportion of hired to family labour, as farm-size expands, gives a smaller per acre product [*1964: 63*].

A more recent contributor argues: "people will produce more as small family groups, working for themselves and receiving the whole product of their labour, than as employees in larger units...This points to the frequent superiority of the smaller, self-managed family unit, as expressed in the 'inverse relationship': namely, the generally higher productivity of land, and to a lesser extent all factors taken together, farmed in smaller holdings" [*Lipton, 1993a: 1524*].

Because family members are residual claimants to profits, they therefore have higher incentives to provide effort than hired labour. They share the burden of risk and have no search or recruitment costs in the labour market: thus, the claimed superiority of family over large wage labour-based operations [*Binswanger & Deininger, 1993: 1452*]. Due to the advantages of peer monitoring, agents such as family farmers benefit more from supervising each other in small groups than from external supervision by costly foremen. Small farms reduce unit labour-related transaction costs (search, screening, supervision, shirking) by providing nearby, informed, rapid and flexible family overview of labour, and by building on intrafamily altruism and on the extended fungibility of family members between the household and the family farm [*Lipton, 1993b: 648*].

It is further argued that individual peasant farmers have better knowledge of local natural conditions than managers of large farms, and that potential losses from imperfect information are minimised by the ability of the small farmer to adjust to micro variations in the natural environment [*Binswanger & Deininger, 1993: 1452*]. This is accentuated by weather variability which requires rapid and flexible response by the farmer.

In the Indian context, Rao [*1966: 11*] suggests that capital and labour input intensities are dependent on these management and labour factors. Farm operations require close personal supervision, and the scope for such a division of functions and their delegation remains limited. It is further postulated that managerial and supervisory bottlenecks will arise at small farm sizes, with large farms avoiding control-intensive cropping patterns: crops requiring careful handling or high levels of labour application. This stage will be reached earlier under labour-intensive techniques of production. Such managerial bottlenecks will effect a productivity decline via the decline in labour and capital inputs per acre.

This brings us to another explanation that falls within the rubric of this section and which relates to the notion of a superior technique being used on the smaller farms. Sen [*1964a: 323*] writes: "Because of personal participation and supervision that a small business allows, a small holding may permit the use of some techniques - efficient ones - that cannot be used in larger holdings. Some techniques require not only inputs in the usual sense but also loving care, and Adam Smith had directed our attention to the 'affection' that small property inspires."

Efficient production based on labour-using, capital-saving technologies (which are held to be economically and socially desirable) therefore depends on decentralised decision-making and the incentive which owner-cultivators or tenants have to exercise judgement and initiative because of their direct interest in the outcome [*Mellor & Johnston, 1984: 558-9*].

Much of the foregoing arguments, if they have any validity at all, would appear to have more relevance for vast landed estates or extensive ranch-type farming involving thousands of acres. They will have much less relevance for the types of large farms we are considering, in the range from 10 to 50 or even 100 acres.

Supervision costs, under such conditions, would seem to be greatly exaggerated. The use of attached labour in a supervisory role, or even better, the use of family labour, in setting work tasks and ensuring execution is sufficient to ensure that the requisite labour effort has been expended on the part of the workforce. The threat of losing access to wage labour opportunities will provide the incentive for the worker to supply the quantity and quality of labour effort demanded. The often highly personalised relationship between employer and labourer, sometimes involving access to credit and land, help to provide "nearby, informed, rapid and flexible" supervision of labour [*see Bhaduri 1973*].

On the small farm side of the equation, the idealised notion of "family altruism" and "fungibity of family members" ignores the unequal distribution of income within the farm household and intra-household exploitation. Further, the idea that small farmers have better information on the local environment is a dubious proposition, and is probably outweighed by the superior knowledge of large farmers concerning the use of modern technology.

The really critical problem, however, for these approaches is that if small farms were indeed characterised by superior management or labour quality, these should have been reflected in a productivity advantage with regard to individual crops. However, as Bharadwaj (see Table 6, Appendix A) has shown in her study of the FMS data no systematic or significant relation between farm-size and the physical yields of individual crops exists (in fact, irrigated wheat-gram and cotton in Punjab showed a positive relation). That they do not would seem to undermine further the hypothesis that the inverse relation arises from superior rural entrepreneurship of the small farmer.[2]

This approach is further undermined by the fact that the inverse relationship phenomenon is not limited to a simple comparison between small family labour farms and large hired labour farms. All the evidence shows that the inverse relationship runs across small family farms themselves. How the adherents of the above approaches might explain this has been left unwritten. Indeed, they seem not to have even recognised the problem.

Finally on the superior technique approach. Technique relates to the use of a particular production input such as labour or land. While we have seen that any superior technique that might exist does not seem to be manifested in higher physical yields of individual crops, it might be argued that the higher cropping intensity on small farms (see chapter II, section 2.5) is evidence of superior technique. However, what this really boils down to is a question of the intensification of effort rather than any qualitatively different technique. As such, discussion of this matter belongs in the following chapter.

Rao emphasises that the supposed managerial or supervisory disincentives are especially acute under labour-intensive techniques of production [*1966: 11*]. Indeed, much of the literature on diseconomies of scale comes from regions where agricultural mechanization is incomplete and technical change has been slow [*Binswanger & Deininger, 1993: 1452*]. With traditional unmechanized technology, it is claimed that large landholders' supervisory capacity soon becomes binding [*Binswanger & Deininger, 1993: 1468, fn. 2*].

However, in the dynamic context of changing forces of production, with the introduction of more capital-intensive techniques, these constraints would be progressively attenuated. Indeed, the FMS evidence clearly shows that modern technology is concentrated on the large farms [*Bharadwaj, 1974b: A-14*]. This a topic which will be further explored in Chapter V.

3.2 Land fertility hypothesis

A second qualitative approach centres on the proposition that small farms are located on land of superior productive potential. Land enters both sides of the farm size-productivity relation, and is the crucial input in backward agriculture, often the limitational factor. While it is relatively free from annual fluctuation and change in composition, it needs to be standardised in terms of soil quality, a process which can tend to be arbitrary. Consideration of this factor leads us to the fertility-based explanation of the inverse relation.

Bharadwaj [*1974b: A-15*] notes that there is some evidence in the FMS Bombay Report for intrinsic soil differences between farm sizes: small farms appear to have a higher proportion of medium and deep soils, and the uncultivated area is higher on the larger farms, but this should be interpreted cautiously as uncultivated land includes current fallow[3] as well as uncultivable bunds and irrigation canals. Indeed, it is difficult to distinguish between qualitative land differences and those arising from the application of fertility-augmenting inputs. Furthermore, superior soil quality may not be picked up by individual crop regressions because to some extent crop choice is dictated by soil type, and quality differences will be reflected predominantly in crop patterns [*Bharadwaj, 1974b: A14-15*].

Sen perceives some truth in the fertility based approach. Over time, a correlation between land fertility and size of holdings will be established via population expansion on more fertile land. Faster population growth on more fertile land (due to higher growth of income opportunities) leads to greater subdivision of the land. This is easy to see in interregional variation where population expands faster due to natural increase and immigration, but also within regions, claims Sen, where the ability of a farm household to withstand famine or crop disease is greater with more fertile land. Kalra writes: "The average size of holding is generally small in areas where the yielding capacity of land is more by way of assured rainfall, irrigation facilities, better quality of soil, etc., and the density of population is high".[4] Note that this approach ignores the crucial distinction that must be made between the inverse relation at the macro level, and that at the micro level (see Chapter II, section 2.2).

Sen's argument regarding fertility differentials relies upon a rather dubious Malthusian link between income and family size and between level of income and fragmentation, and ignores alternative employment opportunities off-farm. An alternative hypothesis proposed by Bhagwati and Chakravarty [*1969*] suggests that large farms build up holdings by land purchase and foreclosure on loans leading to a high degree of fragmentation, and consequently low productivity. Bardhan [*1973: 1385*] adds that distress sales by poor farmers result in the latter parting with unirrigated land first.

Of course, neither version of the fertility hypothesis (Sen or Bhagwati and Chakravarty) holds the promise of economic betterment for the small farmer nor reflects any inherently progressive characteristics of the latter. However, while the fertility hypothesis based on partible inheritance or small farm distress sales may appear plausible, it is weakened by the fact that small farmers may sell land to other small farmers. Likewise, land reform laws may simply lead to the large farmers divesting their worst quality land. Bharadwaj also points out that according to the FMS database, whereas large holdings do tend to be composed of a greater number of fragments, the intensity of fragmentation (number of fragments per acre) is higher on the small farms (see Table 8, Appendix A).

Khusro points out that the FMS survey deals with crude acreage figures with no correction for fertility.[5] He [*1964: 64*] claims to show, based on the behaviour of land revenue, that as farm size increases the proportion of bad or indifferent land increases and that this accounts for the decline in land productivity. The land revenue index is used as an indicator of relative soil fertility and land conditions. The data provided by Khusro[6] appears to show declining land revenue per acre as farm size increases. Thus, land in successive size-groups of the FMS data is not uniform, but declines in quality and needs to be standardised.

Khusro's standardised figures[7] show that gross output per corrected acre increases in four cases and declines in three with only one regression result statistically significant. He writes: "Thus it cannot be asserted that O/Ac [output per acre] either decreases or increases with Ac [acreage] and the hypothesis of constant gross output per corrected acre as size changes appears to be as good as any...We thus reach what is perhaps an important conclusion: in Indian farming of the 1950s gross output and farm business income per corrected acre had no general tendency either to increase or decrease, while net profit per acre increased with farm-size" [*1964: 72*].[8]

However, Sen expresses some reservation about empirically testing the validity of the fertility variation hypothesis inasmuch as Khusro uses land revenue data as an indicator of fertility. Land revenue may be based on other considerations. Roy [*1979: 10, fn.*

2] cites the 1940 Land Revenue Commission: "The absence of any systematic assessment in Bengal has led to a rate of rent, the incidence of which varies considerably from district to district and from holding to holding and has little relation to the productivity of land."[9] Indeed, the land revenue figures may reflect neither natural soil fertility nor man-made improvements, but simply output per acre itself. In other words, land revenue figures may simply reflect that which we are trying to explain.

Bandhuhas Sen [*1967: 77-78*][10] notes that Khusro's results on fertility are biased by the fact that farms are still grouped by acreage rather than by land revenue and that the corrections for land quality (using land revenue data) have been made on grouped data rather than ungrouped for individual farms. When individual farms are regrouped by land revenue assessment, a significant inverse relationship is still in evidence. He further finds that while farms are not homogeneous with respect to soil quality and that the latter does affect output, when acreage and output are adjusted by a soil fertility index to take account of inter-farm differences in soil quality, there is still a significant inverse relationship between farm size and output per unit size. Mellor and Moorti in a field study in Uttar Pradesh, found that farm to farm differences in soil were evenly distributed as between farm groups and so did not bias the results.[11]

3.3 Prannoy Poy on soil quality explanations

Having succinctly and clearly demonstrated the crucial difference between the macro level inverse relationship and the micro level relation, Roy [*1979: 4*] attempts to prove the thesis that at all levels of disaggregation, the inverse relationship arises along macro lines i.e. the main line of causation runs from soil fertility and therefore productivity to farm size. Thus, it needs to be shown that: 1) land is heterogeneous with respect to soil quality within the village; and 2) better quality land is parcelled into smaller operational units even at the village level.

Roy's chain of reasoning runs as follows: in the Indian context (as in tropical agriculture in general), the principal determinant of land productivity is soil moisture content rather than soil quality as a whole. Whereas soil quality variations tend to occur quite naturally at the macro level, soil quality and texture become more homogeneous at the more disaggregated level. This is not true of water availability however. The factor that causes most variation in soil water content at the micro level is topography.[12] Roy therefore needs to show that small farms are situated on land with higher soil water content, and hence on land of suitable topography. However, due to "paucity of information", Roy is forced to use "indirect forms of data" of an "illustrative and ... indicative nature only" [*1979: 68*].[13] Roy's conclusion is that it is not labour intensity that determines the inverse relation, but the fact that small farms are situated on better land (with higher water availability).

Roy [*1979: 6, figure 1.1*] shows how land values decline with size in seven of the FMS states, particularly in the smaller size groups.[14] The per acre value of land reflects some capitalized service value (the net present value of land is the flow of net output discounted by the prevailing interest rate) and, therefore, rent will be proportional to yields. Thus, despite his earlier criticism, land value is taken as a rough surrogate for the intrinsic quality of land. Roy [*1979: 44*] further mentions references in the FMS studies to large farms located on poor land: "a comparatively larger percentage of area held on the bigger holdings comprise barani land of inferior quality and consequently of lower value" [*Punjab Report, FMS, 1954-5: 47*]. Roy also cites [*1979: 47*] Dantwala[15] who uses data from the RBI Rural Credit Follow-up Surveys: "Incidentally, it may also be noticed that the quality of land of the big cultivators is generally inferior to that of the small cultivators. If the value per acre of the land cultivated by the big and the small cultivators is an indication of the quality of the land, in 7 out of 12 districts it was larger for the lands of the small cultivators. In three other districts, though it was smaller, the difference was insignificant". Thus, claims Roy, the direction of causation of the inverse relationship is the same at all levels so far.

If the above is true, of course, then there will be no point in redistributing such land to small farmers. However, land price may be a downward-biased indicator of land quality on large farms due to land market imperfections [*Berry & Cline, 1979: 13*]. The flow of net output is neither invariant with the type of production system (capitalist farmers discount profits, while landlords discount rents) nor is rent independent of tenurial status.[16] Furthermore, the pattern of land values is not static: changes due to irrigation and changing crop mixes may reverse the prevailing pattern over time.

Roy then turns to Wellisz et al.[17] who find in their study of Andhra Pradesh a positive correlation between farm size and average soil quality as measured by a soil-type index, but a strong negative relation between farm size and soil moisture content (in the month of October)[18]. They conclude that interdistrict yield differences are strongly correlated with soil moisture content which has a direct impact on output per acre. Note however, that these results are based on interdistrict regressions using grouped data, which as we have seen may simply reflect an element of aggregation bias or the macro level inverse relation. Wellisz et al. also admit that their results are marred by multicollinearity: "The moisture indices could not be included in the logarithmic regressions because of the frequent occurrence of zero values. It is impossible therefore to compare logarithmic regressions with the size coefficients with logarithmic regressions with the moisture coefficients" [*Wellisz et al., 1970: 674, fn. 50*]. Furthermore, the conclusions of Wellisz et al. represent scant evidence for an inverse relationship: while admitting caution (because of under-reporting by small farmers) they find increasing returns to scale [*1970: 673, table 8*] "casting a serious doubt on the decreasing returns to scale argument" [*1970: 675*].

Roy also admits that he will have to use similar indirect methods, using FMS data for West Bengal 1954-5, to demonstrate a connection between topography (as a proxy for soil moisture content) and cropping pattern [*1979: 71, table 2.5 and 73, table 2.6*], and between these and the inverse relationship (see Table 14, Appendix A). Again this exercise represents a weak link in Roy's chain of reasoning. He writes: "these correlations are of course necessarily vague due to imprecise data." [*1979: 72*] Note that the crops in the tables refer to a broad range of varieties with different soil and water requirements, thus increasing the imprecision of the results and the vagueness of the conclusion. Note too that Roy abstracts from any differences in physical yields of individual crops and cropping intensities to focus on the overall crop distribution pattern. While the data in Table 15, Appendix A [*from 1979: 76, table 2.8*] shows a strong inverse relationship between plot size and output per acre, when potatoes and pulses (and their areas) are removed the inverse relationship disappears.[19] Small farms have a higher proportion of irrigated high land under potatoes, and large farms grow more pulses on unirrigated high land [*1979: 78*].[20]

In chapter three, Roy goes on to demonstrate that the distribution of this major asset is determined by 1) the pattern of tenancy and 2) the legal superstructure via partible inheritance. We deal with each in turn below.

For tenanted land, plot size is seen as a control variable: the smaller the plot, the greater the tendency for the marginal product of labour to approach zero. Thus, in order to maximise output per acre, and to circumvent labour supervision problems, the landlord rents out land in small plots.[21] Roy suggests [*1979: 91*] that where soil quality is good, plots will be small and conversely for poor quality land and thus, the size of tenants' holdings will vary inversely with land quality, thereby generating an inverse relationship. The tendency for landlords to hire out land in small plots may be reinforced by the need to create dependency.[22] With land improvement, landlords will parcel out even smaller plots. Thus, intertemporal changes in farm size would appear to reinforce the cross-sectional pattern of the inverse relationship. NSS data (rounds 8 and 17) show the average size of tenant holdings falling from 4.57 to 2.95 acres between 1954 and 1962. Roy suggests this is due to land improvements, but note that this took place over the period of redistributive land reform prior to the Green Revolution [*1979: 101*].

While plot size can indeed be a crucial control variable within tenancy agreements,[23] the hypothesis that land quality enters into account in the foregoing fashion is seriously impaired by the lack of robust data: evidence on tenancy is notoriously unreliable and tends to be at a highly aggregated level. Furthermore, data on soil quality is practically non-existent at the required level of detail. Roy [*1979: 98, table 3.1*] shows a clear correlation between rainfall in inches and the percentage of area leased under five acres.[24] However, not only is rainfall a poor indicator of soil quality, but this correlation surely only reflects the macro-level inverse relationship (where fertile land with good water availability has smaller farm size because of higher population density).

Roy also cites [*1979: 99*] the FMS studies [*Bombay Report, FMS, 1955-6: 39*]: "the values of land per acre taken on lease by smaller cultivators were more than the values per acre of such land with the bigger holders". However, grouped data is only available for two districts, and only for tenants up to 25 acres is such an inverse relation shown [*1979: 100, table 3.2*]. Furthermore, large farms over 25 acres have just as high land values per acre as the smaller size groups. Indeed, if the smallest size group (0-5 acres) is excluded, this inverse relationship between size and land value disappears.

Roy then turns to the situation on owner-occupied land [*1979: 107*] here, superstructural factors like the legal system generate an inverse relationship through Hindu laws of inheritance. This had evolved from the pre-capitalist system of peasant proprietorship under which land subdivision and fragmentation was encouraged by the role of inheritable equivalence. Under this system, where land is heterogeneous, the bequeathment of equal shares does not correspond to each share being of equal acreage. This leads to the parcelling out of plots in sizes that are inversely proportional to their quality. Fragments are traded off against each other in terms of their quality. Roy [*1979: 121*] also notes that to a certain extent land reform programmes also take land quality into account when redistributing land.

However plausible the above hypotheses may seem, they nevertheless fail to establish an *a priori* foundation for explaining the distribution of land. They do not take into account the possibility that inheritance patterns may mean that heirs receive plots of all land qualities [*Sen, 1981: 204*]. Neither do they take into account the power relationships between the members of a particular family (between different parts of a family clan, or between genders for example). Neither is this form of partible inheritance necessarily operative in Muslim or Sikh areas or other areas where these types of laws do not exist or have been considerably modified. Furthermore, this type of explanation does not take note of the fact that often (as in the Egyptian case) the family farm continues to be operated as a single unit after inheritance [see chapter X].

Roy has persisted in his attempt to develop a land fertility-based explanation of the inverse relationship. In Bhalla and Roy [*1988*][25] data for 21,499 farms over all-India are used to test whether soil quality is a significant explanator of productivity differentials.[26] Individual farm level data was used to regress output per net cultivated area on farm size, indicators of soil quality, a land fragmentation index, and an exogenous irrigation index.[27] The model variants were estimated at four levels of aggregation: district (the lowest level), agronomic zone, agronomic sub-zone,[28] and state levels.

The results appear to show a clear pattern: the smaller the unit of estimation (i.e. the more valid the assumption of homogeneous environment), the lower the number of samples reporting a negative relationship for the traditional specification of the model. The addition of soil quality variables decreases the number reporting an inverse relationship for all levels of aggregation. The traditional model indicates a significant inverse relation in 16 out of 17 states (95%), in 54 of the 78 agronomic zones (69%), in 73 of the 142 sub-zones (51%), and in 83 of the 176 districts (47%). When soil quality variables are included, these percentages fall to 94, 56, 37 and 29 respectively [*1988: 48-50*].

These results are used by the authors to "lend support to those who use fertility based arguments" to explain the inverse relationship [*Bhalla, 1988: 60*]. However, what these results in fact show is that despite the existence of the 'natural', macro-level inverse relationship (discussed in Chapter II, section 2.2 and section 3.2 above), and despite the inclusion of soil quality indices in the model specification (which after all are there to control for soil quality differentials), there is still strong evidence for the existence of a significant inverse relationship in a high proportion of these relatively highly aggregated samples. And in almost one third of the district samples, we have a significant inverse relationship across farm size that needs to be explained.

The authors also attempt to use these data to claim that land quality is a more important determinant of the inverse relationship than factors associated with technology and technical change in agriculture. They find no systematic relationship between the progressivity of state-level agriculture, in terms of fertiliser and HYV seed use, and the proportion of districts in each state in which a significant inverse relationship occurs. Further, gross elasticities of output per acre with respect to farm size at the state level show little change between the two survey dates, even though technological change had been considerable [*1988: 52-5*].

As Roy [*1981*] himself has shown however, in a very much more robust study, aggregate data on technical change and gross elasticities at the state level cannot be used to say very much about the association between the inverse relationship and technical change at the district or village level. If technical change is unevenly distributed across a state, with the introduction of modern technology concentrated in particular areas, then such aggregated comparisons are invalid. At a more disaggregated level of analysis, Roy showed a highly significant positive correlation between the degree of technical change and the disappearance of the inverse relationship. The inverse relationship remained strong only in those areas of relatively backward agriculture. We will explore this finding in much greater detail in Chapter V.

3.4 Irrigation hypothesis

Any discussion of the land fertility-based explanation of the inverse relation would be incomplete without commenting on the perhaps curious empirical finding that small farms appear to have a greater percentage of acreage under irrigation [see Chapter II, section 2.5 and Table 12, Appendix A]. Many writers have focused on this fact as an explanation for the inverse relationship.

While Rao [*1963: 2043*] rejects the soil fertility hypothesis, he does recognise that a tendency exists with regard to current fertility which includes natural characteristics of and man-made improvements to land. He adduces the evidence from the FMS data (Bombay Report) that shows average per acre rental values and thus capital values per unit of land higher on the small farms. This reflects in part the relative availability of irrigation. Correction for the irrigation factor (by including the percentage of area irrigated as a regressor) leads to results that show rental values varying proportionately with farm size [*Rao, 1966: 7*].

A.P. Rao [*1967: 1990*] also shows that wherever there is no significant variation in irrigation ratios across farm size, output per acre is constant: thus, the FMS findings may be attributable to the irrigation factor. Other inputs are complementary to irrigation and this may explain why small farmers use higher levels of other inputs per acre.[29] Roy [*1979: 68*] notes that Bharadwaj finds the inverse relation statistically significant only for unirrigated farms and not for irrigated farms, and claims that this is due to the fact that water availability does not vary much for the latter.[30]

Bharadwaj [*1974b: A-19*] offers two possible explanations for the statistically significant inverse relation between irrigation ratio and size: 1) better irrigation leads to greater soil fertility which over time produces greater land fragmentation; and 2) abundant family labour is deployed to create and maintain irrigation facilities. However, the first explanation along the lines of the macro inverse relation, would not explain why within a given district, small farms have a higher percentage of irrigated area. Secondly, if such irrigation facilities require capital investment, then the purported advantage of the small farmer will be counterbalanced. Roy [*1979: 12, fn. 3*] notes that investment in irrigation has not been a matter of individual farmer choice. Historically, the state (or village community or zamindar) has been responsible for the construction of the irrigation system.[31]

Bharadwaj also very interestingly directs attention to the possibilty that landlord strategies generate such a finding. Thus, she suggests: "The landlord may prefer parcelling out the irrigated land among very small tenants for two reasons: while the bargaining position remains strong vis a vis the petty tenant, the latter may also have to resort to very intensive cultivation in order to eke a subsistence out of the small plot leased to him. Thus the landlord may find it possible to maximise his returns (as a share of the total gross output on his entire land) if he leases out the land in smaller plots" [*1974a: 42*]. This approach has a great deal of plausibility, and tends to fall within a class-based explanation, to be closely examined in Chapter V.

However, an inverse relationship between farm size and percentage area irrigated tells us nothing about the quality of irrigation facilities on various farm sizes, nor its effectiveness. The irrigation ratio is a rather poor index which does not indicate the effectiveness, source, quality, controllability or quantum of water supply. Indeed, Bandhudas Sen states: "A large proportion of the area officially classified as irrigated is no better than unirrigated land, depending on rainfall as the source of water" [*1974: 27*]. Therefore quantitative comparisons of irrigation ratios are both imprecise and inaccurate.

Wellisz [*1970: 665*] states that empirical studies give a conflicting picture of irrigation effects. Studies of individual projects indicate that irrigation leads to crop intensification, but the percentage area which is double cropped is approximately equal for irrigated and unirrigated land.[32] The major contribution of irrigation appears to be in improving crop patterns and raising yields of individual crops (in regions where the level of irrigation is generally low). Bharadwaj [*1974b: A-19*] notes that while irrigation increased output per acre by making feasible intensive application of inputs, the latter tended to increase more than proportionately to output, especially on the small farms generating a lower productivity of labour. Thus higher irrigation ratios on the small farms cannot be regarded as a sign of economic strength or superiority.

Summary and conclusions

We have seen in this chapter that the explanations of the inverse relationship based on qualitative factor differences are severely flawed. The various approaches are both theoretically inadequate and their assumptions are not supported by the empirical evidence.

Neither the qualitative differences in land nor in management and labour provide an adequate explanation for the inverse relationship. The differences in output per acre among farms cannot be ascribed mainly to inter-farm differences in soil quality or farm management. This essentially untestable hypothesis rests on an uncritical acceptance of the inverse relationship data, relying on a residual hypothesis tested by weak and unreliable proxy variables without consideration of other factors which a more critical analysis of the data suggests are important.

We have seen that any productivity advantage that might exist is certainly not supported by any evidence in terms of physical yields of individual crops or in terms of profitability. If indeed qualitative factor differences of this kind were involved, then one would expect to see discontinuities in the data at certain farm sizes and not a monotonically declining distribution of the observations. That we do not observe such discontinuities further undermines the technique-based approach.

The alternative hypothesis concerning differentials in land or soil quality between farm sizes rests on conceptual confusion over the meaning of fertility and on the distinction that must be made between the macro and micro levels of aggregation. The attempt to use land values or land revenue as proxies for soil quality have proven quite misleading. At best, indirect and imprecise data has been used to support a priori reasoning which neglects factors which would tend to undermine the hypothesis.

Notes to Chapter III

1. In fact, the empirical evidence from both the FMS data and the Land Holdings Inquiry conducted by the NSS 16th round 1960-61, would suggest that such diseconomies are negligible. Indeed, Hanumantha Rao himself claims that Indian farming exhibits constant returns to scale rather than diminishing returns - scant support for any residual hypothesis pertaining to management diseconomies. See C.H.H. Rao, *Size of Holdings and Productivity: some empirical verifications,* [unpublished and no date] cited in Khusro [*1964: 63*].

2. See also Roy [*1979: 39*].

3. If the percentage of area under current fallow increases with farm size then this would have some explanatory value for the FMS finding of declining output per acre with farm size. Note however, that this would be no indication of inefficient use of land on the part of the larger size groups, even where land was the limiting factor: under conditions of technologically backward agriculture, fallow periods are required for soil nutrient replenishment. Constant use of land would be quite unsustainable without increasing dosages of fertiliser. Given its importance, current fallow should perhaps be deducted from cultivable area for purposes of comparison. Nevertheless, there is little evidence to show that current fallow is a major cause of the inverse relationship.

4. Cited by Roy [*1979: 47, fn. 2*] from B.R. Kalra, *Regional variations in policy regarding size of agricultural holding*, Indian Journal of Agricultural Economics, vol. 20, no. 2, Apr/Jun 1965, (p.33).

5. A.M. Khusro, *Some basic generalisations in Indian agriculture*, unpublished, no date, cited in Sen [*1964a: 325*].

6. See [*Khusro, 1964*]: third column of table II on pp. 65-7.

7. See Khusro [*1964: 65-7, table II and 71, statement II*]. Given their importance, we reproduce the regression results in Table 13, Appendix A.

8. Using data from the FMS studies, Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, Studies in the Economics of Farm Management Uttar Pradesh, Punjab, West Bengal, Madras, Bombay, Madhya Pradesh and Andhra Pradesh.

9. Land Revenue Commission, 1940, cited in FMS West Bengal Report, 1955-6, page 9.

10. Sen uses the FMS data for Bombay, 1955-56 (cost accounting survey), and uses both land revenues per acre and rental values per acre to test the fertility hypothesis.

11. Cited in Paglin [*1965: 825*]: J.W. Mellor, 'Increasing Production in Indian Agriculture - A Farm Level View, *AICC Economic Review*, New Delhi, January 4, 1962, pp.47-50.

12. Roy mentions other factors as being important including evaporation demand, groundwater supply, irrigation, soil properties, crop characteristics, rainfall, and other inputs. It is not clear why Roy singles out topography as the prime factor. By topography, Roy means that land productivity, as a function of water availability, is inversely related to altitude. Roy admits that this may be an over-simplification [*1979: 56*].

13. Roy [*1979: 59, fn.1*] mentions that many studies have noticed heteroscedasticity and high variance within farm size groups which he offers as circumstantial evidence for his thesis

concerning water availability. The presence of substantial heteroscedasticity and high intra-group variance when data relating only to irrigated land is used however, would tend to suggest that other random factors are at work.

14. This relates to Rudra's point that the inverse relationship exists only for small farm size categories. See [*Rudra, 1968a*].

15. See M.L. Dantwala, *Agrarian structure in 12 districts*, The Economic Weekly, special number, vol. 13, nos. 29-31, July 1961, p. 1159.

16. Landlords may be able to impose higher levels of rent onto small sharecropping or marginal peasants than onto the larger tenant farmers with some local political power.

17. See Wellisz S., Munk B., Mayhew T.P., and Hemmer C., *Resource allocation in traditional agriculture: a study of Andhra Pradesh*, Journal of Political Economy, December 1970, pp. 655-684.

18. The October moisture index measures the amount of soil moisture left over from the southwest monsoon and the amount added by the northeast monsoon in a month crucial to germination. See [*Wellisz et al., 1970: 676, Appendix A*].

19. One acre of potatoes gives a yield of more than twelve times that of pulses measured in value terms: 865 Rs. as against 68.7 Rs.

20. Roy claims that potatoes are <u>less</u> labour intensive than other crops and that investment per acre is higher for potatoes than other crops which would benefit the large farms. Nevertheless, small farms would appear to have a higher share of area under potatoes [*Roy, 1979: 78*].

21. There are, however, important constraints. These include the fact that minimum plot size may be determined by peasant family reproduction. While a large family implies greater labour input, it also implies a higher minimum consumption requirement (although this may be mitigated if usury via consumption loans is important). Further, the possibility exists that below a certain size, the range of sizes over which the marginal product of labour is near or at zero may be quite extensive. See Abhijit Sen [*1981*].

22. This situation may involve interlinkages between land, credit and labour markets. Such non-price links develop more easily under conditions where the tenant is struggling for subsistence. See Bharadwaj [*1985: 12*]: "A dominant party conjointly exploits the weaker parties in two or more markets by interlinking the terms of contracts."; and Bharadwaj [*1979: 11*]: "The exchanges are set not only in terms of 'prices' but there can be non-price factors, explicit and/or implicit, which mainly rely on personal dominance and power equations."

23. See Bharadwaj [*1974b: A-15*]. Very small plots compel the tenant to intensify input use to provide a subsistence income after paying rent obligations. This will be further explored in Chapter V.

24. Roy cites Kalra [*1965*] for the leasing-in data and Rao [*1968b*] for the rainfall data.

25. Both writers seem to have shifted significantly their position on the causes of the inverse relationship. Roy [1981] had made some attempt to explore a political economy approach, particularly in relation to technological change in the Indian Punjab (see Chapter V). Bhalla [1979], on the other hand, was an erstwhile supporter of a neo-classical approach based on factor price differentials (see Chapter IV).

26. The data was collected by the National Council for Applied Economic Research (NCAER) Fertiliser Demand Survey for the agricultural years 1975-6 and 1976-7. Significantly, no data was collected on the use of labour input which would have allowed direct testing of the labour intesity hypothesis.

27. The soil quality indicators comprised three indices of soil colour, soil texture and soil depth.

28. These agronomic sub-zones are defined by soil type.

29. See Ishikawa [*1967*] on irrigation as a leading input. See also Verdoon [*1956*]: once land is given, there is a clustering of other inputs - perfect substitutability exaggerates adjustment possibilities, thus a complementarity approach is preferable.

30. See Roy [*1979: 14, table 1.4*] which summarises the FMS data on the percentage area irrigated by size: 12 statistically significant regressions out of 21.

31. Citing Bandhudas Sen [*1974: 27*]: "A large proportion of the area officially classified as irrigated is no better than unirrigated land, depending on rainfall as the source of water."

32. Citing Panne [*1966*].

CHAPTER IV

Factor intensity explanations: the labour-based approach

Introduction

The extensive list of complementary relationships revealed by the FMS data tends to suggest that the inverse relationship is associated with variations in cropping intensity and the quantum of labour and other production inputs per acre as the major explanatory factor (see Chapter II, section 2.5). This has generated a group of explanations which we may call factor intensity explanations. In most regions of the FMS studies, small farms have some combination of higher labour intensity, higher cropping intensity, and cropping patterns associated with more labour-absorbing and/or remunerative crops. We have, then, three possible explanations in terms of factor intensity: 1) labour input, 2) cropping intensity, and 3) choice of crop mix.[1]

We will consider which of these explanations is determinant in section 4.5 below. However, one influential interpretation of the findings is that it is labour input intensity which explains higher cropping intensity, and much attention, therefore, has been directed toward the factors which explain labour input intensity. The findings from the FMS studies which show that small farmers tend to apply a higher intensity of labour and other factors to production have led to a vast debate over what we might call labour-based explanations of the inverse relationship.

It is clearly the case that a very strong inverse relationship exists between size of holding and labour input per acre (see Chapter II, section 2.5, and Tables 1 and 9, Appendix A). Bandhudas Sen states: "the level of labour resource used per unit of land by the small farms in India is high irrespective of the quality of soil" [*1967: 71*]. Mellor and Moorti in their field study in Uttar Pradesh found that "differences in yields (per acre) seem to be largely due to differences in the use of the fixed, low opportunity-cost inputs, in particular, family labour."[2] Saini [*1969b: A-120*] comments: "the higher output per acre in smaller farms is really a function of the higher input of labour per acre - the other factors varying in the same direction as labour. It may be added that relatively higher input of labour on smaller farms contributes to the associated higher intensity of cropping and the choice of crop-mix which in turn raise overall productivity per acre". Here, the postulated direction of causality is stated with great clarity.

Given the importance attached to labour use intensity, it is the rural labour market that has attracted most attention. It was to such questions that Amartya Sen directed himself by positing the existence of labour market dualism as the underlying explanation for the inverse relationship. In section 4.1, we will outline the essential logic of the model developed by Sen. Then, in the following section 4.2, we will confront the hypotheses associated with Sen's model with some empirical evidence on labour use in Indian agriculture. Sen's model has been very influential, and more explicitly neoclassical models - "pricist" variants of the Sen model - have been developed. These are outlined in section 4.3. In section 4.4, we present a critique of the marginalist approach, within which both the Sen model and its neoclassical variants can be located. Finally, in section 4.5, we attempt to go beyond the labour-based approach in anticipation of the class-based explanation of the inverse relationship to be presented in Chapter V.

4.1 Labour intensity and labour market dualism: the Sen model

Sen, in his seminal 1962 article, states that the FMS observations regarding the inverse relationship are to be expected given what he calls the "mode of production" of Indian agriculture and its variation over farm size. He continues: "we must focus attention on the systems of production underlying Indian agriculture" [*1962: 245*]. Sen further states [*1966: 443*] that it would be dangerous to analyze the peasant economy in terms of ideas borrowed from capitalist economies.

The Sen model[3] divides the rural economy into two parts: a modern, capitalist large farm sector based on hired labour, with the goal of profit maximization; and a traditional peasant small farm sector based on family labour aiming to maximise gross output. While this approach, then, does hint at the question of determinacy alluded to above, Sen leaves the reasons for the primary motivation of output maximisation on the peasant farms unexplained, and concentrates on the causal factors behind higher labour input intensity.

On the large wage labour-based farms labour is hired in up to the point where the marginal product of labour is equal to the market wage, thus maximising profits. On the small family labour-based farms, "provided labour has no outside opportunity of employment and provided there is no significant disutility of work in the relevant range of effort", labour will be applied beyond the profit-maximising point until its marginal product is zero [*Sen, 1962: 245*].

In a more sophisticated version of the model [*Sen, 1966: 440*], the small farms maximise utility in a trade-off between increased income from extra output and leisure. Thus on the family labour-based farm, the marginal product of labour is not equalised to the market wage, but is determined by the subjective evaluation of the marginal disutility of effort. Hence the market wage is no guide to the opportunity cost of family labour. The peasant household with under-employed family labour will accept lower returns in self-cultivation than in the rural labour market at the prevailing wage. Only in the case of output maximization, will the marginal product of labour on family labour-based farms approach zero. The internal family worker wage will be the average product, greater than the marginal product, and setting a floor to the market wage.

On this basis, the market wage does not reflect the 'true' opportunity cost of labour in the economy. Sen claims that capitalist labour allocation reflects this distortion, but peasant labour allocation is correct in calculating from the real cost of labour. Alternatively, of course, the wage gap may reflect the genuine social cost of hired labour and so there is no misallocation [*1966: 443*].

In more formal terms, a wage gap exists where the wage rate (w) is greater than the real cost of labour (x). This latter is represented by $x = V'(l)/U'(q)$ where the ratio is the individual rate of indifferent substitution between the utility of income ($U'(q)$) and the disutility of labour effort ($V'(l)$). This ratio or real labour cost will be equated with the marginal product of labour for peasant farm labour equilibrium: $x = V'(l)/U'(q) = Q'(L)$. With output $Q = f[Q'(L)] = f(x)$, and since f is a decreasing function of x ($f'(x) < 0$) and $w > x$, then $f(x) > f(w)$. That is, capitalist wage labour-based farms will have a lower output per acre than peasant family labour farms. At the extreme, with a zero real cost of labour and a positive wage, we have $f(0) > f(w)$ for output maximization [*Sen, 1966: 439*]. Sen [*1966: 440*] recognises that it is not necessary that real labour cost on peasant farms equal zero ($w > x = 0$), but sufficient that there is a wage gap ($w > x$).

This family labour allocation rule is similar to that advanced by Chayanov in his theory of the peasant economy.[4] Unlike Sen, however, Chayanov assumes the existence of family labour farms to the exclusion of wage labour-based farms. Nevertheless, they arrive at similar claims as to the relative superiority of the family labour farm. The subjective evaluation of labour is lower on the peasant farm than on the capitalist farm and this provides the former with greater resilience (via the ability of the peasant family to compress income).[5]

Thus, the inverse relation, according to Sen, is the natural result of an economy characterised by the existence of widespread surplus labour and family-based non-wage cultivation. The crucial factor is not size as such, but the system of farming (a large cooperative, for example, operating on the basis of family or non-wage labour may have higher yields than small capitalist farms [*1962: 246*]).

Modifying Rudra [*1973b: 990*] we can break down Sen's chain of reasoning into the following hypotheses:

1) labour input per acre increases as farm size becomes smaller
2) all other factors are applied with equal intensity per acre over all farm sizes
3) the higher the labour intensity, the higher the yield per acre
4) the higher the proportion of family to hired labour, the higher the labour intensity

5) the higher the proportion of family labour to hired labour, the higher the productivity of land

6) large farms have a higher proportion of hired labour to family labour

As we have seen in Chapter II, section 2.5, propositions 1, 3, and 6 can be accepted on the basis of the data, thereby supporting Sen's case. The Sen argument is centred, however, on propositions 4 and 5. Any break in the chain would render the hypothesis invalid. These hypotheses will be confronted with the evidence on labour use in Indian agriculture in the next section.

4.2 The Sen model and labour use in Indian agriculture

A number of writers have criticised the Sen approach as being analytically deficient given that even small farms do not rely on family labour exclusively, and a large number of small farms are engaged in off-farm income generating activities. It is pointed out by these authors that the Sen model requires the non-existence of off-farm employment opportunities and the absence of labour-hiring on the small farms [*Khusro, 1964; Bhagwati & Chakravarty, 1969; Rudra & Biswas, 1973; Taslim 1989*].

Mazumdar [*1963: 1259*] argues that Sen's explanation breaks down given the fact that the FMS data shows that even small farms sometimes employ permanent labour or a semi-attached labourer, perhaps to allow greater labour flexibility in peak seasons. As long as any hired labour is used, the marginal supply price of labour to the farm will be given by the ruling wage rate, and consequently, input of labour would be carried to the same point on farms of various sizes, so long as the production function is the same. Mazumdar offers an alternative explanation in terms of the supply price of a composite unit of labour over peak and slack seasons.

Sen [*1964b: 325*], in defence of his position, points out that the FMS data on labour hiring are size-class averages. More complete individual holding data would be necessary to substantiate Mazumdar's criticism. He adds that there is no need to assume homogeneous labour units in seasonal agriculture, and admits that even small peasants hire in labour at peak seasons when the wage gap may disappear. It is only necessary to make the assumption, however, that labour in different seasons is mutually reinforcing. The marginal product of both types of labour is diminishing and an increase in slack season labour will increase the marginal product of peak season labour and increase its use. Thus a lower value or real cost of slack season labour will mean more peak season labour applied per acre on peasant farms. This will guarantee that output per acre is higher on the latter [*1966: 440*].

Thus, claims Sen, Mazumdar's alternative approach [*1963*][6] is, in fact, simply a variant of the cheap labour argument. Mazumdar's argument is an extension of the cheap labour argument rather than a new kind of explanation: since there is complementarity between labour applied in both busy and slack seasons, the lower opportunity cost in the slack season makes the cost of a composite unit of labour less than the average wage. Mazumdar merely describes a special case of Sen's argument with one unit of labour from the busy season and another from the slack season.

Saini [*1969b: A120-21*] finds that on average, the marginal value product of labour tends to be higher than the wage rate and farmers adjust labour productivity to labour cost. This means that the wage rate is a relevant economic factor and family labour can be imputed at the market wage rate. Saini runs regressions for different size-groups of farms (less than 7.5 acres, 7.5-10 acres, and greater than 10 acres) and tests the equality of the regression coefficients: none were statistically different from each other. The marginal value products of labour, computed at the geometrical mean level of inputs are positive and higher than the wage rate. This would appear to confirm that the market wage is relevant even for family labour. Thus, the losses incurred by small farmers are due not to imputation of a wage to family labour as Sen claims.[7]

However, Rudra and Sen [*1980: 393*] note that Saini's results, obtained by fitting a Cobb-Douglas production function, and estimating the elasticity with respect to labour, and then calculating the MPL at the geometric mean value of labour use, are of dubious validity as the calculated MPL is not significantly different from a wide range of values. The fact that the APL increases over farm size suggests that no equalization is taking place. The production function estimation is based on the assumption of <u>different</u> factor ratios, while the calculated MPL is obtained on the basis of a fixed factor ratio (at geometric mean level). Using <u>observed</u> factor ratios would give widely varying values for the MPL [*see Rudra 1969 and 1973a*].

Nevertheless, sensitive to the criticism that family labour farms and wage labour farms are not hermetically compartmentalized, and therefore that the wage rate may indeed be a decision variable for both sets of farms, Sen does attempt to look for other explanations of the wage gap. He suggests that the wage gap may be to some extent explained by the efficiency wage hypothesis:[8] the higher efficiency of wage labour and thus labour measured in efficiency units may mean that labour is not any more expensive for capitalist farms than it is for peasant farms [*1966: 443*]. On the demand side, either the efficiency wage hypothesis to ensure high labour productivity on the large farms or the monopsonistic position of large farm employers explains the offer of high market wages.[9] The fact that large farms have a marginal product of labour greater than the wage rate suggests that large farms are unable or unwilling to employ labour up to the profit-maximising position. This implies monopsonistic labour market behaviour and/or the presence of supervision problems [*Sen, 1981: 210*]. Large farmers' oligopsonistic position in local labour markets and their demand for labour will affect the wage rate. Sen also mentions the possibilities of an institutionally determined minimum wage rate, or compensation for the loss of average product by out-migrating workers,[10] as potential explanatory factors in some cases.

The wage gap will be increased if family members on small farms discount market wages by the risk attached to job search. In the extreme case the marginal product of labour will equal zero, but in the more general case, the opportunity cost of labour will be the wage rate weighted by the probability (p) of finding a job with (p) less than unity. As long as the probability of finding a job is less than unity, it is to be expected that there will be lower output per acre on wage-based farms where the marginal product of labour and wage rate are equated. On the family farm, labour will be applied until the marginal product of labour is equated with the wage rate discounted by the probability of off-farm employment (MPL = w.p) [*Sen, 1964a: 323-5*].[11]

Of course, the fact that small farms hire in labour does not imply that they should follow the MPL = w rule. Time constraints may necessitate the hire of labour for urgent tasks to avoid harvest failure, which is quite consistent with under-employment throughout the rest of the year. Further, certain operations require specialized skills requiring hired labour which cannot therefore be seen as a substitutive category. The hire of certain equipment for example may require hired labour.

The wage rate will not represent the marginal social opportunity cost of labour in the context of employment barriers [*Sen, 1962: 246*]. Indivisibilities in labour demand during the peak season, when agricultural operations are under a time constraint and there are risks and costs to the large labour-hiring farm in delay, may constitute an important labour market barrier. A partially unemployed farmer/labourer having to cope with coordination between off- and on-farm work and domestic chores will be at a disadvantage against the fully unemployed landless worker. The free time at the disposal of the farmer may be less than the minimum required by an employer [*Bardhan, 1973: 1380*].[12] The FMS data provides no information on free or unpaid labour services linked to rental or credit contracts. Such services may be extracted in the peak season, thus "no simple 'opportunity cost' concepts can be applied" [*Bharadwaj, 1974b: A-17*].[13]

Furthermore, there may be sociological factors behind labour market imperfections: barriers to employment of women and children on account of status, or reluctance to work outside the farm [*Bardhan, 1973: 1380*].[14] Family labour and off-farm labour are not always coterminous. Social convention and traditional behaviour may determine the allocation of tasks, dependent on class, caste and gender status.

Neither hypothesis then (that family and hired labour are exclusively separate categories so that family labour becomes a datum to the cultivating household, or that they are perfect substitutes so that the wage rate measures opportunity cost) is justified. The wage rate is only one determinant of labour use and possibly not the most important factor [*Bharadwaj, 1974b: A-18*].

A second major criticism directed at the Sen model is an extension of the above argument. Clearly, farms are neither exclusively family labour-based nor wage labour-based, but this can be taken further: examination of the FMS data shows that the proportion of exclusively family labour farms is negligible among the large farms (it is not even very high among the small farms) so that the labour allocation pattern posited by Sen on such farms cannot be used as a firm basis for an explanation of the inverse relation over the entire range of farm size [*Chattopadhyay & Rudra, 1976: A-112*].[15]

Rao [*1966: 10-11*] comments: "the labour-based explanation, in the sense of its application beyond the profitable range...is not relevant for farms operated partly or wholly with hired permanent labour." The Sen model may hold true for the range of farm size where the necessity of hiring labour in the slack season does not arise, but Khusro [*1964: 63*], in the Indian context, has shown that family labour is fully employed on the 7.5-10 acre size class, and hired labour is necessary beyond 10 acres. Once 15 acres is reached, the fixed quantity of family labour wears thin (per acre use of family labour is negligible both on 15 acre and 50 acre farms, with both depending on hired labour). So the use of family labour cannot be used as an explanation of higher productivity on 15 acre as against 50 acre farms.

Hossain [*1977*] restricts the opportunity cost explanation of the inverse relation to the range of small farms, but this does not explain the fact that the inverse relation is just as strong among the large farms relying on hired labour as between the small farms and large farms [*Taslim, 1989: 56*-7].[16] Nor does such an approach explain the lower labour use per acre on hired labour farms or the absence of any relation between labour use and the proportion of family labour as shown by Rudra [*1973b: 989-91*]. Even on farms greater than 10 acres where casual or permanent hired labour is used, input and output per acre declines generating an inverse relation [*Rao, 1966: 9-10*].

Rudra presents scatter graphs of size-class averages for 149 sample farms in Hooghly district, West Bengal 1970-1. The proportion of family labour to total labour input drops from 60% to 10% as farm size increases from less than 1.25 acres to 10 acres, while labour intensity falls from 900 man-hours to 600 as size increases. Output per acre increases with labour intensity up to a ceiling of Rs 2,500 (about 1,400 man-hours). However, labour input per farm, labour input per acre and output per acre show no systematic or meaningful pattern against the proportion of family labour to total labour. Statistical tests of labour input per acre against the proportion of family labour show that labour input per acre is not higher for family labour-based farms and there is no significant variation in labour input per acre across type of farm. Indeed, labour input per farm and output per acre are both less for the pure family based farm than pure hired labour farms. Thus there is no systematic dependence of labour input per acre or output per acre on labour composition, and therefore average output per labourer does not vary across labour composition [*Rudra, 1973b: 992*].

Taslim [*1989: 58-62*] in his study of Bangladesh[17] also finds empirical support for Rudra's results. A number of the propositions of the labour-based approach (specifically evidence for the links between labour intensity, yields and farm size) are supported, but the link between abundant supply of family labour and higher labour intensity at the heart of the family labour-based explanation is not supported. Evidence for the inverse relationship itself was inconclusive (statistically significant only at the aggregate level), but even if shown to exist, the evidence against the core hypothesis of the Sen approach shows that the opportunity cost of family labour explanation cannot be valid.

4.3 More explicitly neoclassical models: 'pricist' variants

More explicitly neoclassical models exist which posit different sets of factor prices facing small and large farms as an explanation for the inverse relationship [*Srinivasan, 1972; Bardhan, 1974; Griffin, 1974; Bhalla, 1979; Berry and Cline, 1979*]. Here, the question is one of optimal use of factor inputs in the context of relative scarcity.

These authors present the following hypothesis as the main explanation for the inverse relationship: factor prices differ between the large farms and the small farms, such that the effective prices of land and capital are low for the large farms and the effective price of labour is low for the small farms. The presence of relatively abundant family labour on small farms and the relatively low implicit price of land for the large farmers dictate choices of technique with different factor intensities. Thus small farms have high labour/land ratios, whereas large farms use labour and land less intensively. Small farms with a lower opportunity cost of labour, can exploit more marginal land, cultivate a larger proportion of their land, and achieve higher yields.

Berry and Cline take a rather eclectic position on the causes of these factor price differentials between large and small farms. The authors mention Sen's labour market dualism framework where the supply price of family labour is the average product of labour and not the marginal product. The MPL on the small farms will be lower than on the large farms. The main qualification to this is where the opportunity cost of labour is high (due to the availability of off-farm employment). However, the market wage may be discounted for labour market risk and search costs, or the family may try to hire out labour, but family preferences or unwillingness to share output with the hired-out worker will keep the MPL less than the wage [*1979: 8*].

In these factor market imperfection theories,[18] then, large farms go for production techniques with high land/labour and capital/labour ratios because factor market prices diverge from social opportunity cost, and this produces an inverse relation.

The empirical studies presented show markedly lower labour/land ratios on the large farms and this is taken to mean that capital and land market imperfections complement the effects of labour market dualism or are not strong enough to counteract them. The effective land price may be higher for the small farms because 1) small plots have higher unit costs (a greater potential market and inconvenience for landowners); and 2) land purchase needs credit, and large farms have better ratings and so cheaper credit (thus the real price of land will be lower). Land price differentials reinforce labour cost differentials and lead to higher labour/land ratios and output/acre on the small farms. The holding of land for asset price speculation or for reasons of social prestige and/or political power is also adduced as a possible explanation for lower productive activity on the large farms [*Berry & Cline, 1979: 10-12*]. Imperfections in capital markets reinforce low labour use on the large farms: a low effective price of capital leads to substitution of machines for labour.

However, the principal thesis of differential factor prices between large and small farms, and its explanation in terms of the Sen framework, is highly problematic. If indeed factor price differentials were the main explanatory mechanism at work, then we would expect to find higher capital intensities on the large farms manifested in technological innovation, both biochemical and mechanical. However, as we will see in Chapter V below, in this context the inverse relationship breaks down. Indeed, this hypothesis would appear to be more appropriate as an explanation for the non-existence of an inverse relationship rather than its cause. Further, the supposed ability of the small farmer to exploit more marginal land (because of a lower opportunity cost of labour) is hardly conducive to higher crop yields.

Lau and Yotopoulos [*1971: 105-6*] reject the hypothesis of equal efficiency between large (over 10 acres) and small farms, and find that small farms are more profitable i.e. more efficient. The relative economic superiority of small farmers is claimed to be due to technical efficiency since both groups are price efficient. This may imply that the supervisory role of the owner-manager of a farm is crucial for attaining efficiency [*1971: 107*]. Abhijit Sen [*1981: 202*] suggests that the inverse relationship "cannot be understood in terms of scale advantages among isolated farms or simply in terms of the poverty and unemployment facing poor peasants...[it] also reflect[s] problems of labour use on large farms and the relative inability to resolve this through land and credit markets". Ghose [*1979: 41*] states that labour supervision costs rise with size, and therefore the effective unit cost of labour rises.

This brings us to the new neoclassical transactions cost approach to explaining the inverse relation, an approach we have already seen in relation to some of the explanations of the inverse relationship based on qualitative labour and management differences. The central argument here though is that because small family farmers avoid most transaction costs in labour markets (search, screening, supervision), it pays them to use more of their relatively cheaper labour per hectare, and thus to achieve higher yields per acre.

Lipton [*1993a: 1524*] mentions the "well-established economic advantage of the family farm - that family members, with few costs of supervision or job search, will saturate their land with this labour, thus producing higher levels of output per hectare, and usually per unit of capital and other inputs, than large-scale farmers." Large farmers face problems of screening job applicants, searching for new workers, and providing incentives and supervision: the "avoidance of costs of search, screening and supervision in labour markets are the main explanation suggested for the alleged inverse relationship, and hence the case for redistributing large holdings to create small family farms" [*1993b: 642*].

Taslim [*1989: 66*] suggests that supervision problems are the principal explanatory factor behind the inverse relation on the large labour-hiring farms. The ability of large farms to employ wage labour will be constrained by the availability of family labour, essential for supervision. Statistical exercises show that family labour and hired labour are substitutes on the small farms, but complementary on the large farms where family labour fulfils a supervisory role.[19] He tests the hypothesis that the greater the ratio of hired labour to family labour (a proxy for the degree of supervision problems), the lower the productivity. This was corroborated for farms employing over 70 man-days of hired labour per family worker.

However, as we saw in the previous chapter, such supervision costs would seem to be greatly exaggerated. Farmers can reduce supervision problems to a certain extent by employing a higher ratio of attached or permanent workers who can undertake some supervisory responsibilities. The use of attached labour in a supervisory role, or even better, the use of family labour, in setting work tasks and ensuring execution is sufficient to ensure that the requisite labour effort has been expended on the part of the workforce. The threat of losing access to wage labour opportunities will provide the incentive for the worker to supply the quantity and quality of labour effort demanded. The often highly personalised relationship between employer and labourer, sometimes involving access to credit and land, help to provide "nearby, informed, rapid and flexible" supervision of labour [*see Bhaduri 1973*]. Taslim [*1989: 68*] notes that the attached labour solution is only partial up to a certain level. Beyond that, an alternative strategy involving the introduction of labour-saving technology which increases both land and labour productivity might be more common.

Furthermore, the link between the ratio of hired labour to family labour and output per acre, and hence the link between supervision problems and productivity depends on the robustness of the proxy variable used in the correlation. Indeed, as Taslim himself recognises [*1989:68*], the ratio of hired labour to family labour may not be an index of supervision problems, but instead reflect the ability of the farmer to hire wage labour. Employment of wage labour requires a fund of working capital. A low hired labour to family labour ratio may simply reflect the lack of access to such a fund. If such capital constrained farms are characterised by lower productivity, then the above correlation is spurious. This, of course, points in the direction of a very different type of explanation for the inverse relationship which will be discussed in the next chapter.

4.4 A critique of the marginalist approach

One common element between the Sen model and these more explicitly pricist variants is that they share the same marginalist conceptions and categories. The critical problems arise from the production function methodology employed. Much of the FMS analysis is set out in terms of problems of resource utilization in analogy with producers in competitive firms: production function analysis and optimality of labour use. They share a set of similar assumptions involved in the purported behavioural calculus at the centre of the models. The only difference between Sen's model and the factor market imperfection theories mentioned above is that the latter consider all relative factor prices whereas Sen considers only one price: the cost of labour, which varies according to the system of production. Note that the pricist variants do not recognise different farming systems in agriculture: "We believe the agricultural systems in most parts of the third world are essentially capitalist" [*Griffin, 1974: 83*].

An important point of criticism of both the Sen model and the neoclassical variants concerns the simplifying assumption of a single crop and a single production cycle. This misses entirely the crucial significance of cropping intensity and cropping pattern. Roy [*1979: 38-9*] notes Sen's emphasis on "for any one crop", and points out that Griffin [*1974: 41*] talks only of the relation between the output of a single crop per acre, in particular rice yields, and farm size, and deals with individual production cycles. Griffin claims that the subdivision of holdings would increase both employment and rice output. Thus, we see that both models were geared to explaining a non-existent relationship: while the inverse relationship can be observed in value terms, no such relationship exists with respect to the physical yields of individual crops. Of course, the models can be respecified to look at total value of crop output and labour input intensity, with a strong relationship between cropping intensity and labour application.

Production function studies, however, suffer from the problem that they are estimated with flow measures which obscures the role of indivisibilities in agricultural production [*Sen, 1981: 204*].The whole exercise of comparing the marginal product and wage rates is meaningless for agricultural production. Agricultural production is very different from industrial production. It is sequential in nature, subdivided both temporally and operationally. The production cycle in agriculture is prolonged and varies greatly between crops. No straightforward marginal productivity rules can be applied here as the productivity of family labour inputs prior to harvest time will depend on the timely application of the necessary amount of labour during the harvesting period. Labour demand at the harvesting stage is largely determined by elements of previous stages.[20] Labour at earlier stages thus has to be seen in the nature of fixed costs. Labour demand at harvest is a derived demand dependent on conditions earlier in the production cycle.[21] Under such conditions, the meaning of the marginal product of labour in agriculture becomes extremely hazy almost to the point of becoming operationally useless [*Roy, 1979: 20-3*].

A second common element is that both approaches assume the same production function for all farm sizes and systems of production. Both peasant and capitalist farms are assumed to be operating on the same production function, an assumption not identified by Sen in his 1962 or 1964 papers, but eventually admitted in his 1966 article. Sen focuses on two different systems of production: small peasant farms and large capitalist farms. It is not obvious therefore why these two systems are located on the same production function (the same marginal product of labour curve).

Roy notes: "the model is comparing farming methods which have fundamental differences in their organization of production and qualitative differences in their division of labour" [*1979: 19*]. A theoretical justification for assuming the same marginal product curve for family labour-based and wage labour-based farms is not provided by Sen. If either class of farms use more capital or other inputs or enjoy some other advantage then that marginal product curve would be higher.

A similar problem undermines the more explicitly neoclassical variants of the production function approach. While labour homogeneity is assumed, this is not sufficient: the use of a single MPL curve requires concomitant assumptions regarding the organization of production, homogeneity of all factors of production and equal factor intensities. Such models must also assume that different farms apply identical capital inputs per acre (both in quantity and type of capital) and that land is homogeneous regarding soil quality and irrigation. The isoquant diagram of Griffin includes land and labour <u>holding capital constant</u>, but if capital intensity varies across farm size then the isoquant will shift unequally.[22] Bagchi [*1962*] has shown that variation in the intensity of capital utilization may make it difficult to analyze such relationships in neoclassical terms.[23]

Indeed, Sen himself was later to admit: "it is illegitimate to eulogize peasant farming on the basis of an analysis in which every type of farm has access to the same production function and to the same factors of production" [*1966: 444*]. A peasant farmer may be constricted to a less efficient set of production conditions including lack of access to economies of scale, lack of technical knowledge or access to particular factors, or risk aversion to using new inputs.

The use of a single production function to compare two very different systems of farming, points to the identification problem at the heart of the Sen model and its disciples. This concerns the assumption that large farms are capitalist farms, and small farms are peasant family labour-based farms. This conceptual sleight of hand obscures the real relations at work which produce the inverse relation. This crucial point will be further discussed in Chapter V where we turn to a class-based approach to analysing the inverse relation. We must go deeper than the size of holding categories to the underlying social relations of production, in the dynamic context of agrarian transition.

4.5 Beyond the labour-based model: towards a political economy approach

We pointed out in the introduction to this chapter, that three possible explanations in terms of factor intensity have been posited: 1) labour input, 2) cropping intensity, and 3) choice of crop mix. A crucial point in the debate over the causal factors behind the inverse relationship, but one that is more often ignored or obscured, is which of these explanations is determinant? These findings are clearly inter-related, but what is the direction of causality? No simple econometric analysis can tell us the answer.

There are two possible interpretations however. The first, labour-based approach, we have surveyed critically in this chapter. The second is that it is higher cropping intensity and a cropping pattern associated with either higher labour absorption or remuneration (and hence the higher income derived from production) which implies greater factor use intensity, in particular labour intensity. Bharadwaj [*1974b: A-16*], indeed, suggests that value productivity differentials between farms boil down to the differential cropping intensity components of crop patterns.[24] Here, the primary motivation is output maximisation, with cropping intensity appearing as the proximate cause of the inverse relation. Higher cropping intensities imply a higher intensity in the application of other factors of production, particularly labour.

Bharadwaj [*1974b: A-16*] notes from the FMS evidence that while there is a strong inverse relationship between labour input and size, this is not manifested in terms of individual crops. An explanation in terms of efficient factor substitution (with land fixed and the same production function with small farms operating with higher labour/land ratios and with higher productivity per acre but lower labour productivity) is undermined by the fact that there is no such relationship between labour productivity and size to be found in the FMS data. She concludes: "Thus the higher use of labour on small farms cannot be explained in terms of land-labour substitution along a production-possibility frontier" [*1974b: A-16*].

A further set of problems arise from the proposed behavioural calculus of the farmer internal to the farm and to the methodology of comparison of the wage rate and marginal productivity. It is inappropriate to postulate effective leisure preference among poor peasants who are very close to subsistence; the effective limits are more likely to be biological [*Sen, 1981: 207*]. As we saw in section 4.2, family labour allocation is determined by objective factors like involuntary unemployment and intensity of poverty. Poverty and unemployment, rather than leisure preference, are the main reasons why small farmers intensify family labour use [*Sen, 1981: 209*].

Chattopadhyay and Rudra [*1976: A-114*], although taking a rather eclectic view of the inverse relationship,[25] make the following powerful and incisive statement which takes us beyond the confines of the marginalist approach: "Among the forces that drive a small farmer to more intensive effort the most important one, of course, is his need for survival. There is a certain basic minimum of consumption that a poor peasant family has to have without which it will be simply wiped out. It is only understandable that such a poor peasant family, depending on a small piece of land, submerged in a vast population of surplus labour in the countryside, and thus not having any alternative sources of employment and income, would try to produce the maximum output on his piece of land. He would not only ignore any marginal productivity calculations insofar as family labour is concerned, he would employ hired labour whenever necessary to supplement family labour, and in doing that would pay no heed to marginal productivities. He would also try to apply non-labour and non-monetized inputs with maximum intensity, once again by using labour without any calculations. He would try to improve the quality of land by small-scale irrigation and other such means as can be procured with the help of labour. He will tend to leave fallow as little land as possible, and try to cultivate as many crops as possible and choose such crops which after meeting his minimum consumption needs would meet his minimum cash needs." Further, under sharecropping, the "tendency to intensify his effort would be all the more so because of the fact that he has now to meet his minimum needs with only a share of the results of his effort". Aspects of this we will wish to pursue in Chapter V.

Summary and conclusions

Clearly, the empirical evidence provides support for an explanation of the inverse relationship based on factor intensities, and in particular, a labour-based explanation. The clustering of empirical relationships around cropping intensities and labour input intensities (the latter subsuming capital and irrigation factors) in association with the inverse relation finding certainly justifies the focus on patterns of labour use.

However, the models presented above which attempt to explain how the inverse relationship is generated via labour utilisation are theoretically flawed, while crucial elements in their underlying assumptions are also subject to empirical refutation. The critical problems arise from the production function methodology employed.

The principal factor intensity-based explanation of the inverse relationship is the labour utilisation model developed by Sen. This essentially static framework has proven to be seriously defective. As Abhijit Sen [*1981: 210*] points out: there is "an unexplained inconsistency between the *a priori* evidence that it is labour use which causes the inverse relation and the negative results from direct tests of labour-based hypotheses." We have seen that Sen's opportunity cost model cannot be used to explain the existence of the inverse relationship among predominantly wage labour-based farms nor where most farms employ hired labour. Indeed, Rudra and Mukhopadhyay [*1976: 34*] show that labour-hiring is a generalised phenomenon on the small farms.

Conceptually, the cheap labour theories (both those of Sen and the more neoclassical variants) depend on a spurious calculus involving the marginal product of labour and the wage rate. As we have seen, the former is an operationally useless concept in agricultural production, while the latter is only one and probably not the most important variable taken into account in determining labour use. The situation encompasses a more complex set of market and non-market relations than the suggested behavioural assumptions incorporated in the models allow. This more complex enovironment will be explored in the next chapter where we turn to a class-based explanation of the inverse relationship in the dynamic context.

Notes to Chapter IV

1. There is empirical support from the FMS data for a possible capital-based explanation of the inverse relation given that small farms appear to have more capital inputs per acre. This too may be related to a labour-based approach. Sen [*1964a: 326*] provides an explanation of this surprising finding within a labour-based approach: in as much as a substantial part of capital investment on small farms takes the form of direct labour input in capital projects, rather than deriving from off-farm purchases, the cheap cost of labour is reflected in cheaper capital. This further implies an economy in working capital in "peasant agriculture" as such agriculture is not based on wage advances (see Sen [*1964*]).The lower labour cost will also increase the use of complementary factors of production. There is a sense in which smaller farmers can invest more cheaply by utilising family labour: an argument which clearly can be subsumed under the labour-based approach. There may, of course, be no special advantage to peasant farms if capitalist farms have access to cheaper purchased capital inputs. This we will pursue later.

2. See J.W. Mellor, 'Increasing Production in Indian Agriculture - A Farm Level View', *AICC Economic Review*, New Delhi, January 4, 1962, pp. 47-50. Cited in Paglin [*1965: 825*].

3. A.K. Sen [*1962*] in a model remarkably similar to that developed by the Russian economist A.V. Chayanov [*1966*]: as pointed out by T.J. Byres in *Output per acre and size of holding: the logic of peasant agriculture under semi-feudalism*, unpublished manuscript, 1977, and in Patnaik [*1979: 417, note 4*].

4. Indeed, Roy [*1979: 15-6, fn.1*] traces these cheap labour theories to Chayanov, but notes that the constraints on family labour farms hiring labour past the point of intersection of income and drudgery curves is not explained.

5. Sen notes that Georgescu-Roegen has traced this line of thought to the historical "Agrarian Doctrine" and related it to the logic of feudal agriculture [*Sen, 1964b: 439*].

6. And Agarwala [*1964a*]. Agarwala takes the case of a "fixed distribution of labour over the agricultural year" which is "rigidly determined by technological consideration" and it is total labour over the year that is varied. If there is use of hired labour in some seasons, but not in others, "the marginal cost curve of labour facing the family farm is lower than that facing the capitalistic farm".

7. Saini suggests that these losses are due to indivisibilities associated with bullock labour [*1969b: A-121*]. Saini uses disaggregated FMS data for Uttar Pradesh (Meerut and Muzaffarnagar districts) and Punjab (Amritsar and Ferozepur districts) for the years 1955-56 and 1956-57. This paper is a shorter version of Saini [*1969a*]. The regression model estimated is specified as follows:

$$\log Q = \log C + b1.\log A + b2.\log L + b3.\log B + b4.\log F + b5.\log I$$

where Q is gross value of output in Rupees, A is land in acres, L is human labour in adult man-days, B is bullock labour in pair-days, F is expenditure on fertiliser and farm manures in Rupees, and I is expenditure on irrigation in Rupees. The sum of the regression coefficients indicate constant returns to scale. All land coefficients are significantly below unity which shows an inverse relation.

8. See H. Leibenstein, *The theory of underemployment in backward economies*, Journal of Political Economy, vol. LXV, April 1957, and also D. Mazumdar, *The Marginal productivity theory of wages and disguised unemployment*, Review of Economic Studies, vol. XXVI, June 1959.

9. See Bliss and Stern [*1978*] for an example of this model of rural wage determination.

10. See W.A. Lewis, *Economic development with unlimited supplies of labour*, The Manchester School, May 1954.

11. Roy [*1979: 18*], commenting on Sen's defence of the model, notes that the assumption of independence between p and w is questionable. It is just as likely that there is a functional relationship between the two variables.

12. The FMS data reveals the following employment patterns: the smallest farms rely heavily on off-farm work, with severe underemployment on the farm. On medium-size farms, total employment increases, both on and off farm, but the opportunities of off-farm work are inhibited by peak season work on-farm. The large farms are characterised by high employment on-farm [*Bharadwaj, 1974b: A16*-7]. Bharadwaj [*1974b: A-17*] notes however that on and off-farm employment are not independent categories.

The availability of off-farm work affects the rhythm and intensity of on-farm work through choice of crop pattern, which commits family labour over crop cycles and this may limit off-farm employment opportunities. This is crucial when farms have a single earner (the FMS West Bengal Report, pp. 54-7, shows that over a third of the farms have a single earner). Thus on and off farm work are not additive or simple alternatives [*Bharadwaj, 1974b: A-17*].

13. See also Chattopadhyay and Rudra [*1976: 112-3*].

14. See P. Visaria, *The farmers' preference for work on family farms*, in *Report of the Committee of Experts on Unemployment Estimates*, Planning Commission, Government of India, New Delhi, 1970. The data cover nine villages in Ratnagiri district, Maharashtra state, and 14 villages in Kutch district, Gujarat, in 1966. Some 54% and 80% respectively, of male farmers, and 66% and 84% respectively, of female farmers expressed unwillingness to work off-farm. Cited in Bardhan [*1973: 1380*].

15. Rao [*1966: 4-5*] points out from his pro-small farmer viewpoint that since not only labour, but also capital and irrigation vary less than proportionately with size, the net MPL curve cannot be the same for different farm sizes. Higher capital input per acre (labour-absorbing investment) and the greater managerial efficiency of the small farm imply a net MPL curve higher for small farms than large farms. However, large farm access to capital could push their MPL curve outwards.

16. See section 4.3 below for Taslim's explanation of this empirical finding.

17. The survey data were collected by the Department of Economics, University of Dhaka, in 1982. The data cover two villages from each of Mymensingh, Comilla, and Rajashahi districts. Fifty households were selected from the village populations conditional on their involvement in the land-lease market (300 households *in toto* comprising pure landlords, cultivating landlords, owner tenants and pure tenants.

18. Even in the absence of market imperfections, Srinivasan has shown that labour intensification on the small farms is an efficient outcome. This explanation runs in terms of farmer behaviour in the face of production uncertainty: the choice of labour allocation between self-cultivation at an uncertain return and employment at a given wage. In order to maximise the expected utility of income, the farmer should devote a larger amount of labour per acre to self-cultivation as the size of farm decreases.

This holds under Arrow-type risk-aversion postulates: absolute risk-aversion decreases and relative risk-aversion does not decrease as wealth increases. However, the plausibility of non-decreasing relative risk aversion is not self-evident, and the assumption of a given wage rate independent of the influence of production uncertainty is unsatisfactory.

19. See Taslim [*1989: 64*]. The correlation between family labour and hired labour was negative on the small farms, but positive on the large farms (large farms are defined as those greater than 6.5 acres in Mymensingh, 3.5 acres in Comilla, and 10 acres in Rajashahi; the small farms are less than 5, 3.5 and 7.5 acres respectively. Further, the correlation between family labour per acre and total labour input per acre is negative on the small farms and positive on the large farms (but not statistically significant).

20. See Roy [*1979: 21*]: at the final harvesting stage, the constraint on labour-hiring is <u>not</u> the MPL = wage criterion, but whether these fixed costs can be covered. This means that not only will labour continue to be hired when the MPL is less than the wage rate, but also even when the wage rate is greater than the APL. The only limit to labour-hiring occurs when the gross revenue from a day's harvest is less than the cost of a day's harvesting.

21. See Roy [*1979: 22*]. The physical yield of a crop is already determined (plants per acre times yield per plant), and therefore the number of labour-hours required to harvest the crop is also predetermined (for any given technology). Whereas with Sen, higher labour input causes higher yield, there is in fact a reversal of causation: higher yields produce a greater demand for labour.

22. Indeed, the FMS data also shows higher capital intensity on small farms <u>contrary</u> to Griffin who claims that the shadow price of capital is lower for the large farms than the small farms.

23. Cited in Sen [*1964b: 441-2*].

24. See Bharadwaj [*1974b: A-16*]. Punjab, Uttar Pradesh, Bombay, West Bengal and Madras show an inverse relation between cropping intensity and farm size, although it is not significant in all cases.

25. Rudra mentions the wide range of different explanations of the inverse relationship found in the literature, and he recognises the validity of all of them in different combinations in different regions of India.

CHAPTER V

A class-based approach and the breakdown of the inverse relationship in the dynamic context

Introduction

Despite the criticisms of the methodology and assumptions employed in Sen's labour utilisation model and the neoclassical "pricist" variants, the former does have the great merit of attempting to locate an explanation of the inverse relationship in terms of the different conditions of production facing farm households. These he explores within the logic of what he calls the "mode of production of Indian agriculture" and its correlation with farm size [*1962: 245*]. However, Sen's notion of mode of production is conceptually nebulous and constrained by its choice theoretic framework based on relative resource endowments.[1] There is clearly a need to go beyond farm size as the relevant stratifying variable to examine the underlying relations and forces of production.

In this chapter, we propose an alternative class-based approach to understanding the inverse relationship.[2] This class-based approach proceeds from the proposition that the peasant farm is embedded in the socio-economic context of an emerging capitalist agriculture in which however, non-capitalist forms of surplus appropriation are still prevalent. Such a transitional state has been described by Bhaduri [*1973*] and Bharadwaj [*1974b*] as one of semi-feudalism, a situation in which the relations of production have more in common with feudalism than capitalism. Bharadwaj writes: "where capitalist farming is emerging out of a semi-feudal agriculture, the coexistence of both the modes shapes the labour market...while the characteristics of the labour market itself influences the form and process of transition" [*1974b: A-11*].

Agriculture remains backward inasmuch as "the process of commercialisation has not culminated necessarily or rapidly in the pervasive dominance of capitalist relations [*Bharadwaj, 1985: 9*]. The process of commercialisation has intensified peasant differentiation but has not generated a qualitatively changed peasantry: it has not resulted in a fully-formed capitalist agriculture in which rich peasants are transformed into capitalist farmers and poor peasants into wage labourers. Neither commercialisation nor the development of wage labour, however, are sufficient conditions for the development of capitalist agriculture.

This directly addresses Sen's and other writers' erroneous identification, on the basis of the labour-hiring criterion alone, of the large farms in their samples with capitalist farms. That identification needs an altogether more complex specification. Section 5.1 provides a digression on the criteria for capitalist transition in agriculture as a first step towards fulfilling that requirement.

A second critique of Sen involves the partial and misleading focus on the internal farm household calculus. Sen's focus on the output maximising criterion of a family labour-based farm within an endogenous choice theoretic framework obscures the severe exploitation in the relations of production within which poor peasants are entwined. Section 5.2 situates the inverse relationship within the context of the relations of production which characterise backward agriculture.

Finally, section 5.3 focuses on Sen's (and others') extrapolation of an essentially static result to a dynamic context in which both the relations and forces of production are changing. The inverse relationship appears to arise in a situation where all cultivators are employing the same technology, but if large farmers have access to a superior technology then the Sen logic breaks down, and with it the inverse relationship itself.

5.1 A digression on the criteria for capitalist transition in agriculture

A number of criteria have been presented as being crucial in determining whether capitalist relations have fully emerged and become dominant in agriculture. The various criteria identified in this section can be distilled from the exhaustive discussion which constitutes the Indian mode of production debate. This is the most important debate on this subject to have taken place in a poor country. It would be inappropriate to reference that debate fully here, but the major contributions are comprehensively and very usefully summarised in Thorner [*1982*].[3] It is also worthy of note that the mode of production literature is referred to remarkably little in the inverse relationship literature, and *vice versa*.

The first issue is the move from petty or simple commodity production to generalised commodity production. Generalised commodity production is often seen as the encapsulating criterion by which one judges whether capitalism has swept all before it. Commodity production becomes the general form of production, with all of the key economic relationships in society mediated by the market and reduced to the exchange of equivalents. Generalised commodity production entails the following:

Firstly, the products of labour become fully commoditised: i.e. produced for market exchange. Commodity markets are fully formed, with full price responsiveness. True commercial surpluses become the norm, rather than distress surpluses. Participants have direct access to markets with the grip of merchant capital broken and subservient to productive capital. Monetization of transactions has become dominant, with a high degree of market participation and orientation. We move from the logic of the C-M-C circuit to M-C-M+ circuit as analysed by Marx.

Secondly, the means of production become commoditised. Seed, fertilizers, irrigation water, and other machinery and equipment are purchased from the market rather than produced on-farm using family labour. We shall see that these aspects of commoditization are crucially dependent on the process of differentiation of the peasantry, a differentiation, not only quantitative, but also qualitative and cumulative.

Thirdly, land, the principal means of production in agriculture itself becomes a commodity, with the development of alienable and transferable property rights through land and rental markets.

Finally, labour power itself becomes a commodity. In the circuit M-C-M+, the secret of surplus value is discovered: the owners of capital (M) find a commodity which has the property of creating new value - labour power.

Indeed, the commoditization of labour can be seen as an important criterion in its own right. This entails a move from a focus on concrete useful labour (productive labour of a particular type) to a focus on general abstract labour power as the source of value. This in turn entails a shift from servile or unfree labour to labour that is free in Marx's famous double sense: free of the means of production, and free to sell their labour power. Labour loses control over the production process. We have a shift from petty commodity production (where the direct producers possess the means of production) to commodity production where they do not.

In its turn, this relationship indicates a crucial change in the manner of appropriating surplus labour. Now it is a question of appropriating surplus labour via the wage relation - the hallmark of capitalism. Further, this entails a shift from appropriation of absolute surplus value (lengthening the work day or squeezing necessary labour via extra-economic coercion) to appropriation of relative surplus value via the wage relation and the continuous revolution in technology, increasing labour productivity.

The appearance and dominance of capitalist relations of production has as its corollary the disintegration of pre-capitalist relations. We have for example a shift away from pre-capitalist customary ground rent to capitalist ground rent. Rent is no longer the major mechanism of surplus appropriation. Capitalist profit is now the major form, with rent now simply a surplus over capitalist profit.

With this, we find a shift away from payment in kind, and certainly away from payment via labour rent, to fixed money rents, freely negotiated. This further implies the elimination of usurers and merchant capital as dominant elements in the countryside. Formal money and credit markets become the norm along with formal commodity markets. The extraction of surplus via usury and unequal exchange exercise a powerful constraint upon development of the forces of production. The grip of moneylenders and merchant's capital must be broken, must become subservient to productive activity, otherwise they may prevent its emergence. Marx saw these as antediluvian forms of capital that must be eliminated.

Similarly, sharecropping as a dominant tenurial form must be eliminated. Its existence implies labour immobility, possibly debt bondage, and pre-capitalist rent as the dominant mode of surplus appropriation. A transitional form might be cost share leasing, but secure capitalist tenancy or production using wage labour should become the norm.

A further crucial criterion of capitalist development concerns surplus utilization and capital accumulation. Capital accumulation must become the dominant tendency: the surplus value appropriated must be re-invested in the production process, and not disappear into pre-capitalist channels of consumption and/or unproductive investment: e.g. moneylending or trading capital. Accumulation is the essential motor of capitalist development, entailing capital intensification and the continuous development of the forces of production.

Finally, at the level of the social formation, we have the need for simultaneous capitalist industrialisation. Otherwise labour and capital become trapped in agriculture, exercising a powerful depressing influence on productivity and encouraging pre-capitalist forms of surplus extraction in the countryside. Usury and merchant capital thrive on the existence of surplus labour. There is also the importance of industrially-produced inputs in developing labour productivity and the forces of production in agriculture.

Note that in any attempt to identify whether or not agrarian transition has taken place, whether or not capitalism is in some sense dominant, we must stress the elementary logical point that while a particular criterion may be necessary to the existence of capitalism, it may not be sufficient. The existence of wage labour is a necessary, but by no means a sufficient condition for capitalist development. Wage labour may well be found in pre-capitalist circumstances: in, for example, ancient Rome, Moghul India, Ottoman Turkey etc. The other criteria may not be met. Lenin suggested that when analysing the agrarian situation, it is not useful to employ too stereotyped an understanding of the theoretical proposition that capitalism requires the free landless worker. Neither does the appearance of wage labour prove the existence of capitalism - it depends on the context within which wage labour operates. Landless labour may not really be free, but may be bound in a situation of extra-economic coercion which has more in common with feudalism than capitalism.

Nevertheless, the appearance of free wage labour does provide some indication of the extent to which pre-capitalist relations of production have been dissolved with the separation of the direct producers from their means of production.

Similarly, production for the market is a necessary, but not a sufficient condition. Petty commodity producers may after all produce for the market, and there may be significant levels of market participation by peasants, without capitalism being dominant. Generalised commodity production may simply be grafted on to the pre-existing agrarian relations without altering those relations. However, the argument does exist that generalised commodity production entails capitalist relations of production. It is possible that the continuity of pre-capitalist relations of exploitation in a transitional period conceal changes in the effective relations of production.

Further, one might conceive of both wage labour and market orientation present, but still no dominance of the capitalist mode of production if say capital intensification is absent: if surplus value, instead of being re-invested in productive activity, is syphoned off into pre-capitalist channels.

While it may appear that commercialization is proceeding apace, it may well be in reality that what is happening is the further penetration of merchant capital. This may occur with stagnant production, and no capital deepening in agriculture. Although usurer's capital and petty trade are quite effective in separating the direct producers from their ownership of the means of production, impoverishing feudal landlords, and providing a stock of capital that can be used for later capitalization of production relations, the existence of capital in the sphere of circulation cannot be used to establish the existence of capitalism.

Thus, the transition from rich peasant to capitalist farmer cannot simply be assumed (as it is generally in many studies of the inverse relationship) - it requires demonstration. While the use of wage labour and market participation may be an important indication of the process of agrarian transition, the evidence contained in Bhaduri, Bharadwaj, Patnaik and others, as to the lack of capital intensification on the large farms, and to the continued existence of unfree relations between labour hirers and workers would suggest that Sen's (and others') elision of rich peasant/capitalist farmer is invalid.

5.2 The inverse relationship in the context of backward agriculture

It is within the context of a backward agriculture that we must seek the factors that give rise to and sustain the inverse relationship. Within a semi-feudal agriculture, the normal competitive assumptions are fundamentally violated. It is therefore highly misleading to hypothesise that individual producers confront technical and market data in an impersonal environment and all are equally free to take decisions in all markets. Much of the discussion in this section leans heavily on the inter-linked rural markets or mode of exploitation literature.[4]

In backward agriculture, dominant classes (landlords, moneylenders, traders, or combinations of these functions) ensure that subordinate classes (poor peasants and landless labourers) can only gain access to markets on a highly personalised basis. This asymmetric economic and social power of the dominant classes over the subordinate classes allows the former to insist that the latter accept manifestly unfavourable terms in one market as a condition of access to another - unfavourable in the sense that those terms are clearly inferior to freely negotiable terms in free markets. Here, the dominant class can take advantage of the economic compulsions to participate in markets (forced commerce) which the subordinate classes are subject to: in order to ensure survival, reproduction or the need to achieve a particular cash income target to repay debt or taxes.

The extent and type of market participation by different groups of peasant and the character of markets themselves will be significantly determined by local patterns of power while markets reinforce those patterns. The initial resource position defines bargaining position while relative bargaining power determines access to resources and thus current production activity and asset-income position. Market and social power are vested in the dominant rural classes. Poor peasant involvement in one market may restrict choice in production decisions in other markets.

Bharadwaj portrays a hierarchical structure of exchange relations reflected in market interlinkages. First, the rich peasants and landlords: "In any market - we consider here output, land, labour and credit markets as the prominent ones - there are dominant parties mostly belonging to the substantial surplus households [those of landlords and rich peasants] who set the pattern as well as the terms and conditions of exchange" [*1985: 12*]. These operators are powerful enough to exploit markets from a vantage point and shape market relations via interlocking forces - exploitation in conjoint markets: land, credit, labour, input and product markets.

Next the middle peasants: "...the medium operators [middle peasants and some richer peasants] are basically price takers and 'quantity adjusters' in the sense that they have a safe enough margin of surplus to play the market game to maximise profits..." [*1985: 12*]. These intermediate operators are more self-reliant, but not necessarily in a position to exploit market relations. One might expect to observe defensive market avoidance on the part of the smaller farmers and market participation by the larger [*Bharadwaj, 1974b: A-12*].

Finally, we have the landless labourers and poor peasants: "...the "chronically deficit" and "subsistence" households [landless labourers and poor peasants] are involved in exchange compulsively. The very small cultivators and the landless, not possessing adequate resources for a reliable livelihood, have to enter the labour or credit market to incur consumption loans or obtain advances for circulating capital. Under the pressure of immanent cash needs they have to sell outputs, sometimes under prior commitments, even when they have to repurchase them under more adverse terms for their own subsistence" [*Bharadwaj, 1985: 12-13*].

This compulsive market involvement will be reflected in cropping patterns, resource utilisation and a higher degree of monetisation of transactions under distress conditions. Bharadwaj [*1974b: A-21*] notes that in the West Bengal FMS studies, the farms producing only cash crops were all in the small size groups.

Markets are interlocked through price and non-price links. Such interlocking increases the exploitative power of dominant classes in that they can disperse exploitation over different markets and time periods - thereby circumventing traditional limitations. Exploitation is secured by denying participants in interlinked markets access to any of the individual markets: "the weaker party in exchange loses the option to exercise choice in other markets due to its commitment in one. For example, the tenant who has committed himself into a land-labour tie (that is, to render free or underpaid labour services on the landlord's land as part of the lease contract) cannot avail himself of opportunities to hire himself out at a higher wage, even when such opportunities present themselves. The producer of a commercial crop who borrows on the commitment of selling his output to the merchant/creditor cannot gain from the higher return otherwise possible as he loses the option of selling it in the market. Often, unlike pure usurious capital, the merchant/creditor intervenes directly in the production organisation of the debtor, dictating the decisions regarding the crops to be produced" [*Bharadwaj, 1985: 13*].

This closing of options cements exploitation since it "weakens the possibility of the indebted party recovering from a dependency situation, especially when there are no alternative means of livelihood" [*Bharadwaj, 1985: 13*].

Interlinkage further maximises exploitation over time, by the range and depth of control it makes possible: "The power of the dominant party to exploit in interlinked markets is much more than in markets taken separately. There are conventional limits to exploitation in any one single market. For example, the crop share is conventionally laid down. The division of produce becomes a matter of convention...There are also limits to exploitation set by the sheer minimum survival needs of the exploited party. With interlinked markets exploitation can be spread over markets (such as intervening in an output market on the basis of a credit tie) and even across generations, when the labour of future generations is committed by the debtor or tenant. Moreover, with options receding for the weaker party, the situation develops as one of dominant control over the entire livelihood of the weaker party. In proportion as the dominant party stretches the domain of exploitation, the weaker party's possibilities of redress diminish" [*Bharadwaj, 1985: 13*].

Hossain [*1977: 286*-7] also finds evidence for this position in rural Bangladesh. Here, the inverse relationship arises due to the existence of a "pre-capitalist organisation of production, where the market has a limited role and cultivators have differential access to various resources". The pre-capitalist mode of production dominates the Bangladeshi social formation: private property in land exists but the forces of production are backward (capital plays only a limited role); markets in commodities and means of production are not significantly developed; and barely capitalistic large farms cultivate only a part of their land with hired and family labour and rent out the rest in small plots under sharecropping.

Thus, here we have a very powerful mechanism rooted in the social relations of production of an essentially pre-capitalist mode of production that ensures poor peasants maximise output. The poor peasant maximises output because his/her survival as a peasant depends upon it. It would appear therefore that the factors driving a poor peasant to intensify labour effort are more important than the factors permitting him to do so. The inverse relationship cannot be understood in terms of scale advantages among isolated farms or simply in terms of the poverty and unemployment facing poor peasants. The inverse relationship arises because of factors which are related to farm size, but not because of some independent size effect *per se*. It is thus misguided to treat the inverse relationship as a sign of relative efficiency rather than of distress. Chattopadhyay and Rudra [*1976: A-115*] conclude: "if the inverse relationship be made the basis of a policy for preserving small farmers as they are, the result would be the destitution and expropriation of poor peasants...". At the other end of the class spectrum, rich peasants, who have not yet been transformed into capitalist farmers, use the same technology, but with much lower labour intensity, and thus achieve lower yields.

5.3 The static nature of the Sen approach and the breakdown of the inverse relationship in the dynamic context

We turn now to the third set of considerations that need to be taken into account: the essentially static nature of the Sen approach. The extension of a static result which emerges in a given set of unchanging circumstances to a dynamic context in which the essential circumstances are changing markedly is invalid. The most significant change is likely to be with respect to technology. Chattopadhyay and Rudra [*1976: A-115*] note: "It is ironical that a static comparative situation between small farms and big farms, allegedly prevailing in the fifties in certain parts of the country - and even that, not at all established beyond doubt - has been the basis of plenty of friends of the rural poor opting for an agrarian policy that is ultimately destined to cause immiserisation of the rural poor. For even if the static comparison is valid in a certain stage of development of agriculture with low technological inputs, it cannot remain so during a period when there is a mounting drive by richer farmers to go in for more and more technological agriculture in search of higher profits."[5]

In those areas where we find an inverse relationship, it is the case that all farm sizes have access to a more or less similar technology. Large and small farms use the same set of production inputs, and the small farms achieve higher output per acre via far higher cropping intensities which in turn imply higher application of labour effort per acre. With the introduction of a new technology which favours large farms due to its associated economies of scale, then the so-called advantage which the small farms have with respect to labour input intensity, may be matched or more than matched by the new advantages which large farms have with respect to technology. In this situation, we might expect the inverse relationship to break down and eventually disappear, and with it part of the case for redistributive land reform.

In terms of the class-based approach, which is essentially a dynamic theory, what is happening here is that with the development of the forces of production in the form of Green Revolution technology, it is the rich peasants who are better placed to reap the benefits. When the new technology is removed from the laboratory test beds and research stations, and inserted into the wider context of agrarian relations, factors operate to benefit disproportionately the large farmers. Institutional services (extension, credit, input/output prices, information, marketing, and political power) exhibit a strong bias in favour of the large farmer - both cross-sectionally and sequentially, with the large farmers being early adopters and therefore early gainers in terms of high output prices, low subsidised input prices [see *Byres, 1972*].

It is the rich peasants who have the resources, which the poor peasants do not have, to gain access to the whole package of new inputs (HYV seeds, chemical fertilizers, plant protection materials). It is the rich peasants who are able to monopolise the available credit necessary to purchase the Green Revolution package. The rich peasants dominate the institutions which supply and distribute the new inputs. While these biochemical inputs may be scale neutral[6], their adoption steps up pressures for mechanization which does have associated scale economies. Abhijit Sen [*1981: 212-3*] notes that with high labour supervision costs on the large farms, this sets a limit to increasing output per acre unless labour-augmenting technology is adopted. Mechanization can thus be seen as a response to problems of labour supervision on the large farms.[7] This leads to the breakdown of the inverse relation with large capitalist farmers achieving higher yields. Much of this is supported by evidence from the Punjab [*see Chadha, 1978; Roy, 1981; Patnaik, 1972*].

In terms of the other sets of explanations we have looked at, those based on qualitative factor differences and those based on factor scarcities/imperfect markets, being essentially static arguments, have not adequately addressed this question: either the evidence on the breakdown of the inverse relation is denied or ignored and the relationship holds in all places at all times, or it is explained in terms of a U-shaped relation with small farms specialising in labour-intensive production and large farms in capital-intensive production, both sets of farms utilising resources efficiently and achieving high yields. Why such specialization occurs is only incompletely examined however.

Some neoclassical writers do seem to be aware of the impact of technological change on the inverse relationship however, but have few suggestions as to the mechanism operating.[8] Mellor [*1967*] writes: "the two prime inputs of traditional agriculture are land and labour. Capital is not only much less important in quantity, but also is largely a direct embodiment of labour in land improvements, water systems, and simple tools. The level of agricultural production in traditional agriculture is, therefore, limited by the amount and quality of land and by the amount of labour provided by the farmer, directly for production, or indirectly through the formation of capital goods". Ghose adds: "The specific conditions for this superiority [the inverse relationship] appear to be primitive technology and insufficient development of markets...It seems fairly clear that technological progress involving the introduction of chemical fertilizers, labour-saving machinery (e.g. tractors) and modern irrigation equipment (e.g. tubewells) is likely to erode the basis of superiority of small-scale production" [*1979: 42*].[9] Sidhu concludes: "Thus a major source of greater technical efficiency of smaller farms during the mid-1950s seems to be less important during the late 1960s" [*1974: 749-50*].

The empirical evidence does indeed support the proposition that following the introduction of the Green Revolution technology, the inverse relationship has disappeared, markedly so in those areas where the new technology has penetrated most deeply. Rani [*1971: A-89*] writes: "Whatever the situation may have been in the early sixties when the FMS were conducted, the whole controversy loses much of its importance in view of the developments which are taking place in Indian agriculture because, even if the small farmer has certain advantages over small farmers in labour-intensive techniques, these are likely to be wiped out as capital-intensive techniques gain popularity among farmers."[10]

Kahlon and Kapur [*1968: 79-80*], in an early study[11], concluded that it was "apparent that the adoption of yield increasing technology on the large farms in recent years had reversed the trend in yield per acre on large farms". The trend reversed with technological breakthroughs on the large farms through adoption of improved strains such as hybrid maize, hybrid bajra and Mexican wheat, and intensive use of improved methods and practices. Kahlon and Kapur suggest that it was the higher application of chemical fertilizers that resulted in higher yields on the large farms. While the small farms used higher levels of farmyard manure than the large farms for desi maize, desi cotton and sugarcane, the large farmers used higher doses of calcium ammonium nitrate and superphosphate fertilizers than the small farmers, particularly for hybrid maize and wheat sown after the kharif crops and for irrigated groundnuts.[12] The seed rate per acre was higher on the large farms for almost all crops, especially American cotton and wheat. Rapid technological change and intensive use of non-traditional inputs on the large farms also resulted in higher per acre yields in the Hissar district.[13]

Saini [*1971: A-82*] however produces some contrary evidence: "Under the impact of the 'green revolution', one would expect the inverse relationship to undergo a change and to cease to be true at least in the areas which have experienced the 'green revolution'. The data relating to Punjab (Ferozepur) and Uttar Pradesh (Muzaffarnagar), however, do not provide any evidence of such a change. It is perhaps too early to expect a change in the first two or three years of the setting in of the 'green revolution'." A later study by Bhattacharya and Saini [*1972: A-71*] shows that for Muzaffarnagar in all years there was a significant inverse relationship, but the evidence was not clear for the Ferozepur district. While they claim that the green revolution had not affected the inverse relation in either region, regressions using gross cropped areas show a shift from negative to positive correlation over time in Muzaffarnagar and from zero to positive in Ferozepur.

In an attempt to study the inverse relationship in an area where the new technology had been widely adopted, Singh and Patel found no variation in yield per acre over farm size and no sign of an inverse relationship: the regression coefficients were all greater than unity, but not statistically significant. They write [*1973: 47*]: "it may be concluded that in the context of new technology there is no indication of decrease in output per hectare with an increase in farm size and, therefore, the hypothesis of inverse relationship is rejected in the area under study."[14]

In a major study of the Punjab, Chadha[15] finds that the inverse relationship ceased to hold in the post-green revolution areas as the resource structure between small and large farms changed. He divides the post Green Revolution Punjab into three agro-economic regions (on the basis of soil conditions, cropping patterns and irrigation systems) with three distinct technological levels: 1) the sub-montane region growing wheat, rice, and maize under rainfed irrigation; 2) a central zone growing maize with tubewell irrigation; and 3) the south-western cotton belt with canal irrigation. The central region was ahead of the other two in terms of irrigation, cropping intensity, HYV use and tractors.

With the introduction of the new technology, high labour/land ratios become less important. The new factors are land saving and capital-absorbing and largely purchased, not produced on-farm so that the on-farm labour content of capital is no longer important. Indeed, the capital/labour ratio becomes as important as the labour/land ratio in traditional agriculture. Investment in machinery was higher in region 2 and on the large farms (the latter invest three times as much per acre as the small farms).[16]

There was a clear relation between levels of irrigation and investment in new technology. Region 2 has a well-developed rental market for tubewell water and machinery. Region 2 was the most modern and region 1 the least modernised in terms of per acre investment in modern machinery.

While small farms show higher per acre investment on traditional items such as hoes, they lose this advantage when improved techniques are taken into account, with large farms showing much higher investment in modern machines such as tractors.[17] In region 2, the small farmers have over 70% of their investment in traditional implements, but large farms have almost completely moved to improved items. On the large farms, the increase in capital inputs outstripped increases in labour input, while the smaller farms experienced a less than proportionate increase in capital input to labour input [*Chadha, 1978: A-93, table 9*]. While the small farms could compete with the large farms in terms of HYV seeds and fertilizers, given cooperative services and government aid, they could not compete in terms of machinery [*1978: A-95*]. Chadha notes [*1978: A-87*] that while the biochemical innovations are labour-absorbing, land-saving and scale-neutral, the mechanical innovations are labour displacing and biased to scale. Furthermore, both types of innovation call for substantial capital investment.

Region 2 had the highest capital/labour ratios, generating increased output per acre. While the inverse relation still held in region 1, it had broken down in region 2, with region 3 intermediate.

Moving beyond farm size as the stratifying category, Rao and Brahme [*1973*][18] divided farms into peasant farms and wage labour based farms with the former defined as those where family male labour input was greater than 50% of total male labour input. They conclude: "the inverse relationship [was] noticeable in the peasant sector, while it [was] not apparent in the capitalist sector" [*1973: 15*]. On average, the wage labour-based sector registered higher labour input than the family labour-based sector [*1973: 22*].

Roy also examines evidence from the Punjab to show a significant transition from traditional to modern capitalist agriculture.[19] As in Chadha, Roy divides Punjab into three heterogenous zones: the relatively backward eastern Punjab, the more recently advanced central districts, and the advanced western Punjab [*1979: 139*]. He notes that the latter region benefited from the existence of British-built canals, it being historically a cotton area with significant market oriented production, and so was most suited to the introduction of the new technology. The central zone also saw recent tubewell expansion in the period 1965-75, thus permitting rapid progress with the green revolution technology. Contrariwise, the eastern submontane region lagged behind in new technology.[20]

The district regressions show a still significant inverse relationship in the eastern zone, insignificant for the central zone (Bhatinda, Jullunder, Kapurthala, Gurdaspur), and in the western Punjab a statistically significant positive relation between output per acre and net cropped area (see Table 16, Appendix A). Using gross cropped area in the regressions revealed that several western and central districts exhibited a positive relation (see Table 17, Appendix A). Roy awards these results some importance, as normally the relationship between output per acre and gross cropped area is neither significantly positive or negative. Since the relationship has turned significantly positive, he suggests that large farmers have attained important scale advantages.

The fact that the inverse relationship disappears despite the still significant inverse relationship between cropping intensity and farm size confirms the importance of crop pattern and the physical yields of individual crops.[21] The regression coefficients for HYV wheat reveal a positive tendency across farm size in three western districts (Ferozepur, Amritsar and Kapurthala) and a significantly positive relation for HYV rice in Amritsar and Kapurthala (see Tables 19-20, Appendix A).

Roy computes two indices of progressivity (see Tables 21-22, Appendix A):[22]

1) the percentage area irrigated in the 1960s indicates those areas most suited to the introduction of the green revolution technology. Superimposing this pattern on the district maps shows an approximate similarity: the western region with a relatively high percentage area irrigated in the 1960s was the most technologically advanced prior to the green revolution and

farmers there were the earliest adopters of the new technology, while the relatively backward eastern belt of districts were poorly irrigated, permitting only limited adoption of the new technology. Roy notes that irrigation differentials between sizes were no longer important in the post green revolution period.

2) the percentage of cultivated area under HYVs and American cotton as a proxy for commercialisation (the new seeds and fertilizers have to be purchased in the market rather than be supplied from on-farm production). Again, we find a broad correlation between the spatial pattern of this index and the inverse relationship results. The greater the degree of commercialisation of agriculture, the greater the tendency for the inverse relationship to disappear.

Amritsar and Ferozepur are the most advanced districts of the Punjab in terms of the extent of their adoption of the new technology, and were the most advanced prior to the green revolution. By 1974-5, the Amritsar district had 85.6% of net cropped area cultivated under HYV seeds [*1979: 149*]. The district experienced a very high growth rate of agricultural output of 8.11% between 1962 and 1973 and a rapid increase in the stock of technology [*1979: 148, table 5.8*]. The area under tenancy declined and agricultural labourers as a percentage of the male labour force more than doubled from 9.23% in 1961 to 20.12% in 1971 [*1979: 148, table* 5.7]. Ferozepur has a higher than average size of holding (6.32 ha as against 5.0 ha for the state as a whole) and high irrigation ratios. This district specialized in cotton (producing 53.01% of Punjabi cotton in 1967-8) and wheat.

The relationship between farm size and land productivity as indicated by the regression coefficients shows an interesting progression: from a statistically significant -0.17 in 1956-7 to a statistically insignificant -0.03 in 1968-9, and finally to a significant positive coefficient of 2.7415 in 1975-6 [*1979: 151, table 5.9*]. Also noteworthy as an indication of changing relations of production in the district is the rapid decline in share tenancy from 33% of the area in 1954-5 to 6.64% in 1969-70 [*1979: 152, table 5.10*]. The data also reveals a rapid change in the stock of technology towards chemical fertilisers, tractors, diesel pumps and electric pumps for tubewells [*1979: 153, table 5.11*].

The hypothesis supported by Roy is that during the early period of transition, the institutional bias in favour of large farmers ensures that they are the first adopters. Scale advantages become more important in the post adoption period, with large farmers maintaining high investment and growth rates. Thus, rather than the small farmers being able to catch up, the initial advantages captured by the large farmers are further strengthened over time due to intrinsic scale advantages.

Further support for this thesis comes from Pakistan. Khan [*1979*][23] examines 732 irrigated farms in the Indus basin in 1974. He finds the large farms (those over 25 acres) have land productivity some 9% higher than the small farms (below 25 acres). The land coefficient (which represents the sum of factor elasticities) is 1.0974 which shows increasing returns to scale. Purchased input use (hired labour, machines and chemical fertiliser) increases with size [*1979: 72*]. With the introduction of the new technology, capital inputs were subsidized and directed towards the larger farmers. Large farms use more chemical fertilisers per acre and a similar bias exists in relation to tubewell technology: the large farmers had more access to credit for investment. All loans from the Agricultural Development Bank of Pakistan went to farms over 25 acres, the ADBP being the main source of finance for tractors and tubewells [*1979: 76*].

Hoque and Mahmood [*1981*] dispute some of Khan's findings, using a database for 19 districts in West Punjab provided by the Agricultural Census and Rural Credit Survey of 1972. However, note that Hoque and Mahmood use highly aggregated data, grouped in five size classes over districts [*1981: 156*]. They produce a U-shaped relation with small farms and large farms having higher productivity levels than medium farms, but no significant difference between small farms and large farms [*1981: 161*]. Rather than undermining Khan's findings, however, these results tend to confirm them by suggesting an intermediate stage in the introduction of the new technology prior to full-scale mechanization.

Summary and conclusions

We have seen in this chapter, that the fundamental determinants of factor-use intensities are the nexus of property rights and tenurial conditions that shape market characteristics, resource endowments, and the nature and extent of market participation by different size-holdings. Specific resource constraints affect the bargaining position of farmers in the markets for land, labour, and other inputs. Current and past levels of market participation and the nature of that participation strongly influence production decisions, which in turn affect future resource endowments.

The class-based approach identifies farm size with class position. Within the process of peasant differentiation, poor peasants end up with smaller and smaller below-subsistence plots of land, and are forced to intensify land-use and labour input in order to achieve subsistence levels of income. This stratum of poor peasants may also be characterised by compulsive market involvement or 'forced commerce'. Exploitative relations of production and exchange, with landlords, merchants and moneylenders extracting surplus via high rents, usury and price wedges, either singly or conjointly, compel poor peasants to achieve higher than average yields, market a high proportion of high-value cash crops, and sell labour off-farm in order to pay off cash and debt obligations as well as reach subsistence income.

At the other end of the class spectrum, rich peasants accumulate land and do not operate under such subsistence constraints. Through tenurial relationships and moneylending, rich peasants are a part of the exploiting class. They operate on the basis of hired wage labour and market a truly commercial surplus (as opposed to a distress surplus). A middle peasant range is more self-sufficient in terms of labour and consumption/production. This implies lower market participation and they are under no compulsion to intensify labour input.

In those areas where we find an inverse relationship, it is the case that all farm sizes have access to a more or less similar technology. Large and small farms use the same set of production inputs, and the small farms achieve higher output per acre via far higher cropping intensity and application of labour effort per acre. With the introduction of a new technology which favours large farms due to its associated economies of scale, then the so-called advantage which the small farms have with respect to labour input intensity, may be matched or more than matched by the new advantages which large farms have with respect to technology. In this situation, we might expect the inverse relationship to break down and eventually disappear, and with it part of the case for redistributive land reform.

In terms of the class-based approach, which is essentially a dynamic theory, what is happening here is that with the development of the forces of production in the form of Green Revolution technology, it is the rich peasants who are better placed to reap the benefits. They have the resources to gain access to the whole package of new inputs (HYV seeds, chemical fertilizers, plant protection materials). It is the rich peasants who are able to monopolise the available credit necessary to purchase the Green Revolution package. The rich peasants dominate the institutions which supply and distribute the new inputs. While these biochemical inputs may be scale neutral, their adoption steps up pressures for mechanization which does have associated scale economies. This leads to the breakdown of the inverse relationship with rich peasants/capitalist farmers achieving higher yields.

In the next chapter, we will examine what some writers regard as the definitive study of the inverse relationship, in both theoretic and empirical terms, in the light of the framework developed in this chapter. These first six chapters then, set the context for the core part of this thesis: the inverse relationship in Egyptian agriculture.

Notes to Chapter V

1. Bharadwaj writes in this context: "Even when the researcher recognises the inadequacy or irrelevance of some specific assumptions like profit maximization or mobility of resources guided by freely fluctuating prices, he is prone to tinkering with only those specific parts of the competitive model, keeping undisturbed the rest of the framework" [*1974b: A-11*].

2. T.J. Byres was the first writer to develop a consistent and rigorous class-based approach to the question of the inverse relationship in an unpublished paper presented at the IDS Rupag Seminar Programme in November 1977, and in a modified version at

the Institute of Development Studies, The Hague, in April 1979. See also Bharadwaj [*1974a*] and [*1974b*], and Patnaik [*1979*] and [*1987*] for complementary inputs to this approach.

3. Besides Thorner [*1982*], a useful summary and critique of the earlier part of the debate may be seen in McEachern [*1976*]. An excellent selection of the relevant contributions may be seen in Patnaik [*1990*]. Patnaik has been one of the most significant contributors to the Indian debate. Most of her important contributions are listed and discussed in Thorner's [*1982*]. Among Patnaik's writings published after Thorner wrote her survey, see Patnaik [*1983*] and [*1986*].

A major contributor to and critic of the debate on the transition to capitalist agriculture and the agrarian question is the founding editor of the Journal of Peasant Studies, T.J. Byres. See Byres *[1972], [1974], [1977], [1981], [1982], [1986], [1986], [1990]*, and [*1991*].

On the semi-feudalism argument, see Bhaduri [*1977*] and [*1983*].

4. Within this literature, both political and neoclassical traditions are represented. For the political economy approach to inter-linked modes of exploitation, which focuses on surplus extraction by dominant classes, see Bharadwaj [*1974*], [*1979*] and [*1985*]. Other important contributors include Bhaduri [*1973*] and Srivastava [*1989*]. The latter includes a useful brief survey of the literature on interlinkage.

For the neoclassical approach, which focuses on contractual market relationships and market imperfections, see Srinivasan [*1979*], Bardhan [*1980*], Basu [*1983*], and Braverman & Srinivasan [*1984*].

5. Rao [*1968: 93*] writes: "Even though the application of labour may be higher among smaller farms, they may lag behind the larger ones in regard to the application of technologically new inputs such as fertilizers, improved seeds and insecticides etc. owing to their low investible surplus".

6. On the question of scale versus resource neutrality and the pressures for mechanization see Byres [*1972*] and [*1981*].

7. Sen [*1981: 327*] also mentions that sharecropping can be seen as an institutional response by rich farmers to capture some of the "cheapness" of poor peasant family labour and save on supervision costs.

8. Sidhu [*1974: 749-50*] mentions the possibility that large farms assimilated the new Mexican wheat strains more rapidly than the small farms due to a "comparative advantage in research information".

9. Bardhan points to his Ferozepur results. Over the period 1955-69, the inverse relationship becomes positive. He also points out that the results obtained by Lau and Yotopoulos [*1971*] pertain

to traditional Indian agriculture in the mid-1950s. With the introduction of green revolution technology, land productivity no longer depends on labour input intensity alone, but on the availability of fertilizers, irrigation etc. [*1973: 1373*].

10. Rani uses disaggregated FMS data for five IADP districts over three years 1962-65. Altogether 1,431 observations. His Chart A [*1971: A-86*] shows 14 out of 15 negative coefficients indicating an inverse relationship, but only 9 significant at the 10% level, 7 at 5% and 1 at the 1% level: "Hence one can even conclude that yield per acre remains constant over different size groups of farms" [*1971: A-86*].

11. The study relates to the Upper Dhaia region of IADP district Ludhiana, the Dehlon Development Block for the year 1965-6. Small farms are classed as those below 10 acres and large farms those above 22 acres.

12. In a similarly early study, Sinha and Singh [*1966: 19-20*] find that per acre maize yields actually increased with size: small farms produced 10.75 maunds per acre, medium-sized farms produced 11.88 maunds, and the large farms 13.40 maunds. They also found that for groundnuts, the small farmers achieved yields a quarter less than the large farmers. This was also true for gram.

13. C.R. Kaushik, *Farm adjustments on the introduction of new irrigation facilities in canal irrigated area of Hissar district*, unpublished MSc thesis, 1966. Cited in Kahlon and Kapur [*1968: 80*].

14. A study of 120 farms in 4 villages in Meerut district, Uttar Pradesh, chosen on the basis of area under Mexican wheat varieties in 1969-70. Land was standardised for soil quality using land revenue.

15. Chadha uses Punjabi data from three sources:

1)FMS 1956-7 (2 districts: Amritsar and Ferozepur - 200 farms).

2)FMS 1969-70 (61 villages over the state (21 patwar circles)-detailed information on 351 farms on the cost-accounting basis collected by the State Statistical Organization).

3) Agricultural Census data from 1970-71 .

Small farms were defined as those from 2.5 to 10 acres, medium farms from 10 to 25 acres, and large farms above 25 acres. The 1969-70 data does not include the very small farms (less than 2.5 acres).

16. Compare table 4 [*1978: A-90*], for 1969-70, with table 5 [*1978: A-91*] for the mid-50s.

17. See table 6 [1978: A-91] and table 7 [1978: A-92].

18. The data used is from Amarvati and Akola districts 1956-7 and Ahmednagar district 1967-8.

19. Roy uses disaggregated data from the National Council of Applied Economic Research, Fertilizer Demand Study, Interim Report, Volume 1 - General, (mimeo) NCAER New Delhi, February 1978. The results are analyzed in his PhD thesis [*1979*] and in [*1981*]. Roy disaggregates household data by district in the years 1975-6 and 1976-7 (i.e. in the post green revolution period). The total sample size was 22,791 across India, with 869 in Punjab (the non-response rate of 5.5% produced a final sample size of 821 for Punjab). The data included area irrigated and detailed information for each crop (for an array of 66 crops), whether they were HYV or traditional varieties, cultivated on irrigated or unirrigated land, and yields. The household level data avoided the biases associated with the use of size class averages as in the FMS studies.

Roy uses a linear regression model for "simplicity" (he also tried out Rudra's rank correlation tests in the sample cases and found the "qualitative nature of the relation no different". The specification for all regressions was $y = a + bx$ where y = output per net cropped area, output per gross cropped area, percentage area irrigated, cropping intensity, and yield per acre of individual crops [*1979: 131-34*].

20. See tables 5.1-5.7 [*1979: 156-162*]. See also the maps in diagrams 5.1-5.8 [*1979: 141-8*] or alternatively [*1989*].

21. Further, the coefficients on *b* are both smaller and statistically weaker in the advanced regions than in the more traditional areas (only Amritsar and Gurdaspur show no significant relation). See Table 18, Appendix A.

22. These tables summarise the main findings of Roy noted in the text.

23. Khan fits a Cobb-Douglas production function, running log-log regressions of output on gross cropped area, chemical fertiliser use, the ratio of family top hired labour and expenditure on animals and machinery.

CHAPTER VI

A critical view of Berry and Cline on the inverse relationship

Introduction

The literature on the inverse relationship between farm size and land productivity is a vast body of empirical and theoretical work scattered throughout many journals and studies over a long period of time. So far, we have concentrated on the Indian literature, data and debate. But, although nowhere else has there been a debate on the Indian scale or of the Indian quality, the inverse relationship has been identified in a large number of other countries. In the present chapter we shall focus upon an influential attempt "to consider the issues of agrarian structure and productivity at the theoretical level and to bring together recent empirical evidence on these issues from a wide range of countries" [*Berry and Cline, 1979: x*].

That attempt is the study by Albert Berry and William Cline entitled *Agrarian Structure and Productivity in Developing Countries*, published for the ILO in 1979. This collaboration grew out of earlier work by the authors on Colombia and Brazil.[1] It seems to be regarded by many writers as being the definitive study of the inverse relationship [see *Dasgupta, 1993: 525* and *Ellis, 1988: 197*].

We devote a chapter to this study for three reasons. The first is because it allows a more general treatment of the inverse relationship result than we have attempted so far. Secondly, it displays serious methodological shortcomings which need to be addressed. And finally, such a chapter constitutes a useful bridge into the second part of the thesis, which relates to a country other than India: Egypt.

The main focus of the study is "on differences in the productivity of existing farms by size" [*3*][2] and the factors which explain these differences. Based on a wide range of empirical evidence, the authors conclude that an inverse relationship between farm size and productivity is generally found in developing countries: "In short, it is clearly the normal relationship" [*203*]. The specific questions addressed include the impact of factor market imperfections on resource utilization, the potential of redistributive land reform to increase output and employment, the effects of the Green Revolution technology on the inverse relationship, and aspects relating to land tenure.

Various hypotheses explaining the inverse relationship are examined in the second chapter [*5-30*], and two types of empirical evidence are presented in chapters three and four. Chapter three [*31-43*] examines cross-country data on the farm size-productivity relation, while chapter four [*44-127*] and Appendix A [*141-193*] consider the evidence from various individual country case studies. Finally, chapter five [*128-140*] synthesizes the policy implications derived by the authors from both sets of empirical evidence.

We examine the latter first, in section 6.1, taking the empirical evidence at face value and abstracting from the theoretical analysis. In section 6.2, we turn to a critical account of the authors' theoretical framework. We have already covered these various issues in Chapters I and III, and so we deal with them quite briefly. In the final section 6.3, we examine in great detail the empirical evidence produced by the authors, both the cross-country data and each country study individually. We shall seek to show that this empirical evidence is seriously flawed and cannot be used to test the relevant hypotheses generated by the authors.

6.1 Policy implications

Berry and Cline argue that the finding of systematically higher land productivity and comparable levels of total factor productivity on small farms as opposed to large farms suggests "that the expansion of the small-farm subsector of agriculture may be a more effective way of increasing both employment and output than pro-large-farm strategies and thus warrants serious consideration in almost all developing countries" [*4*]. Analysis of social efficiency requires consideration of total factor productivity. This will fall with size where labour is abundant and where land and capital are relatively scarce, although the inverse relationship between total factor productivity and farm size will be weaker than that relating to land productivity alone. Nevertheless, in LDCs, small farms are likely to have higher total factor productivity, and so are the optimal size for output maximization, as well as for labour absorption and income distribution [*16*].

Given that small farms generate higher land productivity and total social factor productivity (the authors do admit an extremely important caveat to this statement: "except in the very smallest farms in some countries" [*128*]), the authors propose the redistribution of land to the small farmers who apply labour more intensively, and the improvement of small farm access to credit and new technology. Both strategies will improve equity and increase output levels [*128*].

With such land redistribution, the authors claim that: "The optimal post-reform farm size, in the absence of technical returns to scale, will be merely the total agricultural area divided by the total number of families in the agricultural labour force (after adjusting for land quality). That is, since total factor productivity falls as farm size rises in the relevant range, the most productive agrarian structure will be that composed of the smallest farms possible, consistent with full allocation of the available land and labour force, i.e., total area divided by the total number of farm families" [*18*]. They add in a footnote: "An equal distribution of available land among the entire rural labour force on a family farm basis will generally result in parcels significantly larger than the smallest prereform farms" [*226, note 23*]. Berry and Cline then reason: "If the equal distribution of all available land among all families implies a labour/land ratio equal to that of the same sized farms in the existing agrarian structure, the land productivity of these latter farms can provide a rough prediction of average land productivity after redistribution..." [*18*].

Estimates of output gains after land redistribution follow a two-step procedure: first, the average farm size is computed by dividing the available land by the number of families in the rural labour force;[3] secondly, a statistical estimate of output per acre for that farm size is applied to the former result. Chapter five presents [*132-3, table 5-1*] estimates of the potential gains from such equalizing land redistribution. Potential output increases range from 10% for Pakistan to 79.5% for north-eastern Brazil, including 19% for India, 23% for the Philippines, 25% for Brazil as a whole, and 28% for Colombia and the Muda river area of Malaysia (see Table 23, Appendix A).[4]

The only caveats to this procedure given any prominence are those arising from price changes following shifts in output mix, and changes in labour input intensities [*18-19*]. However, the set of assumptions required for this astonishingly simplistic calculation to hold are both numerous and highly unlikely to occur in reality.

The first and most obvious problem with this procedure is that the estimates are not constrained by product mix or land quality. In other words, the total land available which is defined as all land currently being used for agricultural purposes including pasture and woodland, can be converted to arable cultivation. Indeed, even marginal and waste land or land unsuitable for arable purposes can be so converted. Clearly, such a computation is inadmissible; the latter category of land would have to be excluded from the calculation, and the remainder would have to be disaggregated by type or use, between arable and pasture for example. Very different figures are likely to result. Indeed, where such product disaggregation has been carried out, as in Cline 1970 for Brazil, the potential output gains from land redistribution have been disappointing. In seven out of twelve regional crop sectors, production changes were either negative or insignificant (see Table 24, Appendix A).

An equalizing distribution might well lead to a modal farm size significantly greater than the smallest currently existing farm size. An important consideration here is the question of minimum feasible size of farm discussed in the introductory chapter above. None of the foregoing calculations takes into account the possibility of there being a minimum efficient scale or of there being a floor determined by subsistence income. Floors might also be established with regard to employment (the size of farm that would provide full-time employment for the average number of family workers) or with regard to the full employment of farm draught animals.

Estimates of output gains after redistribution of land assume that the required inputs exist and that no losses occur due to the process of redistribution. Such estimates do not take into account the extra investment costs of providing irrigation to unirrigated land, or of providing extra inputs (seeds, fertilizers, pesticides etc.). The process of land redistribution itself may involve extra costs in terms of cadastral survey, boundary marking and the provision of access to plots.

The estimates further assume that the current input-output characteristics on existing farms of the "optimal" size would also characterise farms of that size after land reform. This question is not only related to the availability and distribution of production inputs, but also to the whole area of motivation governing labour effort. If incomes were to rise on the small farms, this may relax the subsistence income or debt obligations constraint and allow small farmers to relax labour effort with a lower application of labour per acre, and hence lower output per acre.[5] In such circumstances, while on-farm family consumption might increase, the supply of marketed surplus may well fall with serious consequences for economic activity outside agriculture.

One area dismissed rather cursorily by Berry and Cline is the question of the possible dynamic losses of redistributive land reform affecting negatively the rate of saving and capital accumulation, and the adoption of new technology. The authors doubt the existence of any possible dynamic losses arising from land distribution because 1) there appears to be no evidence for higher agricultural growth rates in countries with higher than average farm size, and 2) there is evidence in Green Revolution areas that small farmers adopt the new technology rapidly [*134-5*].

The first point is quite irrelevant. Average farm size provides no indication of the distribution of farm size or the weight of large farms in that distribution. What needs to be compared is the relative output growth rates of a group of large capitalist farms with a group of small peasant farms in one country. Berry and Cline cite evidence of simulation experiments with rural savings data for Brazil and India by Cline and Bhalla[6] which indicate that income redistribution would have only a limited impact on rural savings rates and total savings [*28*]. However, as Sen [*1964a*] and Bharadwaj [*1974a*] have shown, the vast bulk of small farms in India are highly indebted deficit farms. It is therefore most likely that any post-reform average or marginal rate of rural saving would be very low. Indeed, as we shall see below, Bhalla disposes of this annoying problem of deficit farms by excluding them from his analysis (this reduces his NCAER sample by over 50%).

The second assertion is also highly dubious. The authors assert that small farmers adopt the Green Revolution technology very soon after the large farmers, thus reestablishing an inverse relationship in the form of an S-curve [*28*]. They claim that the association of mechanization with the adoption of new technology is erroneous, simply just another manifestation of factor market imperfections, and that the existence of the latter imply the need to channel new inputs towards the small farms [*27-8*]. However, as was shown in Chapter V above, the empirical evidence does not substantiate this assertion. Patnaik [*1987: 120-5*] has demonstrated that although some farms in all size groups have adopted the new technology, those small farms are in fact, in terms of scale and hired labour use, rich farms. It is the rich farms who both adopt the new technology thus reaping the initial benefits and who maintain that advantage. The evidence in Chapter V above shows clearly that the inverse relation has broken down in those Green Revolution areas as large farmers adopt both the new technology and mechanize. Indeed, Berry and Cline do admit that large farms are able to capture economies of scale with the introduction of mechanized technology [*138*].

6.2 Theoretical framework

These quite erroneous assertions regarding policy prescription are of course founded on a particular conception of the factors which give rise to an inverse relationship in the first place. Berry and Cline begin by asserting that the empirical studies generally show constant returns to scale in developing country agriculture, and that there would therefore be no losses of production efficiency via land redistribution. They continue: "if returns to scale for inputs actually used are constant, then the crucial determinant of the size-productivity relationship is the behavioural pattern of resource utilization by farm size" [*6-7*].

The authors [*13-4*] are aware of the need to distinguish the inverse relationship in terms of falling physical yields of individual crops with farm size, a decreasing land use intensity or cropping intensity with farm size, and a product-mix shift to lower value crops as farm size increases. They mention the possibility that large farms might have higher output per acre but utilise a smaller proportion of their land area. Indeed, they cite evidence for higher output per acre on the large farms in Colombia with lower land use intensity. Similar evidence exists for north-eastern Brazil,[7] in 1930s China and 1960s Philippines, while Pakistan also shows higher yields for some crops (see below).

The authors present the following hypothesis as the main explanation for the inverse relationship: factor prices differ between the large farms and the small farms, such that the effective prices of land and capital are low for the large farms and the effective price of labour is low for the small farms. Thus small farms have high labour/land ratios whereas large farms use labour and land less intensively. Small farms with a lower opportunity cost of labour, can exploit more marginal land, cultivate a larger proportion of their land, and achieve higher yields [*9-10*].

Berry and Cline take a rather eclectic position on the causes of these factor price differentials between large and small farms. The authors mention Sen's labour market dualism framework where the supply price of family labour is the average product of labour and not the marginal product. The MPL on the small farms will be lower than on the large farms. The main qualification to this is where the opportunity cost of labour is high (due to the availability of off-farm employment). However, the market wage may be discounted for risk and search costs, or the family may try to hire out labour, but family preferences or unwillingness to share output with the hired-out worker will keep the MPL less than the wage [*8*].

The effective land price may be higher for the small farms because 1) small plots have higher unit costs (a greater potential market and inconvenience for landowners); and 2) land purchase needs credit and large farms have better ratings and so cheaper credit (and so the real price of land will be lower). Land price differentials reinforce labour cost differentials and lead to higher labour/land ratios and output/acre on the small farms. Imperfections in capital markets reinforce low labour use on the large farms: a low effective price of capital leads to substitution of machines for labour. The authors take a net substitutionist view of mechanization [*11*]: the main influence of mechanization is on substituting for labour rather than raising yields [*see Binswanger, 1984*]. The empirical studies in the book show markedly lower labour/land ratios on the large farms and this is taken to mean that capital and land market imperfections complement the effects of labour market dualism or are not strong enough to counteract them. The holding of land for asset price speculation or for reasons of social prestige and/or political power is also adduced as a possible explanation for lower productive activity on the large farms [*10-12*].

Let us examine these theoretical explanations for the inverse relationship presented by the authors point by point. The fact that the empirical studies in the text generally show constant returns to scale in developing country agriculture does not mean that potential economies of scale are non-existent. In the context of backward agriculture in which the forces of production are not advanced and in which large and small farms are using essentially the same techniques of production, constant or even decreasing returns are possible. However, if the potential for technical scale economies does exist, then land redistribution would not be an optimal strategy.

We have seen quite clearly in Chapters II and IV above that a major factor behind the inverse relationship relates to cropping intensity and possibly cropping pattern. The distinction made above between these factors and the physical yields of individual crops and the proportion of farm area actually cultivated is an important one, but these latter factors do not constitute strong evidence for redistributive land reform. Firstly, there is little evidence for falling yields of individual crops across farm size; indeed, much evidence points the other way. Secondly, lower land use in terms of area cultivated, particularly if there are higher physical yields of individual crops on the large farms, as implied above, is not an argument for land redistribution to the small farms. In this case, the appropriate policy for output maximization would appear to be to induce large farms to increase their production activity (assuming of course that the unused portion of their land is actually cultivable).

The principal thesis of differential factor prices between large and small farms, and its explanation in terms of the Sen framework, has also been shown to be problematic. If indeed factor price differentials were the main explanatory mechanism at work, then we would expect to find higher capital intensities on the large farms in terms of technological innovation, both biochemical and mechanical. However, as we have seen in Chapter V above, in this context the inverse relationship breaks down. Indeed, this hypothesis would appear to be more appropriate as an explanation for the non-existence of an inverse relationship rather than its cause. Further, the supposed ability of the small farmer to exploit more marginal land (because of a lower opportunity cost of labour) is hardly conducive to higher crop yields.

The Sen framework is itself heavily flawed, as we have seen in Chapter IV above. The use of a single production function to compare two very different systems of farming, points to the identification problem at the heart of the Sen model. This concerns the assumption that large farms are capitalist farms, and small farms are peasant family labour-based farms. This conceptual sleight of hand obscures the real relations at work which produce the inverse relationship. Sen focuses on two different systems of production: small peasant farms and large capitalist farms. It is not obvious therefore why these two systems are located on the same production function (the same marginal product of labour curve). The model is comparing farming methods which have fundamental differences in their organization of production and qualitative differences in their division of labour [*Roy, 1979: 19*].

The assumption of labour homogeneity is not sufficient: the use of a single MPL curve requires concomitant assumptions regarding the organization of production, homogeneity of all factors of production and equal factor intensities. It must also be assumed that different farms apply identical capital inputs per acre (both in quantity and type of capital) and that land is homogeneous regarding soil quality and irrigation. A peasant farmer may be constricted to a less efficient set of production conditions including lack of access to economies of scale, lack of technical knowledge or access to particular factors, or risk aversion to using new inputs. Note too, that the alternative use of non-homothetic production functions can result in differential factor prices even with perfect factor markets.

A further set of problems arise from the proposed behavioural calculus of the farmer internal to the farm, and to the methodology of comparison of the wage rate and marginal productivity. It is inappropriate to postulate effective leisure preference among poor peasants who are very close to subsistence; the effective limits are more likely to be biological [*Sen, 1981: 207*]. Family labour allocation is determined by objective factors like involuntary unemployment and intensity of poverty which provides a reason for a wage-gap. Poverty and unemployment, rather than leisure preference, are the main reasons why small farmers intensify family labour use [*Sen, 1981: 209*].

Furthermore, the whole exercise of comparing the marginal product and wage rates is meaningless for agricultural production. The production cycle in agriculture is prolonged and varies greatly between crops. No straightforward marginal productivity rules can be applied here as the productivity of family labour inputs prior to harvest time will depend on the timely application of the necessary amount of labour during the harvesting period.[8] Labour demand at the harvesting stage is largely determined by elements of previous stages. Labour at earlier stages thus has to be seen in the nature of fixed costs. Labour demand at harvest is a derived demand dependent on conditions earlier in the production cycle.[9] Under such conditions, the meaning of the marginal product of labour in agriculture becomes extremely hazy almost to the point of becoming operationally useless [*Roy, 1979: 20-3*].

Finally, the assertions concerning the reinforcing effects of land and capital market imperfections cannot go unchallenged. Firstly, it is not necessarily the case that small plots of land have higher unit costs because of greater demand and inconvenience to landlords. The supply side may encourage small plot size as well, particularly in the context of highly fragmented agricultural land. Secondly, on the question of mechanisation, there is a great deal of evidence that associated with mechanisation is the potential for increasing land use intensity, both in terms of cropping intensity and the utilisation of the cultivable area, thus increasing output per acre on the farms employing such technology [see *Byres, 1981*].

6.3 Empirical evidence

We have seen then that neither the policy conclusions reached by the authors nor their theoretical support are valid. Let us now turn to the empirical evidence presented by Berry and Cline. The authors present two types of empirical evidence: cross-country analysis and a number of individual country case studies. In chapter three, Berry and Cline present evidence from cross-country analysis based on 1960 FAO data for 30 LDCs. This shows:

1) the large farm sector (defined as those farms operating the top 40% of cultivated area) use land less intensively than the small farm sector (farms operating the bottom 20% of area). The data are reproduced in Table 25, Appendix A.

2) the ratio of large farm land use to that on small farms declines as per capita land endowment increases (see Table 25, Appendix A).[10]

3) large farms make relatively poorer use of their land where land distribution is more unequal [*38*].

4) those countries with larger average farm size do not have faster growth of agricultural output (see Table 26, Appendix A).

5) agricultural growth rates are uncorrelated with concentration in land distribution (see Table 26, Appendix A).

6) output per acre and employment per acre are higher in countries with a smaller average farm size and more equal land distribution (see Table 27, Appendix A).

However, no theoretical or policy conclusions of relevance to the inverse relationship between farm size and productivity can be drawn from these cross-country comparisons at such a high level of aggregation. Relation 6 above is clearly indicative of the macro-level inverse relationship: countries with highly fertile land have higher population density and smaller average farm size as well as higher yields. This is confirmed by the higher employment per acre ratios derived from FAO figures on agricultural population densities (in Table 26), and by relation 2 above.

Relations 1-3 are quite meaningless as it is unclear what is being compared. The top 40% of farm area will include many medium sized farms as well as large capitalist and peasant farms. Large areas of farms designated as large may simply be uncultivable land. Land quality clearly needs to be considered here so that like is being compared with like. The authors themselves make the point that "Few studies have attempted to disaggregate in such a way as to allow for land quality differences, so the data do not permit strong conclusions at this point" [*225, note 21*]. In the Latin American context, as farm size increases, land is predominantly livestock pasture, but the authors fail to state whether such land is cultivable as arable land [*14*].

Let us turn now to the individual country case studies presented by the authors which may be able to provide a greater degree of disaggregation and therefore meaningfulness. The first case study presented is based on Cline's [*1970*] work which covers 8,000 farms in seven agricultural states in north-east Brazil.[11]

Brazil

Cline's earlier work found [*44-5*]: 1) constant returns to scale across farm size, 2) an inverse relation between land use and farm size, and 3) an inverse relationship between labour intensity and farm size. He then compares these findings with the data from a later 1973 study. The latter reveals a clear inverse relationship in all product sectors, with the significant exception of the rich cocoa plantation area (Bahia) which shows a positive relation (see Table 28, Appendix A). Regression exercises reveal a significant inverse relation even when accounting for land quality (land price is used as a proxy) and where zonal dummies are included (see Table 29, Appendix A). Note however, that the coefficients on the zonal dummies are not reported, and therefore there is no indication of their significance.

Note too, that the findings in Table 28 are derived from grouped average data by size class with no indication of group variances. The data cover very large areas, sometimes whole states and may thus merely indicate the macro-level inverse relationship. The regressions in Table 29 were performed on the pooled grouped data with zonal dummies. At this high level of aggregation therefore, one would expect to find such an inverse relationship.

With regard to returns to scale, a study by Scandizzo and Barbosa [*1977*] find that for north-east Brazil, the cotton and cocoa product sectors are characterised by increasing returns to scale (there is also some indication of this for the rice and sugarcane sectors).

Cline then analyses farm-level, product-specific data (again using pooled data for the whole of north-east Brazil (see Table 30, Appendix A). All six product sectors show an inverse relationship, but the coefficient for the cocoa sector is not statistically significant.[12] Note that again the zonal dummy coefficients are left unreported. Note too that the method of categorisation of farms is conducive to a great deal of distortion: a farm observation is located in the livestock sector if 50% of total output is derived from livestock activities.

There are major problems too concerning the data used. The productivity measure uses value added which as we have seen possibly includes a bias against the large farms which have higher capital-output ratios. Regressions of value added per unit land value against land value (again using pooled farm level data and no regional dummies) also show an inverse relationship for all product sectors (see Table 31, Appendix A). However, if output and land value (as a proxy for soil quality) are correlated then the regression results will be biased. The value of land may simply reflect output expectations.

The only comparison between the 1962 data and that for 1973 is for Pernambuco sugar and Ceara livestock, but as we have seen above, neither the sugar nor the livestock sectors are typical sectors from which to draw conclusions regarding an inverse relationship. Thus, there is no really strong support for a generalised inverse relationship on the basis of this data, and certainly none for the hypothesis of factor market imperfections as the main explanatory factor. Exercises testing total social factor productivity using shadow prices for labour (zero, half minimum wage and minimum wage) actually show fairly inconclusive and disappointing results from the authors' viewpoint (see Table 32, Appendix A).

Colombia

The second case study presented is based on work by Berry [*1973*] using the 1960 Colombian agricultural census and 1966 yield data. Large farms have lower labour input intensity, a lower share of land cropped and lower cropping intensity. Large farm (more than 500 hectares) yields in value-added terms are only 15% those on the small farms (2-5 hectares), or after normalisation for land value, 45% as high (see Table 33, Appendix A).[13] The main factor appears to be land-use intensity: land-use on the smallest farms is 87%, compared with only 6% on the large farms (see Table 34, Appendix A).

Berry writes [*60*] that the inverse relationship thus arises from greater land use on the small farms: "The obvious hypotheses are those discussed in Chapter 2. The land, labour, and capital markets all are imperfect, with the ultimate result that the opportunity costs of land and capital are higher on small farms, while that of labour is lower...Most of the differences in factor proportions are probably explained by factor price differentials".

However, whether an inverse relationship exists or not depends on whether fallow land is included in the calculations: with fallow, large farm yields fall by 15%; with fallow land excluded, large farm yields rise by 60% because yields for many crops increase with farm size. An index of value per hectare cropped shows large farm yields some 60 per cent higher than the small farms (see Table 34, column 1). Small farm neglect of fallow may not be socially optimal in the dynamic sense, leading to environmental degradation through land overuse; fallow may in the long run be optimal and therefore socially more efficient. Berry's table 4-11 [*63*] reports a higher proportion of small farms using more fertiliser, but the data says nothing about rates of application nor differing needs for fertiliser for different agricultural activities. Note that all the figures reported assume a fixed crop pattern across all size groups, whereas large farms are biased towards extensive cattle ranches.

Berry notes that although there is an inverse relation on the basis of the 1960 data, this pattern has been modified since, although he is not clear as to direction or magnitude [*58*]. He writes that over the 1960s, an expansion in new technology, including greater use of machinery on large farms, has taken place with overall real value added per hectare increasing at 2.4% per annum [*64*]. Indeed, the 1970 agricultural census shows large farms (more than 50 ha) increasing land use intensity and small farms (less than 5 ha) decreasing land use intensity, along with a shift to crop cultivation on the part of large farms (see Table 35, Appendix A).

Berry cites the later evidence of a study of 3,000 farms[14] which appears to show an even stronger inverse relationship than before (yields per hectare drop tenfold between 5-10 ha and 50-100 ha farms) [*67, table 4-15*]. However, this data is an unrepresentative sample: the small farms were selected from an elite with access to credit, while the large farms were selected from colonization areas with untypically low productivity. Thus Berry is forced to admit that "the [INCORA] sample cannot be of much assistance in an attempt to judge whether size/productivity differentials changed significantly during the 1960s" [*68*]. Indeed, the same data disaggregated for crop farms <u>alone</u> and for livestock farms <u>alone</u>, shows no clear trend in land productivity over farm size (over the range from 5-100 hectares). Further, many high income farms are small farms and many low income farms are large farms (see Table 36, Appendix A).

<u>Philippines</u>

The third case study is on Philippine agriculture, based on the Census of the Philippines, Agriculture, 1960. The authors present aggregate grouped estimates showing an inverse relationship: large farm (above 50 hectares) crop yields are some 32-45% below those on small farms (1-3 ha), and livestock output per hectare on the large farms only 22-39% that on the small farms (see Table 37, Appendix A). These results however, are subject to many of the deficiencies remarked on above. Many of the productivity estimates are based on crop areas rather than output figures, and the livestock figures are based on stock not current output. The regression results are based on grouped value added data and are thus not good confirmation of an inverse relationship at the micro level [72]. Again, a comparability problem exists in that large farms have a higher proportion of idle, pasture and forested land than the small farms.[15]

The authors also cite a 1966 study by Ruttan [*1966*] for Bulacan province in which farms are classed by size, tenurial form (share tenants/owners) and land quality (irrigated/non-irrigated; and upland/lowland). Ruttan concludes that yields per hectare bear no systematic relation to size, although they tend to be lower on the large farms above 10 hectares. Note that labour input intensities are estimated on the basis of the distribution of farm population by farm size, thus picking up the macro-level inverse relationship. This is also indicated by the 1960 data which shows the average value per hectare of farm land higher for provinces with lower average farm size [*74*].

A 1955 University of Philippines survey showed that the value per hectare of tenanted land was higher than owner cultivated land.[16] This may reflect the disproportionate share of share tenants in rich rice areas, again indicating the macro-level inverse relationship [77]. Ruttan also found higher yields on sharecropped rice farms, but there are serious problems with the data used in testing the productivity hypotheses: regions with good soil/climate and locational characteristics were atypical in farm size and tenure structure [*76*].

Ruttan [*1964: 104-5*], in a penetrating insight, writes: "In situations characterized by static technology, static standards and levels of living, and low literacy and income levels, both total agricultural output and total marketable surplus can be maximized by a tenure system which forces the cultivator to produce beyond the level which satisfies his family consumption requirement. In this situation, share tenancy does not limit output but rather forces agricultural output above the level that would be achieved under a system of owner-partnership." It is unfortunate that this line of reasoning is not pursued.

West Pakistan

The fourth case study is on 1960s West Pakistan as analyzed by Berry.[17] He presents evidence showing a strong inverse relationship with respect to land productivity and labour input intensity. However, the first estimate is based on the assumption of constant crop yields across farm size, and the second estimate on "scanty evidence" of yield differentials, showing that large farm (50-150 acres) yields are only 45% of those on the small farms (1-2.5 acres) (see Table 38, Appendix A). Further evidence distinguishes between irrigated and barani regions, finding a significant inverse relation in both areas (see Table 39, Appendix A).[18] However, this finding is based on a very small sample of only 53 farms with none less than 7.5 acres. When region and tenurial status are taken into account, the relation is less significant.

The Pakistani evidence cited by Berry again reveals all the problems associated with highly aggregated and grouped data, in particular the confusion with the macro-level inverse relationship. Berry admits: "much of the negative relationship observed in [the Agricultural Census and FAFBS data] is due to large farms being found predominantly in low productivity zones, where the low productivity is mainly the result of lack of water" [*58*]. And again: "much of this inverse relationship must be attributed to a poorer soil-water combination on the larger farms" [*80*]. Large farms have poorer fodder land, while small farmers have access to common grazing land [*232, note 40*].

The census data further shows that the physical yields of sugarcane and wheat are higher on the large farms, and thus the composition of output was a highly significant factor, with those farms above 50 acres specializing in low value products [*86*]. Such differences in crop composition by size results from aggregation over regions with different crop patterns. Regional dummies will compensate for this bias only to some extent - the macro-level inverse relationship will still be present at this aggregate level. With such aggregative data, the authors' explanations based on imperfect factor markets cannot be tested.

While the 1960 census data also shows an inverse relationship between size and fertiliser application (both organic manure and chemical), there has been a massive increase in its use over the decade and especially by the large farms. This would appear to be a significant factor in the breakdown of the inverse relationship as revealed by the 1972 census (see Table 40, Appendix A). However, Berry claims this may be only a temporary phenomenon. He cites Azam [*1973*] who states that water and credit are the major constraints to small farm adoption of new technology, but not enough to have reversed the inverse relationship [*95-6*].[19]

However a later study by Khan [*1975*], based on a 1972-3 survey of five districts in Punjab and four in Sind confirms the weakening of the inverse relationship, and indicates a growing gap between large and small farms in the use of modern inputs. In most regions characterised as Green Revolution areas, Khan finds a positive relation between the value of output of 5 major crops (wheat, rice, maize, cotton, and sugarcane constituting 79% of the sown area in Punjab and 77% in Sind) per cropped acre and size.[20] Of the 9 regions, 6 are characterised as being progressive, and there, large farm (above 50 acres) yields are 18% higher than those of the small farms (below 12.5acres) (see Table 41, Appendix A).

A comparison of the agricultural censuses of 1960 and 1972 shows increasing cropping intensity on all sizes, but with the greatest increase on the large farms over 150 acres, where land use intensity more than doubled (see Table 42, Appendix A). The censuses also show increased renting in of land by the large farms (their share of this category of land increased from 22.5% to 33.6% while the overall share of rented land showed a moderate decline) [*105*]. Khan also finds higher application per cropped area of fertiliser on the large farms and a significant large farm lead in the adoption of new varieties [*101*]. This process appears to be similar to that found in the Indian context, with an irreversible breakdown of the inverse relationship in Green Revolution areas.

Malaysia

The fifth case study is based on a survey of 762 double-cropping rice farms in the Muda River area of Malaysia in 1972-3. The authors use aggregate grouped data, but the area is characterised as a rice mono-cropping region, with well-functioning markets [*116*]. The evidence seems to present a strong inverse relationship in terms of value added per relong,[21] value added per unit land value, and value of farm output per relong. Value added falls by two-thirds between the large farms over 10.5 relong and the small farms below 1.5 relong. The inverse relation is still present but weaker if the smallest size-class is excluded, with small farms below 5 relong having average land productivity 32% higher than large farms over 5 relong (see Table 43, Appendix A).

Small farm (1.5-3.5 relong) total factor productivity is 50% higher than on the large farms (above 10.5 relong), but this is based on imputed labour costs for family labour and estimated average rates of return on land and capital [*121*]. Berry and Cline find labour productivity (based on an index of labour shadow prices) approximately constant across farm size, but this conflicts with their finding that labour input per acre declines with farm size. Barnum and Squire find labour productivity some 10% higher on farms above 5 relong [*234, notes 65 and 66*].[22]

Barnum and Squire [*1976*], working on the same survey area, but with a smaller sample of 386 farms find only a statistically insignificant difference in rice output per relong between small farms (less than 5 relong) and large farms (above 5 relong). This conflicting result possibly arises from the inclusion in the Berry and Cline data of non-padi crops, their use of farm area at the beginning of the agricultural year and not the average over the year (this produces overestimation of small farm land productivity by 8.5%). Barnum and Squire also exclude some farms with acid soils [*233-4, note 64*].

Berry and Cline make almost casual reference to the fact that yields vary little beyond the 1.5 relong size class [*121*]. They also note that when farms are classed by economic scale in terms of value of land rather than by size, the inverse relationship is much weaker (with large farms only 10% below average land productivity) and when farm output per relong is regressed on the value of land plus capital, there is no clear inverse relationship evidenced [*123-4*].[23] While fertiliser and pesticide use per relong are constant across farm size classes, machinery running costs are 65% higher on the large farms [*121*], indicating significant differences in the organisation of farm production between different size classes.

India

The major case study in Berry and Cline is given some prominence in an appendix of its own [*141-193, Appendix A*]. This is a study of farm size, productivity, and technical change in Indian agriculture by Surjit S. Bhalla using data from a National Council of Applied Economic Research (NCAER) panel survey for three years: 1968-9, 1969-70, and 1970-1. The sample includes 4,118 farms from all over India of which 1,772 are used by Bhalla. Bhalla's principal aim is to show that the inverse relationship is still strongly evidenced in India despite the Green Revolution. He refers to the expectations that the Green Revolution will have weakened somewhat the "traditional 'advantage'" of the small farmer because of better education, easier access to inputs and less risk aversion on the part of the large farmer [*236, note 1*]. This barely skims the surface of the large farm advantage in relation to modern inputs.

The main results and conclusions presented by Bhalla can be presented in summary form [*111-116*]:

1) the inverse relationship between farm size and output per acre is confirmed empirically with a highly significant negative coefficient on the log of farm size (see Table 44, equation (i), Appendix A).

2) the inverse relationship holds even when land quality (proxied by average village land prices) and the irrigation factor are

accounted for (see Table 44, equations (iii) and (iv), Appendix A).

3) Bhalla confirms the inverse relationship at the aggregate level for individual crops, but note that the regressions assume no relation between farm size and crop mix - further, maize, jowar and sugarcane crop coefficients are not statistically significant (see Table 45, Appendix A).

4) total social factor productivity (computed by using shadow wage rates) declines with farm size (see Table 46, Appendix A).

5) for the range of large farms above 30 acres, the inverse relationship is not statistically significant "suggesting that in India the dominant influence on the overall size-productivity relationship is labour-market dualism" [*114*].

6) land rental prices and interest rates on borrowed capital are higher for the small farms which leads to differing factor intensity patterns.[24]

7) labour input intensity declines and capital/labour ratios increase with farm size. Cropping intensity declines with size (see Table 47, Appendix A).

8) the inverse relationship persists in the third year although somewhat attenuated (compare equations (i) and (ii) in Table 44, Appendix A). In other words, the Green Revolution has weakened

the size/productivity pattern, but not reversed it. The data show that the proportion of cultivated area under HYVs is relatively constant across farm size which would apparently indicate that the small farms are not lagging in the adoption of new technology (see Table 48, Appendix A).

Bhalla makes the astonishing claim that "A unique feature of this study is that it analyzes data for all of India" [*142*]. Bhalla proudly announces that the regression exercises include "farms from all of India, with differing quality of land and growing different crops" [*146*]. He complains that previous studies are too disaggregated at the village or district level and too many have been carried out in Green Revolution areas. The "dispersion in time, space, and methodology of these studies makes them unreliable for extrapolation to conditions prevailing in agriculture in general...Thus, since local factors can be expected to average out, the general pattern can be observed by analysis of the NCAER data" [*141-2*]. Bhalla does not seem to realise that this is precisely the problem with highly aggregated data. It is precisely the problems associated with aggregation and averaging at the general level that need to be avoided. The tables present highly grouped data: only four size-classes (0-5, 5-15, 15-25, and above 25 acres), with small farms defined as those below 15 acres [*143*]. These are very wide size classes indeed, but nothing is said about category content or in-group variance.

Besides this major defect of the Bhalla study, there are a number of other deficiencies in the way the data has been handled. All farm households that invested in land in any of the three years were excluded in the final analysis. This presents the danger of excluding those progressive farmers accumulating land for expanding production. Further, farms with a gross cultivated area of less than 0.05 acre were omitted. This cut-off point is significantly above the NCAER definition of 0.01 acre for a small plot. The inclusion of these farms might have reduced small farm average productivity, especially in Green Revolution areas. Any farm which had land leased out in the third year was omitted. Again, these may have been largely composed of low productivity small farms. Finally, an upper bound of Rs 3,000 was placed on income per acre (which may exclude some rich capitalist farms with high yields) and a lower bound of zero Rupees eliminated dissavers from the analysis (as Sen has shown, the marginal and poor peasant households with very low yields). All these measures cut the sample from 4,118 to 1,772 [*188-9, Annex A.1*].

Bhalla posits that differential yields per acre between farm size classes are due to either a) differing technical/economic efficiency, or b) different factor prices facing small farmers and large farmers. Since both small farmers and large farmers are asserted to be equally rational, Bhalla reasons that (b) must be the main explanatory factor behind the inverse relationship [*156*]. Note however, that Bhalla (and others) assume homogeneous production functions, but if non-homothetic functions are used, differences in factor ratios will result even with perfect factor markets.

Bhalla continues: land markets will be rendered imperfect by 1) institutional factors such as tenancy regulations, 2) credit financed land purchase, and 3) lower transaction costs for large plots of land [*157*]. The observed relation between rental/acre and farm size, it is claimed, provides partial support for the contention that large farmers face lower land prices, but note that rental price may reflect tenancy arrangements - this effect needs to be removed before testing. However, the NCAER data does not provide tenancy information. Nevertheless, this does not stop Bhalla from trying [*175*]: tests of tenancy effects on productivity show no relation, supposedly reinforcing Cheung's conclusions concerning share tenancy, but note that Bhalla has defined tenancy in terms of area leased in, thus creating conceptual confusion between the different motivation and results on large and small farms.

Although the finding that labour input intensity declines with increasing farm size appears fairly robust, it does not constitute firm evidence for the thesis that the inverse relationship is caused by differential factor prices, in particular, labour market dualism. Bhalla's own data shows that 52% of small farm income is derived from off-farm employment, and some 83% of small farms use some hired labour [*165, table A9*]. The various *a priori* arguments associated with the labour market dualism thesis are however untestable, as the NCAER data that

Bhalla is using provides neither information on the ratio of hired to family labour inputs nor disaggregated data on wage rates. Again, this deficiency does not prevent the author from proceeding to test this thesis. However, the way in which Bhalla has manufactured the data on farm labour input, detailed in Annex A2 [*189-93*], would tend to cast doubt on the validity of Bhalla's interpretation of the results obtained from the production function analysis.

Total farm labour input L* is computed as the sum of hired labour L1 and family labour L2. L1 is computed as H/w where H is total paid out wage costs and w is an average wage estimate. Bhalla uses average district-level wage data (and sometimes even average state-level wage data).[25] Note here that if wage rates in sparsely populated areas are higher than in densely populated areas, and the former areas have larger average farm size, then this will introduce a downward bias into large farm hired labour estimates.

L2 is defined as the sum of farm earner labour input M1 and family worker labour input M2. M1 is computed as (M-e/w)E where M is full employment (300 days), e is off-farm earnings, w is the wage rate, and E is the number of earners. Now, imputation of a constant number of work days for all farms (300) overestimates small farm on-farm employment, so Bhalla uses Punjabi data[26] to correct for this: M1 = (288.3 + 0.596 (farm size) - e/w)E, as total employment is held to increase with farm size. Note that this procedure will underestimate on-farm labour input by members who earn higher than average wages, and if there is a relation between large farms and higher off-farm wages then this adds a further downward bias to large farm labour input intensity. Further, it is questionable to assume that the Punjabi figures are representative of other parts of India. The Punjab is a major Green Revolution area with possibly much higher levels of on-farm employment (due to HYV cultivation) thus biasing upwards the small farm employment level to 288 days for all India.

M2 is computed as (FW x cultivated area x 10 days per acre) where FW is the number of family workers. The 10 days per acre is derived from the full employment level of 300 days divided by the average size of large farm (30.6 acres), assuming that family workers work at the same rate regardless of farm size. Although Bhalla claims that: "This construction of M2 automatically imputes less total work to family workers on small farms than on large farms" [*193*], it may nevertheless overestimate small farm levels of family worker employment by assuming that full employment levels of labour input intensity on the large farms are applicable to small farms. There may be some indication of this in Bhalla's omission of 63 small farms from the analysis whose L2 estimate came to an average of 555 days. The fact that Bhalla's average L* of 82 days per acre falls well within the range of other estimates in the literature [*170*] is irrelevant, as one is not interested so much in the average level of labour intensity, but in its trend over farm size. Given the synthetic nature of the labour input data, the results of the production function analysis have to be treated very tentatively.

Clearly, the NCAER data is a very weak basis for proving that higher labour input intensity on the small farms as compared to the large farms is the main explanatory factor behind the inverse relationship. Even though labour input intensity may be a crucial factor behind the inverse relationship at the micro level, such a relationship between labour intensity and size at the aggregative macro level may hold for spurious reasons. It certainly does not establish the validity of the Bhalla thesis that the inverse relationship is caused by factor price differentials, and in particular, labour market dualism.

Bhalla presents evidence to show that interest rates on borrowed capital decline with farm size (see Table 49a and b, Appendix A). While the commercial banks did lend to the non-HYV sector, mostly to the large farms, institutional lending sources are biased toward HYV growers. Small farmers pay higher interest rates than the large farmers, and HYV cultivation "improves access to credit and diminishes the cost of credit", and there is less variation in the cost of credit for HYV growers [*161*].

The "imperfect market" framework however, is hardly adequate for explaining the deep structural problems associated with rural credit markets in developing countries [*see Bhaduri, 1973*]. Nevertheless, the observation that large and small farmers face different costs of borrowing capital is not an imperfect market phenomenon which can be used to explain the existence of an inverse relationship between farm size and land productivity. Rather, as we have seen in chapter four above, it is one of the important factors behind the breakdown of the inverse relationship. Relatively cheaper capital directed to those progressive farms who are adopting the new technology, both biochemical and mechanical, permits increased cropping intensity and land productivity on the large farms.

Bhalla concludes: "The data used were for the 1970-71 agricultural year - a year some six years after the introduction of the high-yielding varieties. The Green revolution has, therefore, not qualitatively affected the inverse relationship" [*172*]. However the validity of this conclusion is clearly suspect at this aggregate all-India level. Bhalla finds that the inverse relationship still holds for the Green Revolution states for Tamil Nadu rice and Punjab/Haryana wheat on the basis of the NCAER aggregate data [*176*]. Of course, the more carefully disaggregated and detailed studies by Chadha [*1978*] and Roy [*1981*] have superseded Bhalla's findings, but even the latter reveals a significant weakening of the inverse relationship over time with the coefficient on the area variable declining by some 34% over the three years 1968-71 (see Table 50, Appendix A). Indeed, Bhalla's data shows that while small farm earnings increased by only 9% over the period, large farm earnings increased by 42%, significantly reducing the gap in productivity. This is clearly related to the finding that large farms increased their area under HYV cultivation by 63%, significantly more than the increase of 13% on the small farms (see Table 48, Appendix A).

Summary and conclusions

The authors provide some further tentative evidence from a number of other case studies [*194-203, Appendix B*], but these are subject to many of the criticisms noted above, in particular, their highly aggregated nature.[27] The aggregate nature of most of the empirical evidence leads to an inevitable confusion between the macro and micro level inverse relationships which are of entirely different import. This applies particularly to the cross-country data, but also to most of the individual country case studies. Certainly, such data is an inadequate basis for testing the hypotheses concerning market imperfections.

The theoretical framework chosen by the authors, that of differential factor prices and imperfect markets, is both logically flawed and not supported by the evidence. Further, where it does have some validity, however inadequate, it actually undermines its own purpose. The so-called market imperfections adduced, would seem more appropriate to explaining why the inverse relationship might be expected to disappear in the long-run rather than explaining the existence of an inverse relationship. Indeed, some of the more careful analysis, such as that for Pakistan, does indicate some of these problems quite clearly, and also points to the breakdown of the inverse relationship in the dynamic context.

The authors' policy conclusion of an equalising distribution of land towards the small farm sector, is both crude and simplistic, and requires a number of unrealistic assumptions to hold. They are further rendered baseless by inadequate theoretical and empirical support. The authors would have benefited from greater familiarity with the Indian debate.

We now turn to the central part of the thesis: that relating to contemporary Egypt. This will allow us to examine the issues already addressed in a situation which, so far, has received scant attention.

Notes to Chapter VI

1. See Berry [*1973*] and Cline [*1970*].

2. All subsequent page references in this chapter refer to Berry & Cline [*1979*], unless otherwise indicated.

3. In determining the number of family parcels it is assumed that each family has 2.5 workers [*1979: 130*]. Land available is defined as total farm area in the 1960 FAO World Census of Agriculture.

4. Berry and Cline emphasise the importance of the empirical support for their hypotheses. Given the centrality of the data to their arguments, therefore, we reproduce a substantial part of the data sets presented by the authors, in order to show clearly the principal weaknesses of both their argumentation and its alleged empirical support.

5. See Dharm Narain [*1961*] in the context of the effects of rising farmgate prices on peasant supply response, where peasants market a "distress surplus", rather than a true commercial surplus. Poor peasants market a relatively high proportion of their output in order to pay off various cash obligations (debt, rent, taxes). This leaves them with insufficient foodgrain for the rest of the agricultural cycle, and they are thus forced into market purchases later.

6. See Cline [*1973*] and Bhalla [*1975*] using NCAER data.

7. See Sund [*1965*].

8. See Roy [*1979: 21*]: at the final harvesting stage, the constraint on labour-hiring is NOT the MPL = w criterion, but whether these fixed costs can be covered. This means that not only will labour continue to be hired when the MPL is less than the wage rate, but also even when the wage rate is greater than the APL. The only limit to labour-hiring occurs when the gross revenue from a day's harvest is less than the cost of a day's harvesting.

9. See Roy [*1979: 22*]. The physical yield of a crop is already determined (plants per acre times yield per plant), and therefore the number of labour-hours required to harvest the crop is also predetermined (for any given technology). Whereas with Sen, higher labour input causes higher yield, there is in fact a reversal of causation: higher yields produce a greater demand for labour.

10. The authors qualify this by stating that the data measure omits multicropping (important in Asia) and extensive grazing (important in Latin America) and so the decline will be much less than indicated.

11. Cline's data comprises a 1962-3 sample survey for seven Brazilian states conducted by the Getulio Vargas Foundation, and a second survey by GVF on sugar farms. There is also a 1973 survey by the IBRD and SUDENE (Superintendencia para o Desenvolvimento do Nordeste) of 8,000 farms in north-east Brazil.

12. Berry and Cline claim all 6 are significant [*1979: 50*].

13. The effective hectares used in the calculations are defined as hectares divided by the ratio of land price on farms in-group relative to overall average land price (i.e. highly aggregated and grouped data).

14. A study carried out by the Instituto Nacional de Colonizacion y Reforma Agraria (INCORA) of 3,000 farms, analyzed by USAID 1969.

15. As might be expected, the physical yields of individual crops either show no relation across farm size or insignificant differences [*73, table 4-20*]. Sugarcane and corn yields are higher on the large farms. Small farm rice yields (less than 0.2 ha) are not robust due to large rounding errors [*230, note 18*].

16. Citing Estanislao [*1965: 120*] in turn citing Horst et al. [*1957*].

17. Berry analyzes the 1959-60 Census of Agriculture in *'Some evidence on the economic potential of small farms in Pakistan'*, mimeo, 1976.

18. Source: Punjab Farm Accounts and Family Budget Surveys (FAFBS) 1966-67 and 1968-69.

19. According to Berry and Cline, the inverse relationship will be re-established once small farmers adopt the new technology, when technological improvement slows down, and as inputs become more evenly distributed. However, they admit that the indivisibilities associated with tubewells and mechanized cultivation may prevent this. Tractors make marginal and previously uncultivated land cultivable and machines allow a move away from labour intensive techniques of production [*105*].

20. Note however that Khan uses gross cropped area in his computations, and thus introduces a bias against finding an inverse relationship.

21. one relong = 0.7 acre.

22. The authors are somewhat confused on the topic of labour input intensity. They write: "the ratio of labour inputs/area in padi does not vary dramatically by size, being only 20 to 25 percent lower in the largest-farm category than in the smallest-farm categories" [*121*].

23. Land value increases with size, while there appears to be an inverse relationship between capital and size in the range up to 20 relong [*117-8, table 4-48*].

24. Regressing rental per acre (R) on farm area (A), price of unirrigated land (P), and percentage of area irrigated (I), Bhalla finds the following results:

$$\underset{(5.2)}{R = 203} - \underset{(1.9)}{4.9\,A} + \underset{(1.98)}{0.027\,P} + \underset{(0.76)}{0.46\,I}$$

$$R^2=0.19$$

(source: Bhalla in *Berry and Cline, 1979: 113, table 4-45, equation (i)*).

The cost of borrowed capital across farm size shows the following trend:

farm size	rate
< 5 acres	17.3
5-15	13.8
15-25	12.2
> 25	11.8

(source: Bhalla in *Berry and Cline, 1979: 115, table 4-46*). See also Table 49 in Appendix A.

25. From unpublished data for 1969-70 (Mark Rosenstein at Yale). Note that the Bhalla study is for 1970-71 so he uses the growth rate for wages in Jose [1974].

26. D.P. Chaudhri, *Factors affecting productivity on different size class of farm holdings in India*, unpublished manuscript, 1974.

27. B1: Taiwanese evidence shows a strong inverse relationship with small farm productivity below 0.5 ha., twice that of the large farms above 2 ha [Source: Joint Commission on Rural Reconstruction in China, Taiwan Agricultural Statistics, 1901-1965, Economic Digest Series no. 8, Taipei, Taiwan, 1966 pp. 219-29]. However, this is based on highly aggregated and grouped data using farm income per hectare, where farm income equals farm receipts minus farm expenses. It is not clear whether family labour costs have been imputed.

B2: Bachman and Christensen [1967: 247] report data from the Japan Farm Household Survey in 1960 showing that while individual crop yields are somewhat higher on the larger farms, the multiple-cropping ratio is larger for small farms, indicating that cropped land is used more intensively on the smaller units. Total receipts per unit of cultivated area are slightly less on farms with more than 2 cho (about 5 acres) than on smaller farms. Small farms use much more labour per acre than do larger farms. However, there is some evidence that with economic development and the greater use of capital the larger farms are becoming more intensive. Ogura [*1973*] shows that while rice yields are higher on the larger farms, the reverse was true during the 1930s, apparently reflecting the influence on yields of fertilisers, pesticides, and other purchased inputs that are used in somewhat larger amounts on the larger farms. Kaneda [*1967*] notes that by the 1950s, value added per tan (1 tan = 0.1 ha or 0.245 acre) does not vary across farm size.

B3: Mexican data provides evidence for a strong inverse relationship [Eckstein et al., 1978: 9, Appendix C], but this is based on very broad size categories (undefined by Berry and Cline) at the aggregate level. Note too that comparison of 1960 with 1940 data shows a considerable weakening of the relationship, as well as important differences in output composition between large farms, small farms and ejidos. Output per peso of capital plus land was higher on the large farms in 1960 due to the shift from livestock to crops and strong government support with credit and infrastructural investment.

B4: Kenyan large farms in Trans-Nzoia District 1970-1 have a lower share of area under crops and lower output and employment per acre [*source: Ministry of Finance and Planning, Statistics Division, An Economic Survey of African-owned farms in Trans-Nzoia 1970-1, Farm Economic Survey Report no.28, 1972*]. Note however that this is compared to farms less than 250 acres, which implies rather large size classes. There are also some exceptions between 1,000 and 1,250 acres. The Report notes that a number of large farmers lack adequate capital, thus suggesting the existence of an identification problem in the data.

B5: The Kenyan settlement schemes 1967-8 show gross output (shillings) per acre falling from 635 on farms below 10 acres to

111 on farms above 70 acres [source: *Ministry of Finance and Planning Statistics Division, An Economic Appraisal of the Settlement Schemes 1964/5-1967/8, Farm Economic Survey Report no.27, 1971*].

B6: Malawi data shows increasing gross and net output per acre in densely-populated Malawi [*source: National Statistical Office, Malawi Government, National Sample Survey of Agriculture, 1968-9, Zomba province, 1970, p.42*]. Berry and Cline resort to deducting home consumption from output to get value added estimates (the consumption rates are arbitrary with large farm rates being three times small farm rates), and then conclude that "total output per acre is a decreasing function of size of holding" [*202*].

Other countries which show an inverse relationship include: Argentina, Chile, and Guatemala [*source: Comite Interamericano de Desarrollo Agricola, Monografias Sobre Algunos Aspectos de la Tenencia de la Tierra y el Desarrollo Rural en America Latina, Organizacion de los Estados Americanos, Washington, 1970, p.34*]; pre-revolutionary China [*source: John Lossing Buck, Land Utilization in China (New York: Paragon Book Reprint Corp 1968) and Buck, Chinese Farm Economics (Chicago: University of Chicago Press 1930)*]. Note that in fact, Buck dismisses the presence of an inverse relationship in Chinese agriculture as a statistical artefact; and Korea [*source: Bank of Korea, Research Department, Economic Statistics Year Book, 1960, p.278*] all at the aggregate level.

CHAPTER VII

The evidence for an inverse relationship between farm size and productivity in Egypt: a shadow debate

Introduction

In this chapter, we examine the nature and range of evidence for an inverse relationship between farm size and productivity in the Egyptian countryside. In contrast with the extensive Indian literature on the inverse relationship is the rather meagre resonance that the debate has had in Egypt: only half a dozen serious references have surfaced so far (besides a few *en passant* assertions). This relative paucity, however, has not prevented calls by several writers for redistributive land reform in the Egyptian countryside. The Egyptian evidence ranges from simple assertion, by invoking the authority of Berry and Cline [*1979*], to full-scale field studies. One of these latter we shall subject to detailed scrutiny in Chapter IX.

The studies examined in this chapter present apparently strong, but contradictory evidence on the relationship between farm size and productivity, with some contributors supporting the existence of an inverse relationship while others vehemently deny its existence. However, all the writers below reveal crucial conceptual and methodological flaws in their analyses. It is important to consider these in some detail since they are flaws which recur wherever the inverse relationship has been examined and discussed. We draw heavily on the critical analysis of the debate surrounding the inverse relationship which we have discussed thoroughly in the previous six chapters.

Section 7.1 introduces the main participants in the Egyptian debate on the inverse relationship who suggest that such a relationship exists, and that its existence constitutes a strong case for redistributive land reform in Egypt. All these authors operate at a very high level of aggregation.

In section 7.2, that aggregation problem is addressed in a study by Crouch et al. [*1983*]. They provide rather more inconclusive evidence on the inverse relationship, but while they clearly point out the existence of a macro-level inverse relationship, and its origins in regional land heterogeneity, they fail to proceed beyond that and recognise the distinction that needs to be made between the aggregate level of analysis, and the subject of this thesis, the micro-level inverse relationship.

Finally, in section 7.3, we examine the data and methodology of those researchers who deny the existence of any inverse relationship in the Egyptian context. The writers who fall into this category tend to commit an extrapolative bias, in contradistinction to the writers in the first two sections who suffer from an aggregation bias.

7.1 Some evidence for an inverse relationship in Egypt: Shepley, Radwan, Wilson and Mabro

The assertions include Richards [*1982: 177*] who, referring to the work of Berry and Cline,[1] mentions "the very large amount of evidence which shows that small farms are more intensively cultivated and have higher yields per unit area than large farms in the Third World."

Adams [*1986: 81*] likewise refers to Berry and Cline: "Experience in [developing] countries demonstrates that not only are small farmers capable of adopting new technological inputs, but that land productivity, labour productivity, and output per hectare are all higher on small farms than on large."[2] He agrees with Griffin that small land reform peasants use intensive family labour inputs to produce more output per unit of land [*1986: 118*], and concludes: "Thus, if the goal is to raise land and labour productivity in peasant agriculture, it would seem necessary for the state to concentrate on the needs and requirements of small farm agriculture."

Paradoxically, while Adams appears to agree with the theoretical and empirical evidence that land redistribution may result in reduced marketed surplus as peasants consume more of their output on-farm [*1986: 126*-7], he does not see that the inverse relationship would be similarly affected. If the compulsions which give rise to poor peasants marketing a high proportion of their output are relaxed, on-farm family consumption is likely to increase. Similarly, one would expect to see a relaxation in the intensity of labour effort.

More substantial references include Shepley et al. [*1985*] whose production function analysis of 252 farms in four governorates[3] reveals that "tillers of smaller plots are economically more efficient [in terms of higher returns] than their counterparts on larger farms" [*1985: 29*] in rice, cotton [*1985: 79*], and maize [*1985: 91*] production. Small farms are defined as those below three feddans, and large farms as those above three feddans - rather large size classes. Their explanation for this finding is that: "Small farmers are able to coax out high productivities from their land resources because of the concentration of other production inputs on small plots" [*1985: 79*]. As we have seen with regard to the Indian evidence [*Bharadwaj, 1974a*], if this is true, it probably reflects the indivisibilities associated with animal power or equipment on small farms rather than superior efficiency.

Note too that Shepley et al. are looking at single crop figures (both physical yields and values) for which no inverse relationship might be expected. They show small farm rice yields some 11% higher than large farm yields, with small farms using more labour and machinery per feddan (see Table 51, Appendix A). This is expected, according to the authors as small farmers have a lower risk tolerance than large farmers, and therefore must "operate more efficiently than larger producers who are able to spread their risks over a broader resource base" [*1985: 29*]. They also make the interesting observation that the large farmers are operating under a capital constraint, with insufficient machinery and working capital. Furthermore, these large farmers appear to be absentee landlords. The authors, however, do not pursue these interesting points any further. For Shepley et al., the small farm productivity advantage warrants "an increase in credit facilities and input supply by some 99%" [*1985: 31*].

The wheat producers in the survey, however, show higher yields per feddan on the large farms, by some 10% (see Table 52, Appendix A). This is explained by large farm access to parallel markets for fertiliser. Small farms with a mean area of 0.5 feddan under cotton show a high intensity of cultivation, with higher yields and labour input (see Table 53, Appendix A). Thus, "small farm resource-use efficiency would warrant larger plots" [*1985: 83*]. Interestingly, data presented by the authors [*1985: 73*] shows significantly higher labour input intensity on the farms in the above three feddan classes.

A major reference that forms the basis for the next chapter, is that of Samir Radwan in his 1986 book *Agrarian Change in Egypt*.[4] At the end of a section on production conditions, he writes: "we note that the relationship of farm productivity to farm size follows the inverse relationship that has been frequently observed" [*1986: 78*].

He produces regression equations (i) to (iii), reproduced in Table 68, Appendix A, which show for the aggregate level, that net farm output and cropping intensity are negatively related to farm size, as is the input of family labour per unit of land [*1986: 79*].[5] The inverse relationship holds with a negative regression coefficient significant at the 1% level and where y is net farm output per qirat[6] and x is size of holding.

Radwan goes on to state: "Thus, in rural Egypt, as is often the case elsewhere in Third World agriculture, resources are used more intensively on small family farms. Therefore, the scope exists, in the sphere of farm production, to raise total output and reduce income inequality through further land redistribution" [*1986: 79*]. We will examine Radwan's data, methodology and conclusions below in greater detail in Chapter IX. Let us note here however that Radwan employs net farm output (defined as total value of farm output minus input costs, excluding labour costs) in his yield calculations. This methodology introduces a number of distortions and a bias in favour of finding an inverse relationship. Large farms use substantially higher levels of both purchased and own-supplied inputs (seeds, fertilizers, fodder etc.). We need therefore to use the total value of crop output in the yield calculations.[7]

The next reference is that of Rodney Wilson in a 1972 study for the Egyptian National Institute of Planning:[8] "As it is the smallest holdings which are usually the most intensively cultivated, it seems not unreasonable to believe on *a priori* grounds that labour requirements per hectare are highest on these smaller holdings also. The absence of data relating agricultural production to farm size in Egypt is an obstacle here. Nevertheless thee are strong reasons for believing that the tendency for output per hectare to increase, with decreasing holding size, which is observed in other developing countries with similar factor endowments, is also found in Egypt" [*1972: 2*].

His table 4 (column U') [*1972: 8*] shows an inverse relationship between labour utilization per hectare and holding size with man-hours per year declining from 14,348 on farms with less than 0.8 hectares to 2,658 on farms over 4 hectares.[9] Wilson's table 5 [*1972: 9*], reproduced in Table 54, Appendix A, also shows that the tendency for labour utilization per hectare of cultivated area to decline as holding size increases occurs in Egypt irrespective of the cropping system: "At least 3 times more labour is utilized per hectare on small holdings under 0.8 hectares, compared with he larger farms surveyed of over 4.0 hectares in size."

A possible explanation for this inverse relationship is that: "Egyptian land-holders do not aim at maximising their farm incomes per hectare, but are satisfied with incomes which cover their families' subsistence, plus some modest household items. In order to attain this target however, those owning very small farms must utilize their land very intensively, which implies high labour inputs per hectare. Those with larger farms in contrast can easily achieve higher income levels, even if they utilize their land much less intensively. Thus income per hectare on the farms below 0.8 hectares surveyed was almost three times that found on farms averaging over 4.0 hectares. On the larger farms, in consequence, the family labour participation may be lower, and few labourers engaged at peak seasons relative to the size of these farms. The general lack of price incentives in Egyptian agriculture probably discourages the larger farmers from acting in a more ambitious manner" [*1972: 14*]. Wilson continues: "Absentee ownership of the larger farms may provide an additional explanation of this lower land utilization, and consequent smaller labour absorption relative to farm size....Land acquired for these motives [prestige, inheritance provision], or for speculative purposes, is seldom developed adequately" [*1972: 14*].

Furthermore, Wilson points out in his table 7 [*1972: 16*] that labour utilization per hectare is higher on leased or shared farms than on those which are more than two-thirds owned.[10] He writes: "leased holdings are farmed more intensively than owner occupied farms. Lessees need to cultivate their land intensively in order to pay their rents....Landowners, in contrast, may be less aware of the opportunity costs involved in not fully utilizing their land" [*1972: 3*].

Wilson adduces the following implications for agrarian policy in Egypt: "The confirmation of the first hypothesis that labour absorption per hectare decreases as farms become larger has important consequences for land tenure policy. It provides an economic justification for Egypt's land reform legislation, which has placed successively lower ceilings on land ownership. A strong case can be argued for tightening the enforcement of the existing legislation, and perhaps applying the 20 hectare ceiling to total family landholding, rather than individual ownership as at present. Pursuance of such a policy would, in the author's view, lead to a more intensive land utilization, and hence increase rural employment opportunities" [*1972: 18*].

Elsewhere he writes: "The situation [inegalitarian distribution of ownership] could undoubtedly be improved if the 1969 land reform proposals for lowering the ceiling on individual landownership to 20 hectares were implemented. To date many landowners have avoided having their land expropriated. One means of evasion was by registering land in the names of different members of their usually large families, while still retaining control themselves in practice" [*1972: 6*]. Thus: "It would therefore appear that land reform [is] socially necessary in the interests of production intensification and employment creation" [*1972: 19*].

This echoes an earlier reference by Robert Mabro in which he refers to inverse relations between labour intensity and farm size and land productivity and farm size in a study of rural employment problems in Egypt.[11] Mabro writes: "We have shown that total labour inputs per acre (and ceteris paribus yields) are a function of 'n', the land-to-man ratio. If this ratio increases as the size of holdings decreases, an inverse relationship between labour intensity and size would obtain. Such a relationship is well established empirically and has been discussed at length in the literature" [*1971: 412*].

Mabro's explanation for this inverse relationship in Egypt follows the Sen thesis. He writes [*1971: 404*]: "It may be convenient to distinguish two types of farms according to the mode of operation, 'capitalist' (sometimes referred to as 'large') farms which rely on hired workers and 'family' (or 'small') farms mainly operated by the members of the household." The 'capitalist' or wage-labour farms tend to operate according to the postulate of profit-maximization. In the family sector individuals aim at maximizing their utility when they trade leisure for income (say corn) through their work [*1971: 405*].[12]

He continues [*1971: 408-9*]: "The less well-endowed worker applies more labour inputs per acre than his more fortunate neighbour. Other things being equal, yields will vary inversely with 'n'... If average incomes are low, peasants may have to apply labour inputs up to the point where the marginal product is not significantly different from zero in order to secure his subsistence."[13]

While noting that his analysis is limited by its exclusion of capital from consideration and that this factor might turn out to be important, especially on the very large farms [*1971: 414-5*], he concludes that: "Changes in the structure of land holdings and land ownership may result in a better use of resources. For incomes, yields, and employment are a function of the size of farms. On large estates...yields are usually low...On very small farms yields sometimes are significantly higher but the peasant's average income is low and family labour underemployed...The likely effects of a successful land reform are increased yields (and therefore total production), higher rural incomes, and a fuller utilization of family labour" [*1971: 415-16*].

7.2 Aggregation and land heterogeneity: Crouch et al.

One major problem with the above writers is that they operate at an excessively high level of aggregation which obscures a great deal. Regressing yields on farm size across all rural Egypt eliminates any possibility of regional diversity. Such an exercise not only assumes a homogeneous agriculture throughout rural Egypt, but also confuses two levels of analysis. An important distinction must be made between the 'macro' level size-productivity relationship based on heterogeneous land quality and the 'micro' level relationship [*see discussion in Chapters II and III*].

Taking rural Egypt as a whole, land is regionally heterogeneous. In some areas, higher soil fertility or land productivity permits a greater population carrying capacity and hence greater population settlement density. This gives rise to a tendency for smaller farm size in those areas, in a situation of limited land. So, at the aggregate level, we have an inverse relation between soil fertility (and hence farm productivity) and farm size, with the direction of causality running from the former to the latter. At the 'micro' level, which may be at the governorate or even village level, it is postulated that the direction of causality is reversed. Farm productivity is seen as being in some way dependent on farm size [*see discussion in Chapter II*]. It is this causal relation that is at the heart of the debate over the inverse relationship.

This problem is recognised, but misunderstood in Crouch et al. [*1983*]. Using data from the 1976 Egyptian FMS (187 farms from 11 villages in the eastern Delta region which covers three governorates: Sharqiya, Daqhaliya and Dumyat), the latter present tables of yields of individual crops in kg per feddan and of per feddan income net of per feddan cash costs for individual crops by farm size which shows "no clear evidence of any relation between farm size and yield" [*1983: 20-1*] (see Tables 55 and 56, Appendix A).

However, they also perform linear regressions of 1) physical yield per feddan on farm size and a dummy variable representing Sharqiya governorate; 2) individual crop values per feddan on farm size and the Sharqiya dummy variable; and 3) gross revenue per feddan on farm size and the Sharqiya dummy (see Table 57, Appendix A). They conclude that crop yields are not constant across farm size (a weak inverse relation is indicated in many cases) and that regionality, even within the supposedly homogenous eastern Delta region affects yields. They note that when all crops are taken together, the factor whose influence on revenue per feddan emerges most strongly is the Sharqiya dummy variable: "The results on the dummy coefficients give strong support to the idea that inter-regional differences in productivity are more important than social class-based differences" [*1983: 22-3*].[14]

In order to bring out these regionality effects more clearly, Crouch et al. carry out regressions of physical yields, values of individual crops and gross revenue per feddan on farm size and five zonal dummies [*1983: 24-6*] (see Table 58, Appendix A): whereas when only the Sharqiya dummy was used, the size coefficient was significant for all crops except the aggregate case, with the inclusion of the zonal dummies, the size coefficient is statistically significant in only two cases (and marginal in a third) while the dummy coefficients are almost all statistically significant.

Crouch et al. conclude [*1983: 26-7*]: "Clearly, regionality is of much more importance than size in explaining yield variations across farms...Many [studies of agrarian structure in different countries] come to the conclusion that large farm size negatively affects yield, but our results naturally lead to questioning these studies." They continue [*1983: 27*]: "The significance of these regional differences in yields suggest that perhaps the weak relation between size and yield has a causal direction opposite to that normally assumed in studies of agrarian structure. Perhaps in areas where yields are lower, lands are of lesser quality; therefore, farms must be bigger in order to support the same level of monetary output. At the same time, land would be cheaper, so larger farms would be possible. Naturally then, one would expect to see a negative association between farm size and yield, which becomes weaker once one controls for regionality." Here Crouch et al. discover the importance of the distinction that needs to be made between the macro and micro level analyses. But they fail to proceed beyond that recognition to examine the relationship between farm size and productivty at the micro level.

A number of other interesting econometric exercises are carried out [*1983: 28-30*] (see Table 59, Appendix A). Yields were regressed on a number of factors: farm size, nitrogen fertilizer per feddan, nitrogen fertilizer per feddan squared, labour per feddan, dummies for sharecropping, cash rent and land reform lands, and the share of hired labour in total labour as an index of capitalist social relations. However, these equations explain less yield variation than the equations with the zonal dummies:

1) the effect of farm size has almost completely dropped out
2) nitrogen fertilizer was only marginally important in the maize and rice equations
3) labour intensity was only important in the aggregate output case
4) cash rentals appeared to be weakly associated with all crop yields (either because farmers are stimulated to attempt higher yields in order to pay cash rents or because cash rents are more

common in higher yield zones for unspecified agro-ecologic reasons)[15]

5) there was a negative relation between yields and the index of capitalist relations (this though they regard as being a statistical artefact generated because capitalist relations are positively associated with farm size which is negatively correlated with yields).[16]

Crouch et al. conclude [*1983: 32*]: "If one accounts for regional differences, the influence of farm size on yields becomes fairly small, though still noticeable in some crops. And when one accounts for the influence of physical... and social...factors, then farm size is swamped. However, this last result is reasonable given that the per feddan intensity of input use on the larger farms is somewhat less than on the smaller ones. In a nutshell, the hypothesis that farm size affects yields negatively cannot be totally rejected, but we have discovered that the relationship is quite weak statistically and perhaps unimportant economically."[17]

7.3 The inverse relationship denied in Egypt: Platt and Commander

Finally, a number of references deny the existence of an inverse relationship in Egyptian agriculture. Platt [*1970: 16*] asserts: "Figures are not available to show differences in efficiency of production between large and small farms, and between the various forms of tenure at operating level, but a production advantage doubtless went with the larger farms because of their owners' better access to fertilizer supplies, improved seeds, etc., and the production credit needed to utilize them."

A more substantive contribution to this side of the debate however is Simon Commander's study of three Delta villages in Egypt in which he concludes: "no consistent trend in terms of productivity was found to exist across farm size class...There was little evidence that any inverse relation between farm size and productivity existed" [*1987: 227*].

He presents a table (see Table 60, Appendix A) showing crop yields per feddan by farm size which exhibit no one uniform trend for crop production, and a series of regressions for physical yields of individual crops, which all show no significant relation between yield and size. While wheat yields tend to indicate an inverse relation, this does not hold for cotton and rice yields. For maize, the smallest and largest farm size yields are comparable with medium farm size yields lower [*1987: 175*]. Regressing physical yield per feddan for individual crops on operated area yielded the expected positive association between operated area and land productivity from the cotton and rice equations, but for the other crops no coherent pattern emerged that was statistically significant. However, when the total value of crop production per feddan was regressed on the operated area (or gross cropped area) in linear form, a coefficient of LE 4.46 per qirat, or LE 107.04 per feddan, was yielded with a constant term of 1,796 and a mean value of LE 2,002 per feddan [*1987: 176-8*].[18]

The reasons adduced by Commander for this apparent lack of any inverse relationship include the thorough implementation of land reform in the 1950s and 1960s, generally high irrigation ratios, the availability of state subsidised fertilisers and cooperative distribution of other agricultural inputs, and the low variance in production conditions. These all generate a relative homogeneity in cropping patterns and low variance of land productivity across farm size [*1987: 175*].

None of the familiar factors associated with the inverse relationship appear to be present. There was apparently little variation in cropping intensity across farm size [*1987: 178*]: "With cropping intensities varying to a very small extent across farm size this latter factor has limited implications for intra-farm size productivity variation. What proved more significant were differences in cropping pattern. Although virtually all farms had sown the standard crops, the rotational combination was an important factor determining the overall value of crop output when measured over the full agricultural year."[19]

He notes that the positive association between output per feddan and farm size in the case of cotton and rice is interesting, if only because both crops are the most labour intensive of the core crops sown in the sample catchment area [*1987: 178*]. There was relatively limited variance in labour inputs committed to crop production across farm size however: "small farms did not, when estimating labour use over a two-season period, have higher labour commitments to arable farming, even though, as expected, the hired component of that labour time was lower than for the larger farms" [*1987: 179*].[20]

Commander concludes [*1987: 180-1*]: "The relative homogeneity of both material inputs[21] and labour in crop production across farm size clearly shows that no inverse relation between productivity and labour use and farm size is observable in Egypt." He adds [*1987: 178-9*]: "With relatively homogeneous production functions, the idea that small farms devote labour time to crop production without regard for conventional marginal product-wage valuation does not hold. In any event, it is clear that land productivity exhibits no real bias towards the small farms whose labour endowments and scarcity of land assets might, in other circumstances, have been conducive to higher levels of average land productivity."

There are a number of problems with Commander's analysis. Firstly, Commander's regression equation uses gross cropped area (net sown area adjusted for the multi-cropped area) in the yield calculations. This introduces the opposite bias from those writers above, against finding an inverse relationship. If smaller farms have higher cropping intensities than larger farms (as we shall see they do) then small farm yields will automatically be adjusted downward by using gross cropped area instead of net sown area or farm size [*see discussion in Chapter II*].[22]

Secondly, Commander produces evidence for the physical yields of individual crops and adduces this as evidence against the presence of an inverse relationship. As we have observed, however, the inverse relationship pertains to total crop value. Here again if small farms have higher cropping intensities than large farms or if the cropping pattern on small farms is different from that on large farms, then even with no relation between the yields of individual crops and farm size, there can nevertheless be an inverse relationship when we look at yields in total crop value terms [*see discussion in Chapter II*].

Finally, while Radwan, Mabro and Wilson operate at too high a level of aggregation, Commander commits the opposite fallacy of extrapolating his sample results to all Egypt. Again, any possibility of significant regional diversity is *a priori* excluded. We may note here that Commander chooses to work in three Delta governorates (Gharbiya, Sharqiya and Daqhaliya) which all manifest high levels of utilization of modern agricultural technology with some of the highest ratios of tractors, pumps, modern ploughs, pesticide sprayers and threshing machines to land in all of rural Egypt - a fact which, as we have seen, is precisely of extreme importance in the breakdown of the inverse relation (see Table 61, Appendix A).

Indeed, Richards [*1989: 58*] responds to Commander's results showing the non-existence of the inverse relationship by suggesting that these findings could "be the result of larger farmers using greater capital inputs per unit land to off-set smaller farmers' higher inputs of labour per unit land." However, Commander [*1987: 178*] claims that: "such yield differences [showing higher land productivity on the large farms] cannot be explained by differences in the availability and utilisation of machinery" because labour intensive tasks such as cotton picking and rice transplanting were not mechanised. Nevertheless, his data [*1987: 292, table 8C*] do show that the mean value of material inputs per feddan increase by farm size for all crops (see Table 62, Appendix A).

With regard to mechanised inputs, Commander's data [*1987: 295, table 9A*] show a wide diffusion of machinery in the three governorates, but while governorate mechanisation indices show that Gharbiya and Daqhaliya are more mechanised than Sharqiya, the Commander's own data shows that at the village level, Sharqiya is far more mechanised than the other two [*1987: 256*-7]. Indeed, the Sharqiya village had a machine density four times higher than the governorate average. The machine stock in the Gharbiya village was more restricted and the Daqhaliya village "was under-mechanised when compared with the other two sampled areas and the governorate as a whole."[23]

Indeed, perhaps Commander's results have also suffered from too high a level of aggregation. Using his data, we computed output per acre and average farm size for each village. This reveals that whereas an inverse relation appears to hold for the Gharbiya and Daqhaliya villages, it does not exist or has broken down in the Sharqiya village.[24] This would seem to tie in with the evidence on machine use, supporting the hypothesis that advanced levels of technology are associated with the disappearance of the inverse relationship.

Summary and conclusions

In this chapter, we have critically surveyed the contributions to the inverse relationship debate made in the Egyptian context. As we have seen, this literature is rather meagre in comparison to the Indian debate. Certainly, there is no very profound discussion of why such a relationship should arise. A number of propositions echo the Indian debate, ranging from Wilson's satisficing behaviour on the large farms to Mabro's use of the Sen framework.

We have seen too, that the Egyptian debate exhibits many of the errors and misconceptions we have examined in the previous six chapters. On the one hand, those who have found an inverse relationship tend to be operating at an excessively high level of aggregation which reflects the inverse relationship at the macro-level, as remarked upon by Crouch et al. This, however, cannot be used as a rationale for redistributive land reform as most of these authors suggest.

On the other hand, those writers who deny the existence of the inverse relationship in Egyptian agriculture commit the error of extrapolating their small sample results to the Egyptian countryside in general. We have seen, however, that even their use of the micro-level data raises a number of methodological and conceptual problems.

Nevertheless, these inconclusive and partial results do suggest that the inverse relationship may be an important phenomenon in rural Egypt, although not in the way conceived of by the authors looked at in this chapter. In Chapter IX, we will subject the data used by Radwan and Lee to greater scrutiny at a more disaggregated level, and in Chapter X, we examine village level data collected by the author from Egypt in 1990. But before turning to the data analysis, we will, in the next chapter, consider the central features of the political economy of agrarian transition in Egypt, features which are of central relevance to our analysis of the fieldwork data in chapters IX and X.

Notes to Chapter VII

1. See Chapter VI for a critical review of Berry and Cline.

2. Adams also refers the reader to Dorner [*1972*]. Note that Adams is rather confused over the inverse relationship here. Land productivity and output per acre are essentially the same, while the empirical evidence widely shows labour productivity declining with increasing holding size.

3. Buheira, Gharbiya, Qalubiya and Sharqiya in 1981-2.

4. This study was the result of a 1,000 household survey of rural Egypt undertaken in 1976-77 by the ILO/World Employment Programme.

5. $\log Y = 4.016 - 0.5154 \log X$
(.0354)

$r^2 = 0.3637$
$n = 415$

where Y is days worked on the family farm divided by the size of holding and X is size of landholding.

6. 1 qirat = 1/24 feddan = $175.03m^2$
1 feddan = 1.038 acres = $4{,}200.83m^2$
Throughout the text, yield refers to output per feddan.

7. Radwan provides no justification for using this measure of net farm output in his farm productivity computations, but it certainly makes dramatic changes to the results. Such input costs account for 65-66% of crop output on the large farms and only 40% on the small farms. Of course, this does not imply that the small farms are characterised by higher land productivity. What matters here is not the ratio of these input costs to output, but the composition of these inputs.

In contrast to the small farms, where large farm inputs are land and labour augmenting (and small farm inputs are dominated by fodder), farm productivity will be higher on the large farms. Radwan also includes animal produce in total output. This biases small farm yields upward by some 20% as compared to 2-10% on the larger farms. However, large animal/land ratios and animal product/total output ratios on the small farms are not an indication of higher productivity, but rather merely the small size of these farms. The use of Radwan's method on the Qena data below biases large farm yields downward by some 35% in comparison with the small farms.

Such an approach also faces significant problems relating to the imputation of cost to inputs supplied on-farm. For Radwan's methodology, see pages 17-27 of Radwan [*1986*].

8. ILO/INPC Labour Record Survey, *Research Report on Employment Problems in Rural Areas, 6 governorates*, 1964-65.

9.

size H	U′
< 0.8 ha	14348 man-hours per yr
0.8-2	6719
2-4	4322
over 4	2658

Wilson also produces the following regression equation [*1972: 9*]:

$\log U' = 1.6174 - 0.6771 H$

with a correlation coefficient $R_{UH} = -1.00$.

10. land tenure

land tenure	U'(labour/ha)
2/3 owned	5354
2/3 rented	6408
2/3 shared	6103

Wilson explains: "farmers on leased holdings need to utilize their land intensively, not only to provide for their family needs, but also to pay the rents" [*1972: 16*]. However, note that these tenure categories include a wide range of farm sizes [*1972: 15*].

11. Robert Mabro, *Employment and wages in dual agriculture*, Oxford Economic Papers, vol.21, no.3, 1971. This article was based on data collected in *Rural Employment Problems in the UAR*, ILO, 1969, and the UAR/INP/ILO, *Research Report on Employment Problems in Rural Areas* (in 10 volumes), Cairo, 1965-68. This is the same data used by Wilson. Mabro writes: "Labour inputs per unit of land (and sometimes yields) tend to increase as the size of holdings decrease" [*1971: 402*]. Mabro also refers the reader to Mazumdar [*1965*] and Paglin [*1965*] on the Indian Farm Management Studies.

12. This explicit use of the Sen model by Mabro (and the implicit use by other authors) has been questioned by some writers. Harik [*1979:* 77], using 1961 census data, estimates the density of workers per feddan on small farms to be only 4.5 times higher than on the large estates with the greatest density on those farms less than 2 feddans. These estimates are much lower than those given by Mohieddin [*1977*] who estimates a factor of 11. Harik concludes [*1979: 80*] that as labour intensity is not marked by extremes, the gap is not wide enough to justify a dual sector model of agriculture with underemployment at the bottom and labour saving at the top.

Further, Mabro's data [*1971: 413, table II*] on the use of hired labour on small farms in Egypt shows that all farm size categories employ wage labour: including 24% of farms below two feddans:

size	% using wage labour
0.5-2	24 mainly temp
2-5	36
5-10	53
> 10	85

source: ILO/UAR Report C p. 41

This evidence would tend to confirm that even in 1961 there existed a highly developed labour market in the rural areas, reflecting a considerable degree of inter-farm labour mobility. Therefore we are not speaking of highly immobile family labour here.

13. Mabro notes here that: "There is no choice between goods and leisure at a level of income near subsistence" [*1971: 409, fn. 1*].

14. The authors do note however that "smaller farms grow somewhat more high value crops (but not much)" [*1983: 23*].

15. Their own data is however unclear on this. There appears to be no clear association between areas of high land productivity and areas where cash cropping is predominant [*Crouch et al., 1983: 30-1*].

16. Although farm size and the hired labour index are positively correlated, Crouch et al. are aware of the elision made by Sen and Mabro: "while it may be true that capitalist farms are in general larger than peasant farms, it should not be assumed that 'large' and 'capitalist' are equivalent" [*1983: 16*].

In an attempt to go beyond farm size, Crouch et al. perform an interesting exercise by clustering farms into socio-economic groups: [7] small peasants with little marketed surplus and using little hired labour, [3] small farms using more hired labour and marketing a higher proportion of total output, [5] small capitalist farmers with 8-12 feddans using mostly hired labour, [2] large capitalist farmers, and [6] land rented out by large landlords under sharecropping. This shows that for wheat, group 7 has higher yields than groups 5, 3 and 6; for cotton, groups 3, 5 and 7 have higher yields than group 2. They conclude: "Thus, we confirm earlier results about the importance of size and capitalist relations when regionality is not taken into account" [*1983: 31*].

17. Regressions of factor input intensity on size and on size with zonal dummies show that:

1) "farm size certainly does influence factor use intensities. There is no doubt that larger farms use less of every input per feddan, except for chemical nitrogen fertiliser, and manure. In all crops larger farms use less human and animal labour per feddan, and in cotton, rice, and wheat they also use less mechanical power. This holds in spite of the fact that we have controlled for regional variability and the impact of possible bad measurement on in the small farms by providing dummy variables. Of course, these results simply confirm our previous result that there is a definite but weak tendency for bigger farms to have smaller yields."; and

2) "there are clear regional differences in intensity of factor use. In fact, in almost all cases, regionality seems to be just as important a variable as farm size in explaining variability in per feddan input use. However, it is not altogether clear that the zones using less inputs are the same as those achieving less yields" [*Crouch et al., 1983: 37-8*].

18. Commander [*1987: 173-9 and 178, fn.3*]. His regressions of crop value per feddan on operated area show:

linear: $y = \underset{(60.821)}{1795.749} + \underset{(0.888)^{*}}{4.464}\, x \qquad r^2 = 0.31$

log-linear: $y = 2.979 + 0.198\,x$ $\quad r^2 = 0.24$
$\qquad\qquad (0.042)\ (0.027)^*$

* = significant at the 1% level

where y is total value of crop production and x is gross cropped area, which shows a significant positive relation at the 1% confidence level.

Commander exhibits some confusion over his regression results. He writes [*1987: 178*]: "The positive sign for the constant [sic] indicated that the crop value per operated area tended to decline [sic] with area operated. This was confirmed when the regression was run in log-linear form where the coefficient was significantly below one." The fact that the coefficient on the independent variable is positive would suggest that output per acre increases with farms size. The coefficient in the log-linear case simply shows that yields increase, but less than proportionately with size.

These regression results are confirmed by table 8D [*1987: 292, Appendix*]:

average crop value per feddan per annum, 1984

farm size	mean(LE)	index
0-1	1665	100
1-3	2176	131
3-5	2203	132
5-10	2634	158
> 10	2499	150

He adds [*1987: 178*]: "crop values per feddan do indeed rise for farms of up to ten feddans but fall off for the larger units. Nevertheless, the value differential between the smallest farms and those with the highest per unit values - the 5-10 feddan holdings - exceeded 50%. This may be partly due to soil quality differences. In particular, it is likely to reflect the level of investment in drainage on farm, as well as the relative accessibility of irrigation."

19. Commander also mentions land quality as an important factor. While there was no attempt to grade land quality, land values showed a positive relation with farm size [*1987: 177, table 8.3*]. Large farm land values were a third higher than those of small farms. Fallow was non-existent and the reference period covered a two crop cycle.

20. However, Commander's data [*1987: 65, table 4.4*] shows that his Sharqiya village does exhibit higher labour intensity on the smaller farms even though the aggregate results reveal little variation:

average labour inputs per feddan in crop production for 1983-4 (standardized man-hours)

size	Sharqiya	Gharbiya	Daqhaliya	all	all(man-days)
0-1	2214	961	1378	1384	261
1-3	1745	1073	1668	1566	295
3-5	1395	988	1808	1557	294
5-10	1039	1112	1815	1434	270
> 10	1302	--	2027	1544	291

Wheat yields (y) regressed on the ratio of hired to total labour time in crop production (x) actually revealed a negative association:

$$y = 10.051 - 3.280\,x \qquad r^2 = 0.21$$
$$\quad (.3566) \quad (.5737)^* \qquad F = 32.7$$
$$n = 126$$

*significant at the 1% level

Commander suggests that for this crop, family labour may put in greater effort or sustain a higher quality of work, but the result did not hold for other crops [*1987: 179 and fn.4*]. Why this should be the case for wheat and not for other crops is not revealed.

He adds that although small farms have higher available labour per feddan, and there was a clear positive association between farm size and labour productivity (with rice, for example, labour productivity was 45% higher on the large farms), the availability of off-farm work opportunities implied no compulsion to intensify labour effort on the small farms [*1987: 181*].

21. The regression of crop values (y) on material inputs which included seeds, fertilizers, and pesticides (x) showed a positive association:

$$y = 1526.763 + 1.845 \qquad r^2 = 0.24$$
$$(77.397) \quad (0.252)^* \qquad F = 53.4$$
$$n = 171$$

* = significant at the 1% level

Even at the level of individual crops, there was a positive relation between crop value and material inputs [*1987: 180 and fn. 5*].

22. Commander provides no explicit justification for using gross cropped area in his yield calculations. However, he does claim [*1987: 178*] that he finds little variation in cropping intensity across farm size. He does not provide any figures to substantiate this claim.

23. In 1984, the Sharqiya village had 36 tractors and 15 threshers, as well as 6 large sprayers, 31 small sprayers and 10 trucks. The nearby Mechanization Centre had an additional 16 tractors available. The Gharbiya village had only 5 tractors and 3 threshers, and no cooperative or machine centre. The Daqhaliya village had 18 tractors and 7 pumps (below the norm) and no cooperative or machine centre [*Commander, 1987: 257*].

24. The data was derived from Commander [*1987: 53, table 3.3*] which provides average class farm size and [*1987: 293, table 8F*].

Table 3.3 (excerpt) Distribution of landholdings, 1984 sample villages

	Sharqiya		Daqhaliya		Gharbiya	
farm size	units	area	units	area	units	area
0-1	721	405.22	592	264.19	158	79.09
1-3	487	891.05	288	457.09	59	88.19
3-5	43	143.19	28	99.19	4	13.17
5-10	34	236.09	11	65.18	3	21.04
> 10	12	174.11	2	24.22	-	-

source: Village agricultural cooperatives

table 8F average value of crop output (per farm), 1984

	farm size (feddans)				
village	0-1	1-3	3-5	5-10	> 10
Sharqiya	757.6	1658.4	2752.9	6505.5	19941.5
Daqhaliya	496.8	1204.5	2295.7	4571.6	8729.0
Gharbiya	457.6	1144.7	2441.8	3514.0	-

source: ODI/Zagazig survey, 1984

Combining the data in the two tables and computing average output per feddan for each size class in the three villages gives (rounded to the nearest whole number):

village	0-1	1-3	3-5	5-10	> 10
Sharqiya	1348	906	827	937	1374
Daqhaliya	1113	759	648	772	721
Gharbiya	914	766	742	501	-

Notice the strong inverse relationship in Daqhaliya and Gharbiya. But in the Sharqiya village, the large farms have higher productivity than the smaller size classes.

CHAPTER VIII

The political economy of the contemporary Egyptian countryside

Introduction

In this chapter, we shall consider some of the central features of the political economy of the Egyptian countryside, which have been identified by other researchers (most notably Mahmoud Abdel-Fadil)[1] and which are central to our own analysis. In other words, we shall here survey the evidence with respect to the mechanisms and institutions which have been central to the emergence of rich peasant dominance in contemporary Egypt. This is an important prelude to the treatment of the ILO data and the author's study villages in the following chapters. As we shall see, the influences identified in this chapter were crucial in the study villages, both with respect to the causal factors behind the inverse relationship and its disappearance.

In section 8.1, we examine how the Egyptian agrarian reform, begun in 1952, and subsequent legislation, enhanced and consolidated the position of the rich peasantry, particularly those owning over ten feddans of land. The following two sections explore the institutional structure of rural Egypt, and how the agrarian elite were able to exercise their power through the cooperative system (section 8.2) and rural credit system (section 8.3).

Section 8.4 examines the implications of rich peasant domination of these institutions for the diffusion of modern technology which, as we have seen, is a crucial element in the breakdown of the inverse relationship. Finally, section 8.5 shows how that rural dominance has been extended to the national policy-making level and the implications this has had for agrarian transition in Egypt.

8.1 Agrarian reform and the consolidation of the rich peasantry

Prior to 1952, some 2,000 landlords (the pashas),[2] representing 0.01% of all landholders, owned 20% of the land, and some 6% of landholders owned 65% of the land [*Ikram, 1980: 213*]. The agrarian reform of 1952 led to the redistribution of land held by individual landlords over 200 feddans, and in 1961, the permissible ceiling fell to 100 feddans. Later, in 1969, ceilings were reduced to 50 feddans.

Land was redistributed in plots of 2-5 feddans (depending on soil quality and family size). Rents were to be controlled at seven times the basic land tax, but this condition often seems to have been evaded in practice however [*Ikram, 1980: 212*]. There were a variety of ways of evading the land reform regulations: land retained for self-cultivation, false registrations, and open flouting of the ceilings legislation. Although the pashas were weakened, they were not eliminated as a class in the Egyptian social formation, and many have since made a comeback under the Infitah regime.[3] In the non-land reform areas, landlords could easily evade the laws or could shift to direct exploitation using wage labour.

Thus, initially the reform was limited in its impact. A generous ownership ceiling was set originally, thus confining the number of affected landowners to only 1,768 out of a total of more than 2,800,000, or about 6/100 of one percent [*Platt, 1970: 63*]. Only 12.5% of the cultivated area was directly affected with 341,982 families receiving land, and this was restricted to ex-tenants with the landless receiving nothing [*see Abdel-Fadil, 1975 and Richards, 1982*].

Except on expropriated land, tenure structure remained essentially unchanged: landlords retained most of their lands up to the legal maximum (and beyond) and even 18 years after land reform it was still the case that land was cultivated predominantly by sharecroppers and tenants [*Platt, 1970: 44*].

While initially large landlords observed rent ceilings as they felt vulnerable to exposure, the smaller landlords "used their local prestige to force higher rents, being supported, in cases of complaint, by the local courts set up to settle rent disputes" [*Platt, 1970: 45*]. Saab [*1967: 145*] mentions the considerable rental rate abuse that followed the 1956 law allowing landlords to withdraw half their formerly rented lands from tenancy. A common practice was to sign leases calling for the legal rent, but compel the tenant to sign separate bills of exchange for extra amounts. Adams [*1986: 90*] provides an example of land reform law circumvention from el-Diblah: "The concept of renting land with a [written] contract died here 30 years ago, right after 1952. The only land that is rented out now is rented out on an oral basis, for a crop or two at a time." Many poor peasants fear the rich peasant: "many...still 'forfeit' their legal rights out of fear, ignorance and an abiding reluctance to antagonize 'those who matter' in the village" [*1986: 92*]. Hopkins [*1987: 185*] notes that "free market" rents are usually on a seasonal basis and several times higher than legal rents.

The land reform process, including distress sales to the rich peasantry, reduced the large landholdings from 1,177,000 feddans to 354,000 feddans to only 6%, or 30% of the original level. Some 659,000 feddans were distributed to farmers with less than 5 feddans [*Abdel-Fadil, 1975: 11, table 1.6*] (see Tables 63 and 64, Appendix A). But the main beneficiaries of the land reform process were the stratum of rich peasants who acquired land via crash or distress sales. Land was sold directly by landlords in larger sizes to rich peasants [*Platt, 1970: 45*]. Some 164,000 feddans were transferred via distress sales to those with between 20 and 50 feddans (Abdel-Fadil's "rich peasants"). The 5-20 feddan category of middle peasants remained more or less the same.

Abdel-Fadil stresses that even by 1970, land ownership remained highly skewed and the main trend was the "steady improvement in the relative position (increase in numbers and acreage) of the medium-sized properties, and in particular owners of 20 to 50 feddans" [*1975: 23*] representing some 5% of landholders with 30% of the total cultivated area. This compares to 1% of landholders and 11% of the land in 1952. Thus, the consolidation of the rich peasants' position in the countryside was perhaps the most important aspect of the reform. Their purchases of land in distress sales by larger landlords, the elimination of the pashas, and the absence of mobilization of the poor and landless peasants made them the dominant force in the countryside [*Richards, 1982: 179*].

Nasser bolstered the legitimacy of his regime by avoiding the expropriation of rich and middle peasant holdings. By not seizing the medium-sized properties, the reforms avoided alienating the much needed "passive support" of the rich peasantry. Even when ceilings were lowered and all peasants compelled to join cooperatives, the rich peasants continued to control their villages, just as they had always done, as mediators between the peasantry and the government [*Richards, 1982: 177*].

Over the first decade of land reform then, land and income was redistributed away from the large landlords, and moved towards the rich and middle peasantry operating 5-50 feddans. Abdel-Fadil estimates that the share of agricultural income of peasants owning more than 5 feddans rose from 25% in 1950 to 32% in 1961

[*1975: 60*]. The structure of initial asset endowments markedly skewed income distribution.

It is interesting to note that in Egypt widespread inequalities of land holdings tend to persist after tenancy arrangements are made notwithstanding the fact that some 47 per cent of the cultivated area is leased in various ways [*Mabro, 1971: 405*].

The ILO survey income data [*Radwan, 1986: 33*] appear to show that the size of the rental market in land is relatively small: only 18% of landowning households rented out land and such households comprised only 6% of the sample. This was explained by the low levels of rent (LE 1.56 per qirat or 2.7% of the average value of land) brought about by rent controls reducing the attractiveness of renting out land.

However, tenancy data from the same survey [*1986: 66-8*] shows that the land rental market is far more significant than the income data would suggest: 47% of total land area operated in the sample was rented and almost 20% of total land owned was let. Some 72% of all households owning land rented some land, with almost half the tenancies supplied by absentee landlords living outside the village (57% of rented land was from this source).

Of the tenancies supplied by resident landlords, 45% are under one feddan, whereas only 24% of absentee landlord tenancies are under one feddan. The dominant type of tenancy is cash rental (92% of tenancies and 89% of rented land) while sharecropping (on a 50-50 basis) accounted for only 7% of tenancies. The average area rented did not vary between cash and share tenancies. However, the cost of renting under a sharecropping arrangement is on average 80% higher than for cash rents [*1986: 69*]. The strong bargaining position of the landlords results in exorbitant rental values and insecurity of tenants.

Most (94.5%) registered farms are below 5 feddans in size but only 83.4% of operated holdings. Nevertheless, it is the case that the overwhelming proportion of the 2 million Egyptian farmers work units less than 3 feddans. The average plot size is generally small and has been falling over time. At present, there is not more than 0.3 feddans of land for every rural resident and no more than 0.15 for every Egyptian: at this rate, a rural family of 6 persons would only have 1.8 feddans to support it which is less than the amount of land considered necessary to keep a family at subsistence level [*Harik, 1979: 128*]. Mare'i [*1954: 145-6*] suggests that 5 feddans are considered adequate for a peasant household since it would produce LE 128 in the average year (enough to support an average family of 8). A figure of three feddans is however supported by more recent data.[4]

In fact, the degree of land concentration is probably understated in the official records. Rich farmer circumvention of agrarian reform laws continues today. Adams [*1986: 89*] gives the example of one rich farmer who owns 200 feddans but is registered at the cooperative as having only 30 feddans. Commander [*1987: 55*] mentions one farm of 400-475 feddans comprising 22-26% of total land in the village: thus, despite the legal ceiling of 50 feddans, registration of land in the names of family members can circumvent these restrictions - the farm functions as a consolidated entity. Indeed, it is often the case that several families (say, several married brothers) operate several plots together as <u>one</u> business, in spite of having the plots registered as different farms in the official records [*Crouch et al., 1983: 61*].[5]

8.2 The agrarian elite and the cooperative system

The 70 thousand farmers with more than 10 feddans form an agrarian elite with an important role in national and local politics, and are relatively autonomous from direct government action in the countryside. They are descended from around 300 prominent clans that have dominated Egyptian politics over this century and controlled all major political offices outside the major cities: 71% of seats on provincial councils and 55% of district offices. They supply the vast majority of 'umdas (village headmen). When the cooperative system was set up, they were able to circumvent the laws on cooperative board membership by planting poorer members of their clans on the boards [*Sadowski, 1991: 77-8*].

The idea of cooperatives was not new to Egypt in 1952: as early as 1908 Lutfi, a private philanthropist, had introduced rural credit; then in 1923 national legislation set up agricultural cooperatives. However, throughout the 1930s, these cooperatives were no more than credit facilities catering to the needs of the wealthy classes [*Rochin and Grossman, 1985: 16*]. By 1952, there were around 1,700 cooperatives with half a million members. The large landlords dominated at both local and national level, and thus the impact on small farmers was relatively insignificant. Credit, for example, was only extended to those with over 25 feddans of land [*Mayfield, 1974: 23-4*] "who borrowed most of the funds for their own use or for sub-lending to their tenants at exorbitant rates" [*Platt, 1970: 40*].

After 1952, all land reform recipients had to join the cooperative system. At first, the cooperative system was confined to land reform areas; then later (after Law 317 of 1956) extended to non-land reform areas by 1963. The cooperatives specified the crop rotation to be followed locally and took control of crop marketing and highly subsidised input supplies. They also attempted to consolidate blocks of cultivated land. The Department of Cooperatives came under the umbrella of the Ministry of Agriculture. At the national level there were four main groupings: 1) the General Agricultural Cooperative Society (grouping multi-purpose cooperatives); 2) the General Society for Agrarian Reform; 3) the General Society for Land Reclamation; and 4) the Cooperative Society (for special crops), all grouped under the Central Agricultural Cooperative Union (CACU). There are then strata at *muhafidhah* (governorate) and *markaz* (district) levels, and finally at the bottom, village cooperatives with a minimum membership of 20, run by an elected board of 5 to 11 persons and managed by a *mushrif* (supervisor) appointed by the Ministry of Agriculture who is assisted by an accountant from the Village Bank. By the 1980s, there were over 5,000 agricultural cooperatives covering approximately 3 million farm families [*Rochin and Grossman, 1985: 10*].

There is every reason to believe that such a system has favoured the rich peasants: this emerging class of relatively well-to-do peasants replaced the pre-revolutionary wealthy landlord class. Due to an inadequate supply of personnel necessary to supervise the cooperative system,, the government relied heavily on this new elite who in turn, in many cases, exploited the cooperative system to their personal benefit. These land reform beneficiaries quickly gained control of the boards of directors of the cooperatives [*Rochin and Grossman, 1985: 25*].[6]

The pre-reform institutional lines and rankings still persisted, with the Land Reform agent at the top of the order in lieu of the landlord, the landless labourer still at the bottom, and the steps between dependent on relative prosperity. Richards [*1982: 182*] writes: "it is clear that the rich peasants dominated the cooperatives, especially those set up in non-land reform areas after 1963. The government simply did not have the cadre to carry out such a massive extension without relying extensively on the local power structure." This is supported by Baker: "The attitude of these more prosperous peasants toward the cooperative movement has been not so much one of opposition but one of subverting the service offered by the cooperative to their own exclusive use" [*1978: 205*].

However, even in the land reform areas, the rich peasants exerted considerable influence. The mushrif or cooperative supervisor was often the same person as the former landlord's agent. Concerned more with debt collection, he had a short term view that did not encompass modernization programmes [*Platt, 1970: 55-6*]. Further, the managerial personnel, usually from the stratum of rich peasants, continued to act as representatives of the government, just as they had done for the absentee landlords. Even when qualified government personnel appeared in the land reform areas, these men were themselves often of rural middle-class origins; their origins, training, and inclinations (as well as their low pay and lack of incentives) often led them to rely on the more successful local farmers for guidance [*Richards, 1982: 181*].

There is little doubt that rich peasants controlled the board of cooperatives. Before 1969, 80% of board members were supposed to be small farmers with less than 5 feddans, but the latter were easily manipulated by the rich peasants, being "highly vulnerable to rich farmer pressure and bribery" [*Adams, 1986: 69*]. Small farmers depend on rich peasants for land, labour, input purchases, crop sales, cash loans, and intercession with government authorities. Adams [*1986: 136-44*] suggests that the success of all four survival strategies for the poor peasant household (agricultural wage labour, animal raising or intensification of cropping, having a large family or labour migration) is linked to rich peasant patronage. These "ties of dependence mean that the bulk of poor peasants...have been 'captured' - not by the state - but by rich peasants (that is, farmers having access to over ten feddans of land)" [*1986: 80*]. In 1969, the ceiling for cooperative board membership was raised to 15 feddans and illiterates were excluded: this guaranteed rich peasant dominance.

Adams [*1986: 105*] writes that the leaders of four large extended families dominate economic, social and political life in his survey village of El-Diblah: "In El-Diblah the small peasants elected to cooperative boards generally own such minuscule plots of land that they are either economically dependent (in the form of wage labour and loans) or materially vulnerable (in the form of bribes) to rich peasants." [*1986: 84*] One fellah told him: "There is only one *ragul* in this village: the *umda*. Everyone else looks to him for work, loans, and brokerage services with the government" [*1986: 129*].[7]

Rich peasants were able to use their direct or indirect control of cooperative boards to help themselves to cooperative supplies and monopolize tractors and other mechanized inputs [*Adams, 1986: 85-6*]. Richards [*1982: 182-3*] states that the cooperative allocation "mechanism excluded the poor as systematically as a price system in an environment of unequal resource endowments would have done." The rich peasants were first in line for inputs while the poor peasants were locked into a consolidated crop rotation directed by the cooperative: this increased need for credit which the rich peasants supplied. Adams [*1986: 62*] records one peasant: "It is a well known fact here that only the *umda* and certain rich farmers can use the cooperative tractor. No one else here has the connections within the cooperative to reserve the tractor. And few of us have the money needed to buy cigarettes and tea for the driver and his helper."

Only those owning five work animals could participate in animal insurance schemes and therefore qualify for 150 kg of forage at subsidised prices, and only those with 15 feddans could acquire selected seeds [*Richards, 1982: 183*]. Poor peasants with less than 5 feddans were prohibited from planting highly profitable fruit trees, while rich peasants with over 10 feddans could avoid planting regulations on price-controlled crops by obtaining permission to opt out of the official crop rotation in cotton regions, shifting into more profitable crops such as fruit and vegetables [*Adams, 1986: 69*].

An extensive black market emerged on which small farmers sold their quotas of fertilizer to rich peasants [*Richards, 1982: 182*]. Some 10-20% of the total value of fertilizer distributed via cooperatives wound up being sold on black markets at mark-ups of 150% in Lower Egypt and 300% in Upper Egypt [*Sadowski, 1991: 75*]. Mayfield [*1974: 130*] provides an example from Gharbiya where a peasant obtains two bags of fertiliser from the cooperative for each feddan owned; half gets sold on the black market to a larger owner in order to make quick cash; but after harvest, the yields are too low and the farmer finds that he cannot cover his production costs.

8.3 Rich peasants and cooperative credit

Similar diversions affected the subsidized credit programmes as well: most peasants did not gain access to medium and long term loans as the cooperatives employed the same kind of criteria as used formerly by the Agricultural Credit Bank. The critical investment loans for livestock and machinery remained predicated on property with machinery loans requiring a minimum of ten feddans [*Sadowski, 1991: 75-6*], producing what Adams calls a "large farmer bias in the provision of credit" [*1986: 57*].

In 1957, the Agricultural Credit Bank was required to deal only with cooperatives and not directly with individual farmers, and the credit system was used to expand the cooperative system in the 1960s. The Egyptian experience with cooperative credit has a longer history however. According to Saab: "During the first two decades of the twentieth century, ample long-term credit had been made available for agriculture through the Agricultural Credit Bank, but most of it had been appropriated by the large landowning class who either diverted the funds borrowed to consumption purposes or utilized them for the purchase or enlargement of agricultural estates..." [*1967: 7*].

The Agricultural Credit Bank failed to carry out its mandate, as few loans were granted to small farmers. Meanwhile large landowners established a powerful economic and social base, upon which the smaller landholders and landless masses became dependent. Unable to gain credit from the banks, small farmers were forced to turn to village moneylenders - often the same large landholders - who charged high interest rates. Thus a relatively few large landowners were able to dominate credit facilities by borrowing more in total than many small farmers, at considerably lower interest rates, and move to a position of economic control. With the economic crisis of 1907, however, loans to small farmers all but ceased" [*Rochin and Grossman, 1985: 14*]. The Agricultural Reserve Fund advanced loans to small farmers in 1929, but these were limited to export crop producers [*Ministry of Agriculture, 1989: 35*].

Rural credit has unduly benefited the large farmers. By advancing loans to all farmers on the basis of the size of their cultivated crop, the Egyptian government has actually engaged in the unequal subsidization of large farmers [*Adams, 1986: 59-60*]. Large farmers with more than 25 feddans who represent about one percent of all Egyptian farmers received 19% of all rural credit in 1963-4 and 7% in 1972-3.[8] Small peasants, who represent the majority of debtors (83-85%) and the most needy, get half the credit advanced by the cooperative system, while the medium and large landowners get the other half. When the government tried to check this trend by imposing a rate of interest of 4 per cent on loans advanced to holders of ten feddans and more, many large landowners reacted by dividing their holdings into plots of less than ten feddans to benefit from the exemption from interest [*Radwan, 1977: 69*]. As of 1978, 2.6 million peasants owning less than 5 feddans were receiving LE 71 million in government loans, or 56% of total available credits. But 195,000 farmers with over 5 feddans collected LE 55 million or 44% of the total [*Sadowski, 1991: 76*].

The loans from the village banks are given at high rates of interest (relative to small farmers' ability to repay) and with strict rules regarding loan security. Consequently, only a small proportion of poor peasants have been able to benefit from these loans [*Harik, 1979: 137*]. Nadim's study of village banks found that "the small farmer, who really needs the support of the Bank, usually cannot meet the requirements for a loan". While bank managers claimed that the Bank did not favour the large farmers, they admitted that the reliable farmers are the rich ones. In general, small farmers rented land and did not therefore qualify for loan eligibility [*1979: 33*].

Only 3% of the sample took medium term loans from the bank. The percentage of those who received loans increases with holding size, but stops beyond a certain point as very large farmers did not borrow from the bank. Small owners and renters obtain loans from relatives, while larger owners borrow from the bank [*Nadim, 1979: 41*]. The farmers who sought loans unsuccessfully believed they were turned down because their holdings were too small [*Nadim, 1979: 18*]. In Qalubiya, one *fellah* remarked: "if a *hiyazah* is small, the farmer is not entitled to credit" [*Nadim, 1979: 30*]. In both villages, the bank required that the borrower own 10 feddans in order to qualify for a loan to buy a tractor or plough, 5 feddans for an irrigation pump, and 1 feddan for a 6 month loan to buy cows [*Nadim, 1979: 22*].

Complaints about the bank included abuses by employees, the bribes required of farmers, delays in granting loans, the favouring of friends and acquaintances, and the neglect of small farmers [*Nadim, 1979: 24*]. Nadim [*1979: 32*] mentions one case where a bank employee forged a farmer's signature and took rations of seed and fertilizer and sold it on black market.

Only in 1980, did the Principal Bank for Development and Agricultural Credit (PBDAC) begin to recognise that its main orientation in agricultural development gave more weight to the large farmers. They also noted that during the period 1968-77, loans were directed almost completely to short term loans, and that debts borne by farmers were accumulating rapidly [*Ministry of Agriculture, 1989: 12-3*].[9] Only one percent of total credit volume is for medium term loans (for orchards and purchase of cattle and machinery) [*Dethier, 1981: 44*]. This recognition led to the establishment of the Small Farmer Project, but only in trial form in only 21 villages in 3 governorates.

As in the past therefore, poorer peasants continued to secure loans from the wealthier farmers. Dethier [*1981: 44*] notes that "the existence of usury and of private moneylenders has not been eradicated from the countryside." Indeed, Adams [*1986: 57-8*] suggests that the state supply of rural credit has "actually strengthened the importance of local moneylenders." He explains: "In the absence of any government credit for the main food crops grown in the area (maize, wheat), small peasants must still frequently turn to village moneylenders. For example, a small farmer wishing to plant wheat in November may well have to mortgage off part of his future crop at high rates of interest (exceeding 110 percent per annum) in order to obtain the requisite working capital." This would suggest that "usury has not been eliminated...in rural Egypt. The state has only partially, and not completely, assumed the functions of local moneylenders" [*1986: 57*].

It is difficult in the small farm context to separate production from consumption credit: the economic situation of many small *fellahin* is so precarious that when a harvest falls short of family subsistence needs, they are forced to seek consumption loans to survive. Since the latter are not available from the cooperatives, and since credit from relatives and friends is generally very short term, peasants are forced to resort to more onerous informal credit sources such as moneylenders.

Nadim [*1979: 19*] mentions the presence of usurers in his Qalubiya village where interest rates reached 50%. Currently there are few such persons, but more people in Minya borrowed from other farmers at high rates of interest and "judging from the high interest rates reported, usury is still present". He states

[*1979: 20*] that private lenders of interest-bearing loans are regarded as "thieves and embezzlers, and thus have very poor reputations in the village." Some 36% of the Minya sample of peasants pay interest rates above 25%, some reaching as high as 75%.

Marketing is also available as a means of surplus extraction with prices set by centralizing merchants who can store crops until prices are right, whereas small peasants want to sell for cash immediately after harvest [*Hopkins, 1987: 186*]. In pre-land reform Egypt, the first obligation of the tenant in disposing of his crop was to pay the rent (often 75% of net income [*Platt, 1970: 15*]). If there were subsistence or other debts to merchants or moneylenders, these must be paid. If the lender was also a grain or cotton dealer -a usual combination - he commonly required payment in kind, setting the price well below free market value. The tight grip of the local merchants is indicated by the fact that 23 years after the cooperative law was passed there were only 5 marketing cooperativess in existence [*Platt, 1970: 22*]. Nadim's study [*1979: 19*] mentions three cases of peasants taking advances from merchants to whom they sell produce. Another common borrowing practice is to mortgage a piece of land until its produce is sold.

8.4 Implications with respect to the diffusion of modern technology of rich peasant bias in credit

This rich peasant bias in access to cooperative and village bank credit resources has had important implications for the pattern of diffusion of modern technology in Egyptian agriculture. On the basis of extra-economic considerations large farms are able to obtain inputs before other farm households, the timely supply of such inputs constituting a major bottleneck and a condition of high productivity. This is central to one of the arguments of this thesis, already identified and pursued further in the following chapters.[10]

Ownership of tractors, and other modern farm equipment such as irrigation technology, is strongly correlated with farm size. Commander's 1984 survey shows 60% of the tractors and a third of irrigation pumps owned by farms over 5 feddans [*1987: 240*].[11] Hopkins [*1982: 168*] points out that these machine owners are the large farmers over 5 feddans who are also most likely to have bought or sold land in the last 5 years.[12] In his later study of the village of Musha, he discovered that the seven largest farmers who farm 20% of the village land own 27% of the tractors and share ownership of 46% of the irrigation pumps. One of these families with about 300 feddans owned three tractors, nine others owned two each and six out of those nine are from families owning 50 feddans or more [*1987: 106*].[13]

In the 1976 ILO study, only 16% of sample households owned any machines. Tractors are too expensive and indivisible an investment for small farmers. The strict policy of PBDAC lending helps to restrict the diffusion of mechanized equipment to small farmers. Tractor loans require collateral of five feddans and a 25% down payment [*Commander, 1987: 246*] and water pumps require a collateral of three feddans [*Greenberg, 1985: 10*]. Besides interest payments on the loan, the cost of borrowing is augmented by bank commission surcharges. Indeed, only 40-45% of tractor purchases were financed by PBDAC loans or dealership agreements, with over half being financed by private saving or borrowing [*Commander, 1987: 246*]. Hopkins[14] found that 65% of the farmers in his study felt that they would not qualify for a loan to purchase agricultural machinery, while half the respondents felt the government was doing nothing to help them in mechanization [*1982: 115-6*].[15]

Use of tractors via the rental market was more widespread (63% of respondents had an entry for operating costs of machinery). While the proportion of farms using machines increases with size, even tiny farms less than a quarter of a feddan use some machinery and 60% of farms less than 1 feddan use machinery [*Radwan, 1986: 78*].[16]

Most farmers have to rent tractors and pumps from private owners rather than the cooperative [*Hopkins, 1982: 93*]. The 1976-7 FMS showed 86% of tractor horsepower provided by cooperatives, but current evidence suggests over 90% of mechanical power is owned and provided by the private sector.[17] Private farmers have been in the lead in mechanization with most tractors owned by rich peasants [*Richards, 1982: 218*]. Hopkins [*1987: 185*] notes that machine rental has become increasingly important as a mode of surplus extraction: those who own machinery rent to others on a piecemeal basis in return for cash or crop share.[18] The profitability of such operations is enhanced by subsidized fuel, oil and machine purchase. Further, rental prices are set fairly high through tacit collusion between machine owners. Cooperative tractors, when they are available, are rented for 15 piastres per qirat: "far cheaper than renting a tractor from another farmer (25 piasters per qirat)" [*Nadim, 1979: 23*].

In the 1980s, the emphasis has been on machine accumulation rather than land accumulation: "Thus the relationship of the larger farmers to the smaller farmers around them was mediated through their control of the access to machinery more than through control of the access to land" [*Adams, 1986: 189*]. Thus, questions of cost, payment schedules and tips become important [*Hopkins, 1982: 93*]. Hopkins [*1982: 242*] found machine owners were reticent to talk about their relations with machine renters. The relationship between machine owner and farmer is critical for the organization of production [*1982: 93*]. Mechanization has increased the division of labour with the pattern being set by the rich peasants and capitalist farmers [*Hopkins, 1987: 25*]. In the past, reciprocal labour exchange between small peasant farms solved labour availability problems at peak periods, but mechanization and monetization have produced a pattern of hired labour with a high correlation between degree of mechanization and hired labour use [*Hopkins, 1982: 236*-7]. As tractor density increases, it is possible that owners attempt to tie farmers to them [*1982: 242*].

Hopkins notes that the machine owners are strongly differentiated from most farmers by virtue of the size of their own farming operation. While most of the machine owners have farms of five feddans or more, they represent a very small percentage of the farmers in general. This evidence thus supports the contention that the present pattern of agricultural mechanization in Egypt tends to reinforce or even accentuate the distinction between large and small farmers. It gives an additional advantage to the large farmers, and creates a very different pattern of social relationships between the machine owners and the others: "It is probable that mechanization is also to the advantage of the small farmer...but the point here is that relatively speaking it is more to the advantage of the machine owner" [*Hopkins, 1982: 238*]. The mechanization process reinforces the power and position of large farmers and the choice of technology reflects the perceived interests of large farmers.

This process has been of immense importance in accelerating peasant differentiation in rural Egypt, and as we shall see in the following chapters, has had important implications for the inverse relationship between farm size and productivity.

8.5 The dominance of the rich peasantry and the political sphere

This dominance of the rich peasantry extends to the political sphere at both local and national levels. In the smaller villages, with less than 10,000 people, the social structure is more likely to be shaped or influenced by a limited number of families. These family relationships are extremely crucial in local institutions [*Mayfield, 1974: 115*]. The village council chairman's authority and influence rest on his association with the leading families and informal village leaders [*Mayfield, 1974: 92*].

Mayfield [*1974: 111*] found that many village councils do not function as intended because the traditional families still dominate: "The popular powers in the villages have no strength within the ASU (Arab Socialist Union) because the *umdah* and the *shaykhs* in the village dominate the village and the agricultural labourers...They did not organise themselves together into an Agricultural Workers' Union because of the *umdah* and the large families and thus they continue to accept ten piastres a day...The *umdah* is the real head of the village's administrative machinery...His family controls over 800 feddans either by owning or leasing, and the members of the village council are all from his family..."

Adams [*1986: 152*] describes how rich peasants distribute vote money among their client *'umdas* who control the small peasant vote for National Assembly elections. At the national level rich peasant power is clearly visible. Agrarian policy itself was heavily influenced by the rich peasantry. Sayyid Mar'ei (a former large landlord) consolidated and enlarged various supervisory agencies into his own personal fiefdom: the Higher Committee of Agrarian Reform. This latter took control of the Agricultural Credit and Cooperative Bank in November 1955. In 1957, he became Minister of Agriculture and in 1960, the entire cooperative system was transferred to the Ministry [*Sadowski, 1991: 60*].

Sadat himself was from a rich peasant background in Minufiya. His policies consolidated rich peasant power in the rural administration: minimum property requirements were decreed for village mayoral elections, and the number of poor peasants serving on cooperative boards declined throughout the 1970s. Ever since 1952, rich peasants had been assured of at least half the seats in the National Assembly, simply by defining peasants as those with less than 25 feddans. In 1974, this was further diluted by raising the ceiling on this definition to those cultivating up to 50 feddans. Indeed, members of the agrarian elite were soon to form one of the largest and most important blocs in Parliament [*Sadowski, 1991: 81*].[19]

In the 1970s, the main spokesman for the rich peasantry was Ahmed Yunis, head of the CACU. He had established a vast patronage network which was able to influence the top political elite and a third of the parliamentary deputies. This developed into a power struggle between Sadat's Misr party and the CACU, the latter attempting to secure greater cooperative independence while the government tried to expand its control. Sadat disbanded the CACU in 1976 under Law 824 and transferred its functions to PBDAC based in Cairo and its network of village banks. In fact however, the village banks catered even more narrowly to the rich peasants because of property qualifications [*Sadowski, 1991: 82*], and the latter were able to dominate the shift of PBDAC towards medium and long term loans [*Sadowski, 1991: 202*]. By 1980, CACU had been reactivated with the *mushrifs* elected locally.[20]

These developments and the power of the rich peasantry in the Egyptian countryside have, however, been uneven. This heterogeneity has had profound implications for agrarian transition in Eypt. Hopkins [*1987: 4*] delineates two paths of agrarian transition in Egypt: a capitalist path (using hired wage labour and machinery) and a path dominated by petty commodity production with small farmers producing for the market and agriculture becoming increasingly marginalised. The paths are manifested in variant forms of village development. He provides [*1987: 55*] a typology of villages reflecting these different paths of agrarian transition in Egypt: 1) land reform or resettlement villages which have moved in the direction of intensification of petty commodity production; and 2) villages in which capitalist agriculture and the emergence of capitalist relations of production around wage labour have appeared.[21]

The land reform villages are dominated by family farms of 3-5 feddans dependent on the use of intensive family labour. The intent here is to maintain the "traditional" family farm as the unit of production and link it to the market through cooperatives [*Hopkins, 1981: 56-7*]. These small farms are not fully commercialised and operate with different decision variables from the large farms: small farms allocate land first to food and fodder crops, secondly to cooperative quotas and areas (in order to get input supplies), and only market if there is a surplus [*Ikram, 1980: 197*]. Hopkins states however, that "up to a point, larger farmers are not qualitatively different from smaller farmers, just quantitatively" [*1981: 48*].

These villages, characterised by small scattered land possessions prohibit the application of modern technology and lead to the fragile formation of capitalism. Fragmentation weakens their ability to adopt new agricultural methods, representing the intensification of capital utilization [*Ministry of Agriculture, 1989: 79*].

In the land reform village of Zeer, in Adams' study, where a more thorough-going land reform took place, less social differentiation and elite land accumulation occurred. Indeed, in the 30 years since land reform, out of 1,500 beneficiaries in Zeer, only 11 bought mechanised farm inputs, only 22 bought private land, and four of those had owned private land prior to land reform but had concealed it [*1986: 106*]. Thus, land reform had actually had the effect of slowing down capital accumulation: it "actually accelerated the rate at which farm units are unable to save and invest" [*1986: 128*].

In contradistinction, "direct government influence was certainly much stronger in the land reform areas than elsewhere...In the other villages the cooperatives were easily dominated by the rich peasants and the village headmen" [*Richards, 1982: 179*]. Villages in which large farmers have been able to accumulate land and other means of production such as machinery have exhibited a different outcome with increased social differentiation and the potential disappearance of the small farmer rather than his survival.

The capitalist villages appear to have relatively greater concentration of land, larger area and population, and higher levels of mechanization. Such villages also benefited from development efforts in the form of loans for machinery and other modern inputs. The mode of production changes because capital has penetrated the village and changes the system of production instead of being merely externally imposed via market relations [*Hopkins, 1987: 5-6*]. The family farm gives way to larger enterprises organized by the family, but based on wage labour and the intensive use of machine inputs [*Hopkins et al, 1981: 59*]. As we shall see in the following chapters, these distinctions and classifications are echoed throughout the survey data, and provide the political economy foundation for understanding the dynamics behind the inverse relationship and its breakdown.

Summary and conclusions

In this chapter, we have established the political economy parameters of the framework within which to analyse the inverse relationship at the micro level in the Egyptian countryside. We have seen that despite significant land reform measures, important elements of semi-feudal agriculture remain strong: sharecropping tenancy, personalised oral contracts, and debt. Access to land and resources lies through the patronage of the rich peasants and those landlords who managed to evade land reform legislation. This is the environment, the matrix of exploitative relationships, in which the inverse relationship flourishes.

Our hypothesis is however, that in the early stages of transition, institutional biases act strongly in favour of the larger farmers - often the legacy of previously existing systems continuing to operate where political power and status determine access to the resources which make up the package of technological change in agriculture.

Several studies, as we have seen in this chapter, show that the main beneficiaries of the land reform legislation, and subsequently, the cooperative and rural credit system in Egypt were the rich farmers. The control of the latter by the rich peasantry, those owning over five or ten feddans of land, ensured their dominance with respect to the diffusion of the new technology. While at an earlier stage, intrinsic advantages of scale are not unimportant, these become increasingly significant over time, enabling the large farmers to maintain relatively high investment and growth rates. In this two stage process, the first impact of agrarian transition is the weakening and disappearance of the inverse relationship. Later, when scale advantages operate for a substantial length of time the relation turns significantly positive.

In the next chapter, we subject the data used by Radwan and Lee in their 1986 study to much closer examination, in order to discover the nature and extent of the inverse relationship in the Egyptian countryside, and its relationship to technological change. This will provide a stronger empirical support for our hypotheses. Then, in the following chapter, we can explore, at the more disaggregated level of individual villages, just why such an inverse relationship exists, where it exists, and how it is changing.

Notes to Chapter VIII

1. See Abdel-Fadil's 1975 work, *Development, Income Distribution and Social Change in Rural Egypt 1952-1970*, which establishes the central thesis of this chapter: the dominance of the rich peasantry in rural Egypt. While we can agree with Abdel-Fadil in his masterful analysis of the increasing domination of the Egyptian countryside by a rich peasantry, we must, however, following Byres [*1977: 268*], question his assumption that the rich peasantry are necessarily capitalist farmers. As we have seen in Chapter V, this assumption has been the source of somewhat premature judgements concerning the development of capitalist agriculture and the resolution of the agrarian question in particular countries. There are indeed hints in

Abdel-Fadil [*1975: 46-48*] that significant elements of semi-feudal structures remain prominent in Egyptian agriculture.

2. These actors were large absentee landlords.

3. Infitah (=opening) is the process of market liberalization initiated by Sadat in 1974. A more apposite name might be Inghirab (=turning West).

4. This figure was provided by interviewees in the author's survey villages. See Chapter X.

5. Ansari mentions one notable who owned 477 feddans and who kept his holding intact by parcelling out titles among 5 grandsons and 8 female relatives [*1986: 131*]. The operation of several officially registered landholdings as one unit can also be seen in the ten feddan farm in the author's 1990 survey of Shubak al-Sharqi in Giza. See Chapter X.

6. The literature on rich peasant domination of cooperatives includes Kamal, 1968; Dumont, 1968; USDA, 1977; and Baker, 1978.

7. The word *ragul* is used in the sense of "big man".

8. See [*Adams, 1986: 60, table 3.3*].

9. See Ministry of Agriculture [*1989: 56-8*]. The duration of short term loans does not exceed 14 months and repayment is linked to crop maturity and marketing dates. The duration of medium term loans is never less than 14 months and not more than 5 years. The long term loan period is 5-15 years and is lent for land reclamation or building which requires real estate pledges.

By 1985-86, loans in kind still constituted more than 50% of total short term loans: 54.1% in 1985-6 [*1989: 62, table 5*], and PBDAC medium and long term loans accounted for 50% of advances [*1989: 66, table* 7]. The majority of investment loans go for animals, followed by agricultural equipment [*1989: 69, table 9*]. The development of loans for agricultural machinery shows increasing values over the period 1975-88 [*1989: 76, table 11*].

10. Abdel-Fadil [*1975: 31-34*] stresses mechanization in the process of peasant differentiation and the development of a capitalist farmer stratum in a permissive sense: only the rich peasantry had the necessary investible surpluses to invest in improved machinery. Byres [*1977: 265*] asks why this should necessarily be so given the plentiful supply of underemployed and unemployed rural labour. The answer possibly lies in the accelerating process of international labour migration to Libya, Iraq and the Gulf states during the 1970s. This comprised both direct and indirect effects: rural labour moved not only to the labour-importing countries, but to replace urban construction sector workers within Egypt. This produced temporary labour shortages in Egyptian agriculture during this period [*see Richards, 1989; Richards and Martin, 1983; and Birks and Sinclair, 1980*].

11. See Commander [*1987: 244, table 9.5*] which shows machine ownership by type and farm size in 1982 (taken from *Hopkins et al., 1982: 169*). The distribution of machine ownership shows a clear large farm bias.

12. See Hopkins et al. [*1982: 169, table* 7]: 48 out of 83 tractors and 49 out of 112 irrigation pumps are owned by farmers with more than five feddans of operated area.

13. Other studies tell the same story. The ERA 2000 report [*1979: 8.6*] found that of the 158 farmers in the survey, only 7 owned tractors - all of them large; 31 owned pumps, 5 owned sprayers and 4 owned threshers. The majority of these are in the hands of the farmers who hold between 5 and 24 feddans. The larger the farm holdings, the greater the proportion of farmers who are highly mechanized.

Nadim [*1979: 46*] also finds machine ownership increasing with farm size: the single owner who had machines in all categories was the largest landowner in the village (with over 20 feddans). In Minya, no-one with less than 3 feddans owned an irrigation pump, although access was available through rental markets.

14. A survey of 1,000 farms and 170 machine owners in 10 villages across 4 governorates in 1981-2.

15. The ERA 2000 study supports this finding. It finds that farmers were unable to adopt machines because they had "no money for down payment" (53%) or because it was "too hard to get credit" (29%) [*1979: 8.16*].

16. The use of tractors (a) and mechanical threshers (b) has increased markedly over time [*Commander, 1987: 255*]:

	(a)	(b)
mid60s	6%	9%
1970	25	32
1975	66	81

[*data source: El-Kholy and Abbas, 1982: 61-66*].

Commander [*1987: 255*] also cites a nine village survey in Qalubiya, Sharqiya and Minya which shows low levels of machine ownership, but a highly developed rental market [*Goueli et al., 1986: tables 5 and 8*].

See also Commander [*1987: 259, table 9.9*] which shows the use of machinery by operation and farm size for 1984. For all operations, the percentage of farm households using machines increases with farm size. And Commander [*1987: 265, table 9.11*] shows increasing irrigation technology by farm size in terms of the percentage of farm households using pumps in 1984.

17. See Commander [*1987: 255*] who cites Hopkins et al. [*1982: 158 ff.*] and Reiss and Lutfi [*1983: 31 ff.*]. Table 9E [*1987: 298*]

shows a massive increase in the growth of private machine ownership.

18. Radwan [*1986: 39-40*] shows that farm household income from the rental of equipment (and livestock) features only in the upper income classes [*table 3.7*]:

LE	income	no/HH	income/HH
0-300	0	0	0
300-600	130	6	21.66
600-1000	201	4	50.25
1000-1400	1326	6	221.0
1400-2000	1280	4	320.0
gt 2000	400	1	400.0

19. One of the effects of this has been that taxation of the agricultural sector has been a neglected issue in Egypt. In 1973, the Egyptian government proposed exempting small peasants with less than 3 feddans from a series of taxes and duties, but rich peasants managed to get this extended to all farmers regardless of size [*Sadowski, 1991: 82*].

Similarly with the intersectoral terms of trade. Abdel Fadil [*1975: 100, table 5.8*] has shown that these have moved in favour of the agricultural sector, with the prices of manufactured inputs being heavily subsidized and crop output prices being increased. Radwan [*1977*] has calculated two separate terms of trade indices for rich and poor farmers in which the former increased more than the latter. The income terms of trade also moved relatively more favourably for the rich peasantry. Abdel-Fadil [*1975*] has demonstrated that the share of agricultural income of farmers with over 5 feddans increased from 25% in 1950 to 32% in 1961.

Terms of trade indices for the agricultural sector 1960-75 (1960=100)

	all farmers			**poor farmers**			**rich farmers**		
year	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
1960	100	100	100	100	100	100	100	100	100
1965	85	88	79	86	88	79	92	85	86
1970	98	98	101	99	98	104	111	111	111
1975	102	97	120	102	96	124	127	122	146

(1) overall terms of trade index between agricultural output and all manufactured commodities.
(2) terms of trade between agricultural output and manufactured consumer goods.
(3) terms of trade between agricultural output and manufactured inputs.

20. Recent policy developments have also allowed the former landlords to re-enter the rural power structure. In the early 1970s, Sadat packed Parliament with rural notables in order to pass legislation restoring land titles to formerly sequestered

owners, and in 1975 this led to Law 67 which strengthened the hand of large landlords by adjusting tax assessments to give owners the ability to raise rents. This new legislation (which was passed after only six hours of debate) enhanced the power of landowners at the expense of sharecroppers and tenants: rent contracts could be cancelled at the behest of the landowner and rent disputes were to be settled at the local level [*Sadowski, 1991: 293-5*].

Shortly afterwards, these land owners were pressing for more radical legislation, their proposals including: an increase in rents from seven to ten times the value of land tax, the legal right to unilateral rental contract termination, the eviction of tenants who were late rent payers, and a reversion of cash rents to sharecropping [*Sadowski, 1991: 295*]. These measure would have permitted evictions on 90% of the cultivated area by allowing landlords to re-register plots in smaller parcels in order to evict tenants.

In 1982, landlords and rich peasants who formed a sizeable proportion of NDP membership (Mubarak's own party) lobbied to make the right of eviction and landlord resumption of land a centrepiece of their agrarian policy. When the New Wafdists won 58 seats in the 1984 elections, Mubarak conceded, but the proposals proved too radical and unpopular, and large popular opposition led by the Tagammu'a party prevented these proposals from becoming law.

Regardless, the landlords took the law into own hands: half refused to give tenants a written contract, only oral agreements which could easily be revised or single season contracts which were exempt from the rent laws. One method of land resumption was to bribe the tenant to leave the land. The result was massive resumption of own cultivation and tenancy agreements declined. Ownership increased from 25% in 1952 to 58% in 1983, with rich peasants increasing their share of land from 13% in 1977 to 18% in 1982 and large landowners enlarging holdings from 20 to 25% [*Rochin and Grossman, 1985: 300*].

21. Hopkins also mentions a third type of village which is dependent on migrant remittances or off-farm employment, and is mainly non-agricultural.

CHAPTER IX

A disaggregated analysis of the ILO data: technical change and the inverse relationship in Egypt

Introduction

The survey carried out by Samir Radwan and Eddy Lee in February 1977 within the framework of the ILO World Employment Programme provides an opportunity to test the relation between farm size and productivity.[1] The main focus of the ILO survey was on rural poverty, income and asset distribution, and employment, but it also includes information on production conditions with most of the variables necessary for our own purposes.

The principal arguments are, as we have seen in previous chapters, that at a high level of aggregation, an inverse relationship between farm size and farm productivity will be manifested, with its origins in land heterogeneity and long-run processes of population settlement. However, at a more disaggregated level, we may find a very different type of relationship and one that exhibits greater pattern variability. In regions of relatively backward agriculture, we have hypothesised that an inverse relationship will be found. In more advanced regions, however, that relationship may weaken or even cease to be negative with the transformation of existing production conditions from backward agriculture to a system employing modern technology - both biochemical and mechanical.

In section 9.1, we present the methodology and characteristics of the ILO survey. Section 9.2 recapitulates Radwan's analysis and results and the problems associated with his approach. Then, in sections 9.3 and 9.4, we present our results from a more detailed and disaggregated analysis of the ILO data. Section 9.3 presents a contextual account of technological change in Egyptian agriculture, showing the degree of unequal development and regional heterogeneity; while section 9.4 shows how the ILO data reflects this, and its implications for the inverse relationship at a more disaggregated level. This exercise represents a preliminary empirical analysis of agrarian technical change in Egypt before we come to the more in depth study of two of the villages in the ILO survey in the final chapter.

9.1 The ILO survey and its characteristics

The ILO data possess a number of advantages in comparison to much of the data used in earlier debates.

Firstly, since the data were collected at household level there is no need to rely on averaged data according to size-groups. Any level of disaggregation is possible. However, given the small sample size of some of the villages, it was thought that a governorate-wise level of disaggregation would be adequate for our purpose. Secondly, the period in which the data was collected provides a sufficient elapse of time since the major agrarian changes of the 1950s and 1960s - land reform and technological innovations. Finally, the data allow us to examine the size-productivity relation in conjunction with other important variables.

This study is based on the results of a sample survey carried out in 1977. A random sample of 1,000 households in 18 villages was drawn using the 1966 and 1976 Population Censuses as a frame. The sample size was partly dictated by considerations of comparability with the country's Household Budget surveys, which usually cover the same number of households in each of their four rounds. The sample was selected through a multi-stage sampling procedure.

Firstly, the country was divided into strata according to *muhafidha* (governorate or administrative region) boundaries. Seven of the 25 governorates were excluded because of their atypical features (being exclusively urban such as Cairo and Alexandria, or desert such as Sinai). From the list of the remaining 18 governorates a random sample of three was chosen from each of the two major agro-ecological zones, Upper and Lower Egypt. These were: Dumyat, Gharbiya, Menufiya, Giza, Beni Suef and Qena.

Secondly, the total number of households in the sample was distributed among the six governorates in proportion to their share of the total rural population of those governorates. The definition of rural used here is that of the Population Census, where the breakdown between rural and urban is based on administrative distinction: the urban population includes all people counted in the major urban governorates, capitals of all other governorates and capitals of markazes (administrative districts).

Thirdly, a stratified sample of 18 villages was chosen in such a way as to allow large and small villages to be represented in proportion to their respective shares in the six governorates combined. A population of 5,000 in the 1966 Census was taken as the dividing line (the cut-off point of 5,000 inhabitants in distinguishing between large and small villages is the criterion used by the Egyptian Family Budget Surveys). According to this criterion, one third of the villages were large and two-thirds small in 1966. Thus, six large and twelve small villages were drawn at random from the six governorates according to these governorates' shares of large and small villages. The principle chosen was the following: if governorate i had x per cent of the total number of large villages in the six governorates then we select at random 1/100.x.6 large villages from that governorate. For small villages, the formula similarly was 1/100.x.12 where x was the percentage share of i in the total number of small villages in the six governorates. Since whole villages (and not fractions) were to be chosen and since the total numbers chosen were small, the rounding error was large. According to the above criteria the numbers of large and small villages selected from each of the six governorates were as follows.

Finally, the number of households to be drawn from each village was obtained by distributing the number of households to be drawn from each governorate among the selected villages of the governorate according to the relative population of these villages. From each selected village in the governorate ij a sample of r_{ij} households was randomly drawn according to the following formula:

$$r_{ij} = [\, P_{ij}/N_i.\text{SUM } P_{ij}]\ S_i \quad (i=1....6)$$

where: S_i=number of sample households in governorate i
P_{ij}=population of village j in governorate i
N_i=number of sample villages in governorate i

Of the 1,000 households, 586 were to be drawn from the six large villages and 414 from the twelve small villages. A random sample corresponding to these numbers was drawn using the lists of the 1976 Population and Housing Census as a frame. The 1966 Population Census was used as a frame in drawing the governorate and village samples and, as the 1976 Population and Housing Census became available just on the eve of the survey, it was used to draw the household sample. Since the household sample was drawn from a frame different from that of the governorate and village samples, a number of checks were performed to ensure consistency such as relative sizes of governorates, numbers of villages and average size of households within the villages of the sample. No serious inconsistencies were found. Tables 65 to 67 provide a summary of the sample distribution.

The sample's representativeness of Egyptian rural society can be seen by comparing the survey results to national data. The geographical spread of the 18 villages in the sample was such that it ranged from the tip of the Delta (Meet al-Shiukh in Dumyat) to the south of the Nile Valley (al-Amiria in Qena). The villages represented a wide variety of rural economies with those that are purely agricultural (Tilwana in Menufiya), those that can be considered extensions to urban centres (Shubak al-Sharki in Giza), those with traditional handicrafts (head-cover making in Atf Abu Gindi in Gharbiya), and those near a large industrial centre (Kamalia in Gharbiya). Finally, some of the main characteristics of the household sample, such as the age and sex structure, employment patterns and income per capita were not significantly different from the national data. In one aspect, the sample was different from rural Egypt: the distribution of landholding. A comparison of the survey results with the 1976 statistics on landholding shows that the sample may have failed to capture the upper end of the distribution. The analysis of the sample results should therefore be interpreted with this bias in mind..

9.2 Analysis and results: (i) The Radwan regression and its questionable nature - the need for a more disaggregated approach

Given the relatively profound technical changes experienced by Egyptian agriculture, the results obtained by Radwan's regression of net farm output on farm size might seem somewhat surprising. Radwan finds the following relationship to hold:

$$\log y = 2.6517 - \underset{(0.0363)}{0.2559} \log x$$

$R^2 = 0.1075$
N = 425

where y is net farm output per qirat and x is size of landholding.

Radwan argues that this result is consistent with the large amount of evidence which shows that small farms are more intensive cultivators and have higher yields per unit area than large farms in the Third World and provides scope for further land redistribution in order to raise total output and reduce income inequalities.

However, Radwan's approach is questionable with regard to two points: firstly his use of net farm output may seriously bias the results in favour of finding an inverse relationship. Using imputed values both on the output and input sides as well as excluding labour costs on the small farms, as Radwan does, can easily produce substantial bias against the larger farms since an important cost element for the smaller farms is ignored. However we have retained net farm output in our yield calculations below as well as running regressions on yields using total crop values; and secondly, we must relate the results of these regressions to other factors, such as cropping patterns, cropping intensities, labour input intensities, and levels of technological development and commercialisation. Running regressions for all the variables cited, we arrived at the results for all Egypt presented in Table 68, Appendix A.

These mixed results are very similar to those observed repeatedly for areas of traditional agriculture. The relationship between farm size and output per net cropped area is significantly negative for the three alternative versions of the latter. Cropping intensity shows, as expected, a strong inverse relationship with operated area. We get mixed results for the relationship between farm size and output per gross cropped area: using net farm output we get a strong inverse relationship; using Radwan's total crop value figures we get a negative relationship significant at the 5% level; and using the corrected figures for total crop value, we get a positive but insignificant relationship. For individual crop yields we find significantly negative results for winter wheat, birseem, and cotton, while that for maize is negative only at the 10% level. For rice, however we find a statistically insignificant positive relationship.

These regression results would, if our hypothesis is correct, appear to suggest either that Egyptian agriculture has not yet undergone as thorough a transformation as is suggested in the literature, or that the regressions which have been carried out at the all Egypt level are excessively aggregated and providing us with misleading results. Both explanations are partially correct and their joint operation can be seen when we turn to the regression at a more suitably disaggregated level.

9.3 Analysis and results: (ii) a digression on technological change in Egyptian agriculture, uneven development and regional heterogeneity

While scientist man-years devoted to agricultural research and expenditure on agricultural research both doubled in the period 1959-74 [*Antle & Aitah, 1982: 57*], Richards was able to write in 1982: "The Green Revolution has had only a limited impact so far on Egyptian agriculture" [*1982: 215-6*]. Similarly, Antle [*1982: 35*] writes: "The preliminary evidence reported here suggests that there has not been the substantial technical change in Egyptian agriculture needed to generate long-run productivity growth."

However, it is not agricultural pricing policies that have played the major role in the stagnation of aggregate output, but the deficiency of investment in agriculture which has had a significantly adverse impact on the aggregate growth rate of the sector [*Esfahani, 1988: 135-6*]. The shift from public to private investment in Egyptian agriculture in the mid-1970s meant that most of it would have to come from large farmers who were able to expand production through more flexible combinations of crops [*Esfahani, 1988: 217*].

In general, there have been low rates of HYV dissemination in Egypt, despite generous seed subsidies. Less than 1% of the total rice area in Egypt was planted under HYVs in the early 1980s [*Adams, 1985: 714*]. The expansion of Mexican wheat varieties was quite rapid in the early 1970s: from 0.3% of the area in 1972 to 37% in 1974, but this declined steeply to 12.9% in 1976 (this compares with 76% in India and 84% for Pakistan) [*Ikram, 1980: 189-90*].

Improved maize varieties have been introduced since the 1940s but have had only limited impact on yields. Indeed there is little in the way of genetically improved maize varieties actually used by the Egyptian farmer: about 80% of the total area under maize is grown in local varieties from farm-supplied seeds. One "hybrid" (American Early) is now probably more local than improved by current standards. It is also probable that many of the varieties identified as hybrid are in reality seed which has been derived from hybrids rather than true hybrids [*Fitch, 1983: 13-4; Basheer, 1981: 5*].

In general, farmers do not have adequate knowledge of what seed is available from the cooperatives. Morsi [*1982: 242, table 6-19 and 20*] reports that the proportion of small farmers with information on modern technology, but who were unable to adopt were 13-22% of his sample and the small farmers who had tried modern technology were only 17-20% of the sample. Hopkins et al. [*1982: 113-4*] report that less than 15% of respondents in their study had heard of the Soil Improvement Organization and a quarter of those did not think it did any useful work. The extension worker fared even worse: 87% of farmers felt that he had given no information to them.

The reasons advanced for the low adoption rates for HYVs include the fact that these require heavier doses of other inputs such as fertilizer, irrigation water, and more careful handling, but the supply of fertilizer and seeds has been insufficient. While the gross returns are higher for the new varieties, the net returns are less than for the traditional local varieties. Harvest timing is more critical with greater potential losses. Ikram [*1980: 225*] states: "family settlements in the new lands failed because the technology developed was not suitable for small farmers"

Production of HYVs was confined to large farms and areas cultivated under the Land Reform administration [*Morsi, 1982: 52*]. Fitch [*1983: 64*] reports that trials tend to be held on larger farms and therefore may not be representative of typical farming conditions: "The fact that trial farms tend to be larger, and trial farmers better educated than the average, suggest that they may enjoy certain advantages which others do not. In addition to having better access to tractors for ploughing, trial farmers may also have advantages in the acquiring of seed and fertilizer; the fact that they are more timely in their application of nitrogen may reflect that supplies at the cooperatives are more available to them." Similarly with livestock feed subsidies which primarily accrue to large private producers and to the public sector, not to the small farmers who own 80-90% of the country's livestock [*Richards, 1989: 4*].

Antle [*1982: 71, table 2-1*] shows substantial growth in the local production of nitrogen and phosphate fertilisers in Egypt in the period 1965-78. In 1982-3, nitrogen fertiliser production capacity was 727,000 tons per annum with actual production of 666,000 tons produced by four local companies. Phosphate fertilizers are produced by three companies in Egypt with 1982-3 production reaching 127,000 tons [*Kaldas, 1984: 2-3*].

With the massive increase in fertilizer subsidies over the 1970s [*Antle, 1982: 78, table 2-8*], fertilizer consumption in Egypt grew rapidly.[2] The growth of fertilizer consumption decelerated in the 1980s but remained at high levels: indeed Egypt uses more fertilizer per cultivated acre than any other country except Japan - so high that the ecological sustainability of such practices is being increasingly questioned [*Richards, 1989: 12*]. However, while Egypt has very high rates of fertilizer consumption, the figures on annual fertilizer consumption do not indicate actual patterns of fertilizer use. Adams shows that small peasants facing a shortage of liquid resources regularly sell cooperative-supplied fertilizer to rich peasants for cash instead of using it themselves [*1986: 51-2*].

Egypt is mainly dependent on imported pesticides with domestic production limited to one government owned plant [*Schutz, 1987: 4*]. Use is not widespread as the expense of unsubsidized pesticides discourages small peasants from using them. Rich peasants growing fruit and vegetables however, do use them [*Adams, 1986: 225*].

Mechanization is the most obvious example of an increase in the level of the productive forces, together with new crops and techniques such as pesticides and fertilizer use. It has clear implications for the penetration of capitalist relations into rural areas in terms of the participation of the village in the market and in terms of the organisation of productive labour within the village framework. Hopkins writes: "There is certainly a sense in which one can say that mechanization of agriculture is the 'locomotive' of changes in the Egyptian countryside." [*1981: 45*]

The diffusion of farm mechanization in Egypt has followed the typical sequence found throughout the developing world, in which power intensive operations are mechanized first. Egyptian mechanization basically means ownership or use of an irrigation pump and tractor with ploughing and threshing being the operations most likely to be mechanized [*Hopkins, 1982: 93-4*].[3] Most mechanization has been tractorization, but use of grain threshers and irrigation pumps has become increasingly common [*Richards, 1989: 63; Imam, 1983: 2*]. Mechanization spread rapidly in the 1970s with the stock of tractors growing at 7.8% per year, then decelerating to 2.8% per year during the 1980s.[4] Tractor production began in Egypt in 1961 in a joint venture with Yugoslavia (which was halted during 1970-4) and then Romania from 1972 and later Canada [*Khalil, 1981: 12*]. But the industrial capacity for domestic manufacture of modern farming equipment remains limited in relation to imported units, some financed by aid [*El Sahrigi, 1984: 12*].[5]

As we saw in Chapter VII, Commander's Sharqiya village was characterised by an abundance of agricultural machinery and mechanical energy widely diffused for power-intensive activities [*1987: 55-6*]. But the diffusion of mechanization throughout Egypt has been very uneven. The level of mechanization varies considerably even from one village to the next [*Hopkins et al., 1982: 93*]. While some 66% of the cultivated area is ploughed by tractors, mechanised seedbed preparation has reached less than half of the area on farms less than one feddan [*Imam, 1983: 3*].

The benefits of tractorization can be seen in terms of increasing cropping intensity and yields, providing more flexibility in the cropping pattern, timeliness, and cost savings. In the early 1980s, Richards [*1981: 414-5*] did not see much scope for mechanization increasing cropping intensity in Egypt, but did admit that: "Perhaps mechanization will increase the cropping intensity of rich farmers. These crop less intensively than their smaller neighbours because of the problems of supervising and controlling a large hired labour force." This is precisely what brings about the breakdown in the inverse relationship.

Yields have also been improved by mechanization. Hopkins et al. [*1982: 131*] found in their study that the Gharbiya and Qalubiya villages reported higher yields than those in Buheira and Minya: "In general this pattern corresponds to the pattern of highly and poorly mechanized villages." Of course, what is important are the factors which led to the differences in mechanization levels in the first place. Indeed, they found that the variation in levels of mechanization between villages was much more significant than the variation between crops and higher mechanization associated with higher yields [*1982: 235*].

Sahrigi et al. [*1984: 8, table 2*] show substantial net benefits per feddan from mechanization in terms of animal loss recovery, labour cost savings and increased production. They found a wide range of modern farm equipment was associated with net benefits: mower binders [*1985: 33*] reduced labour costs and increased timeliness of operation, and mechanized threshers also [*1985: 40*]. Seed drills produced yield increases [*1985: 49*] and increased seed loss recovery while reducing labour costs [*1985: 52*]. Mechanical irrigation pumps released animal power to increase milk and meat yields and also helped large farmers to avoid labour supervision problems in *saqiya*[6] rings [*1985: 59*]. Mechanized tillage led to yield increases and savings in labour time in cotton cultivation [*1985: 69*], and Imam [*1983: 15*] reports improved yields for mechanized tillage in Upper Egypt for maize and for cotton. Scale economies were also important factors, with large pumps above 7.5 hp more economical to use than small 5 hp pumps [*El Sahrigi, 1985: 64*], while combine harvester use produced losses on small farms, but were feasible on large farms over 5 feddans [*1985: 28-31*].

Thus, in this section, we have seen evidence of considerable technological change in Egyptian agriculture, but this change has been uneven both regionally, and in terms of control and diffusion of benefits which have been skewed towards the large farmers. These benefits have been real and positive, and may have allowed the larger farmers to reap significant productivity advantages. We shall see in the next section how this is reflected in the data through a heterogeneous pattern with respect to the inverse relationship.

9.4 Analysis and results: (iii) A disaggregated analysis and evidence of transition

It remains to choose an appropriate technique to test the relationship between farm size and the other dependent variables. For parametric tests the choice of regression specification lies between the conventional linear, log-linear and semi-log etc. As there is no *a priori* reason to select any particular specification, we employed the same technique as Radwan - the log-linear regression. The specification of the regression equations is the same in all cases: $\log y = \log a + b \log x$ where (x) is always operated area and (y) is the indicated dependent variable.

When running regressions at the governorate level, we first notice the heterogeneity of rural Egypt in terms of production conditions: cropping patterns, levels of commercialization and mechanization. The results are presented in Table 69 in Appendix A. The governorate-wise analysis of the relation between farm size and output per net cropped area reveals that Egypt is undergoing a process of transition. For net yields (y1), based on total crop values, we find that a significant inverse relationship exists only for two governorates: Menufiya and Giza. Negative but insignificant relationships exist in Beni Suef, Dumyat and Gharbiya, but in Qena the relationship is positive. Even for net yields (y4), based on net farm output, we find that while the relationship is negative for all governorates, those for Qena and Beni Suef are statistically insignificant. Again, using corrected net yields (y6), we find that the inverse relationship is significant only for Giza while the other governorates are only weakly negative and that for Qena is actually positive.

This pattern is more sharply brought out by regressing output per gross cropped area on farm size. For gross yields (y2), based on total crop values, we find weak inverse relationships only for three governorates: Dumyat, Giza and Beni Suef, while for Qena governorate the relationship has become significantly positive at the one per cent level. Gharbiya and Menufiya show weak positive relationships. For gross yields (y5), based on net farm output, we find significant negative coefficients for Gharbiya, Dumyat and Menufiya, but for Beni Suef and Giza only statistically insignificant negative coefficients, and for Qena the regression coefficient is positive. Regressing corrected net yields (y7) on operated area we find only one significant result: a positive coefficient for Qena governorate. Gharbiya and Menufiya have statistically insignificant positive coefficients while the other three have weak negative ones.

These results show a clear and important departure from the results obtained by Radwan and others. While it is common to find neither significantly positive nor negative signs in the relation between farm size and output per gross cropped area, the fact that we have obtained significant positive coefficients means that either due to cropping patterns or yields of individual crops, large farmers have achieved important advantages. Since the use of gross cropped area tends to eliminate differences in cropping intensity it would be interesting to see whether small farmers have retained their traditional superiority with higher cropping intensities than large farmers. Regressing y3 (cropping intensity, equal to the ratio of gross cropped area to net cropped area) we do find that the traditional pattern has been retained. Regression coefficients for all governorates are highly negative. For Dumyat, there was no variation across farm size with the cropping intensity 2 for all fifteen farms. However, the fact that the inverse relationship between farm size and productivity has in many cases disappeared, despite greater cropping intensities on the smaller farms, tends to confirm the importance of cropping patterns and yields for individual crops. It should further be emphasised that cropping intensity remains an inadequate measure of land utilization. The possibility that large farmers choose a cropping pattern with longer average growth periods, and that the inverse relationship associated with cropping intensity neglects these differences in cropping patterns cannot be ruled out.

As far as yields for individual crops are concerned, we ran regressions for winter wheat and clover, cotton, maize, rice and sugarcane separately (these crops account for over nine tenths of crop production in Egypt). For wheat (y8), we find a significant inverse relationship (at the 10 per cent level) only for Giza, while in Qena we find a significant positive relationship. All the remaining governorates have insignificant coefficients. Birseem yields (y9) exhibit a significant inverse relationship for Dumyat, Menufiya, and Giza (again at the ten per cent level) while the relationship is statistically insignificant for the other governorates. For cotton (y10), there is no clear relationship: yields vary inversely with farm size in Beni Suef and in Gharbiya, but the relationship is only significant at the ten per cent level, while there is no variation across farm size in Menufiya. None of the sample farms in Dumyat, Qena or Giza plant cotton during the summer season. Summer maize yields (y11) show no significant relationship across farm size, although the coefficient for Qena is positive. For rice (y12), the coefficients are all positive, but insignificant. In our sample, only Qena has land under sugarcane (a Sa'idi crop and one typically grown on large farms with an annual cropping cycle) and yields (y13) exhibit a significant positive relationship with farm size.[7]

On the whole, the governorate regressions indicate a more heterogeneous pattern of the relationship between farm size and productivity, possibly reflecting the process of change that the national all-Egypt regressions do not reflect. Ranking the governorates from those with the strongest positive relationship between farm size and productivity to those with the strongest negative relationships we find the following order: Qena, Menufiya, Gharbiya, Giza, Beni Suef, and Dumyat. We must now attempt to relate these findings to other factors in the process of agrarian transformation in Egypt. We have calculated several alternative indices of relative levels of "progressiveness" ranged in Table 70, Appendix A.

In these tables, Qena which as we saw exhibited positive regression coefficients for the relationship between farm size and productivity is ranked consistently highly for all four indices, which reflect the level of use of both Green Revolution inputs and total purchased inputs. The same holds true for Minufiya, whereas Dumyat with strong negative coefficients in the regressions is here ranked consistently at a low level. The other three governorate rankings vary according to whether we use indices based on total crop values or on net farm output.

For the ratios of purchased to own produced inputs we find again that Qena is ranked consistently highly. High fertilizer use is closely correlated with the cultivation of HYV crops. Fertilizer use is high in Beni Suef also, reflecting the traditional variation in the use of fertilizer for cotton (use of fertilizer for cotton increases from north to south with good yield responses due to higher temperatures and better drainage). The high seed ratios for Giza can be explained by its location in the Cairo vegetable zone in which market gardening is the predominant activity. We can see that for all governorates, birseem purchases are only a fraction of self-cultivated fodder, but again Qena shows the highest level of purchase of this input.

Turning to the mechanization indices, we find that the governorates of Dumyat and Giza are ranked bottom while Gharbiya is at the top. Qena and Menufiya are also ranked in the top three positions. In Tables 61 and 70, which present figures for tractors and other agricultural equipment by governorate, we can see that Qena and Gharbiya are ranked highest for tractors, ploughs and trailers while Qena has by far the highest level of mechanical power for irrigation. By contrast, Beni Suef fares consistently badly as far as this table is concerned.

Thus, the results of the regression exercises on the sample households reveal a more regionally differentiated pattern of the relationship between farm size and productivity, which when compared with the indices of progressivity, appear to reflect a more heterogeneous process of transition taking place. In those areas of progressive agriculture, such as Qena, with high levels of technology use, we find that the inverse relationship has turned positive while for regions where the impact of the new technology has been limited, such as Beni Suef and Dumyat, the inverse relationship remains negative and significant. The other governorates present an intermediate picture, with Menufiya and Gharbiya tending, on the whole, to show a high level of progress and weakly positive coefficients on the size-productivity relation, while Giza tends to reveal signs of backward agriculture still predominating and a strong inverse relationship.

Summary and conclusions

Thus, on the basis of the evidence in this chapter, we might suggest a plausible hypothesis for the impact of agrarian transformation on the relation between farm size and productivity. We have found in the Egyptian rural sector striking parallels with the process of agrarian transition in India, with regard to the technological factors. The heterogeneous pattern of technological change in Egyptian agriculture is mirrored by the pattern of occurrence of an inverse relationship between farm size and productivity. Where technical change in agriculture is at a relatively undeveloped stage, we appear to have evidence of a significant inverse relationship. In those regions where technical change is relatively more advanced, the inverse relationship is absent. We can advance the hypothesis, on the basis of the evidence in previous chapters, that technical change in these latter regions has led to the breakdown of a previously existent inverse relationship.

The 'traverse' from Giza to Qena, representing a development of the forces of production both determines and is determined by the development of the relations of production. In particular, rich peasants, either as proto- or fully-developed capitalist farmers monopolise productive resources and dominate access to the new technology through their control of the cooperative and rural credit systems. The utilization of this new technology accelerates rich peasant accumulation and deepens the process of social differentiation. The productivity advantages thus gained lead to a structural reversal in the size-productivity relationship characteristic of a relatively backward agriculture.

However, there is little more we can say on these political economy aspects at such a relatively high level of aggregation (governorates are certainly a more reasonable level of aggregation than Egypt as a whole, but still exhibit significant heterogeneity with respect to both soil quality and technical and social change). In order to explore these aspects in greater detail, we carried out fieldwork in two of the villages contained in the ILO study in the summer of 1990. The results of this analysis are presented in the following chapter.

Notes to Chapter IX

1. I am greatly indebted to Samir Radwan, Chief, Rural Employment Policies Branch, Employment and Development Department, International Labour Office, in Geneva, for providing me with the original data on which his joint study with Eddy Lee on the anatomy of rural poverty in Egypt was based. Many thanks are also due to his colleagues Albert Wagner and Patrick Cornu for preparing the SPSS-X tape files and instructions. I appreciate immensely the enabling help of Ajit Ghose, formerly at the ILO and Ruchira Chatterji, formerly in SPS, Cambridge University.

2. See Richards [*1989: 63, Appendix, tables 6A and 6B*] who shows the intensity of chemical fertiliser use and growth rates between 1972 and 1988: the nitrogen use index rises from 100 to 493; and the phosphate index rises from 100 to 384. In the 1970s, fertilizer prices were only between 41 and 61 percent of world market prices [*Adams, 1986: 53*].

3. See Richards [*1989: 63, Appendix, table 15*] who presents details of the spread of mechanization by agricultural operation in 1982: 90% of ploughing and 62% of irrigation activities are mechanisd. See also ERA 2000 [*1979: 8.5, table 8.1*] which shows machine use by operation.

4. See Richards [*1989: 63, Appendix, table 14*] who presents figures for the growth in the Egyptian tractor park and combine harvesters over the period 1971-86: the tractor park increases from 17,556 to 44,000; and the number of combine harvesters rises from 1,750 to 2,250.

5. See Khalil [*1981: 14, table 3*] who presents figures for domestic tractor production, reaching only 306 for the Yugoslav model and only 160 of the Romanian type in 1978-9. These were swamped by imports of 6,061 tractors in 1977 [*1981: 16, table 3-2*]. Khalil [*1981: 10*] gives details of aid funds for mechanization in the early 1980s: $32 million from the IBRD, $1.7 million from USAID and $5 million from Japanese AID.

6. This is a traditional form of waterwheel irrigation operated by a group of farmers.

7. The regression equation for sugarcane yields (y13) was:

$$\log y13 = 0.915 + 0.049 \qquad R^2 = 0.029,\ n = 63,\ t = 1.35^*$$

CHAPTER X

A closer look at the inverse relationship in the context of agrarian transition: evidence from fieldwork in rural Egypt

Introduction

In order to test the various hypotheses associated with the inverse relationship in the context of agrarian transition, further fieldwork was required at a more disaggregated level than the ILO data permits. Two village surveys were carried out in the summer of 1990. On the basis of the results from the ILO data, a village was chosen from Qena governorate which was expected to show a positive relationship between farm size and productivity. A second village was chosen from Giza governorate which was expected to shed light on the inverse relationship.

Section 10.1 describes how the fieldwork villages were selected, the survey methodology employed and some of the problems associated with the data. Section 10.2 analyses the data for the Giza village, and section 10.3 shows how and why an inverse relationship arises in that village. The following section 10.4, analyses the data for the Qena village, showing how the inverse relationship has broken down there. Finally, in section 10.5, we compare the results in the two villages, within the wider context of the political economy of the Egyptian countryside.

10.1 Fieldwork methodology and problems

The first task was to select the appropriate villages from the ILO survey for further analysis. Clearly, on the basis of the results in the previous chapter, Giza governorate presented the strongest evidence for an inverse relationship between total crop output per net cropped area and farm size. This governorate also showed a weak, but statistically insignificant negative relationship when crop output per gross cropped area was used in the yield calculations. We have also seen that Giza ranked consistently low in the tables for indices of "progressivity", particularly in terms of new technology use and mechanization.

Qena governorate, on the other hand, provided clear and strong indications of a positive relationship between farm size and productivity: a positive, but statistically insignificant regression coefficient using net yields, and a much stronger and statistically significant positive coefficient when gross yields were used. This governorate ranked consistently high on the indices of "progressivity", particularly with regard to machine use. These two governorates then would be the starting point.

It was possible to disaggregate the ILO data one further stage, down to village level. At the village level though, sample size was too small in most cases to be a reliable indicator of the strength and direction of any relationship between farm size and productivity. Thus, attention was directed only to those village samples of adequate size. The two largest samples were from the village of Shubak al-Sharqi in Giza governorate (151 households, 68 of them with an operated area) and the village of Higaza in Qena governorate (129 sample households, 38 of them with operated holdings). The disaggregated ILO data is presented in Table 71, Appendix A.

The village of Shubak al-Sharqi revealed a statistically significant inverse relationship when net yields were regressed on farm size, and a statistically significant inverse relationship between cropping intensity and farm size. The three villages in Qena governorate all show no relation between farm size and output per acre, although it may be significant that the strength of the positive relationship increases as we move from net yields to gross yields, despite significantly higher cropping intensity on the small farms. Note that the Al-Amiriya results differ, but the sample size is too small to really tell us very much. Higaza, with the largest sample size provides the most robust results. Therefore, the two villages Shubak al-Sharqi in Giza and Higaza in Qena governorate were selected for more detailed fieldwork, the former expected on the basis of the ILO results to be an inverse relationship village, and the latter one in which the inverse relationship had broken down.

Both villages had the additional advantage that they were more suitable logistically in terms of access. The fact that Shubak was only an hour's drive from Giza, and Higaza an hour and a half from Luxor greatly facilitated the fieldwork in terms of accommodation and transport. The Giza governorate Ministry of Agriculture on the Pyramids road was some 30 minutes taxi drive from Cairo. From Giza, the ministry vehicle took us down the east bank of the Nile past the pyramids at Saqqara on the desert horizon. Some 30 kilometres further south we turned off through a date palm grove at Shubak al-Gharbi to cross the cantilever bridge into Tabbin on the east bank. The village of Shubak al-Sharqi lies just to the south of Tabbin.

The journey to Higaza was rather more complicated. From the main bus station in Luxor (721 km south of Cairo and 14 hours by train), a minibus travels north for 90 minutes to the district centre of Qus, where the district Ministry of Agriculture and research station is located. From there a 25 minute ride on the back of a motorbike brought us to the village of Higaza, some 15 km to the southeast.

The survey method comprised both formal questionnaire and informal interview, as well as limited access to the records compiled by the village cooperative and district Ministry of Agriculture. A formal structured questionnaire was necessitated by the impossibility of actually living in the survey villages. It was only possible to visit the villages on a daily basis. The local ministries and village cooperative officials frowned on any suggestion of staying in the villages for any length of time, as the political situation at the time of the visit to Egypt was somewhat dangerous, particularly in Upper Egypt.

The surveys were conducted between June and September 1990 with the help of two assistants loaned by the local ministries of agriculture.[1] The questionnaire was conducted in Arabic, as were the interviews, and can be found in Appendix B.[2] Each questionnaire interview took an average of an hour to complete. The informal interviews were taped and lasted from one hour to 90 minutes. These covered a variety of qualitative indications of the circumstances of the village, village history, locations, amenities, and the dynamics of the villages.

Each questionnaire consisted of fifteen pages. There were several sections to the questionnaire which was based on the original ILO format. The first section covered basic demographic details of the household members: age, gender, marital status, relationship to head of household, principal and secondary occupations, and educational attainment. The second section covered household labour: each working member's on-farm work in each season (winter, summer and nili) in standardised days, permanent and or casual work off-farm, but within agriculture, again for each season, and the wage earnings for work off-farm and outside agriculture both inside and outside the village.

The third section covered land ownership and operated area of the household: land owned, land rented in, land rented out, and estimated land value. Respondents were asked to give details of the terms and conditions under which land was rented in or out (for example, whether it was sharecropped land, the level of share, and whether cash or kind payments were made). This section also included information on the expansion or diminution of land over the previous year, over a five year period and over the lifetime of the current head of household, either by inheritance, purchase, gift or mortgage.

The fourth section covered the ownership of agricultural machinery and equipment: whether fully owned or shared, their going market value (on the basis of new for old), and recent additions to the machine stock, while the fifth section dealt with ownership of animals: whether fully owned or shared, their market value and recent additions or sales. The sixth section asked about the ownership of other assets such as vehicles, non-agricultural machinery, artisanal tools or non-residential buildings, and the income earned from their use. The seventh section covered the house itself: type (mud brick or red brick) and value, facilities such as electricity, running water, sanitation, and building extensions to the house in the recent period. The eighth section covered credit transactions: savings and loans, and their terms and sources.

The ninth section gathered information on the crop production of the household: crop grown, type, season, output, area sown, quantity consumed on-farm, and quantity marketed with unit price. The tenth section covered other income from production: land rental income, dairy and poultry produce, including on-farm consumption and market sales. The eleventh section covered production inputs: land rental cost, fodder, machine rental, fuel and maintenance, the quantities and prices of chemical and organic fertilisers, insecticides and pesticides, seeds, and labour costs for hired labour for each season, with days worked and wages. The final section covered input purchases and credit from the cooperative system, as distinct from the total inputs in the previous section.

Problems of data collection besides the impossibility of living in the village to carry out participant observation, included the impossibility of collecting data on the labour input of female members of the household. Although women are to be plainly seen working in the fields, tending to plants or collecting animal fodder, almost all respondents claimed that women do not work in the Sa'id (Upper Egypt). For female household members to work in the field would have been *a'eb* (disgraceful). Some information on child labour was forthcoming, not by the respondents themselves, but from some large labour hirers in informal interviews (see below).

Another problem was the inability to get good information on savings and loans. No respondent would admit to having savings. And although information on bank or cooperative loans was readily forthcoming, and one or two of the larger farmers gave me details of their private borrowing, smaller farmers were extremely reluctant to give me any information on borrowing from informal sources. The financial status of households has therefore had to be deduced from the cash flow of the household and the sustainability of their declared incomes and expenses.

Finally, we need to pursue the important matter of size classification. Indeed, the question of size as the relevant stratifying variable is to some extent raised by the Giza data. This will be discussed below in section 10.2 within the full analysis of that data. Here we limit the discussion to the question of stratification. Abdel Fadil presents the following stratification schema [*1975: 41*]:

1) landless peasants[3]
2) poor peasants with less than 2 feddans
3) small peasants with 2-5 feddans
4) middle peasants with 5-20 feddans
5) rich peasants/capitalist farmers with more than 20 feddans

This schema he compares with that presented by Samir Amin [*1964*]:

1) landless peasants
2) poor peasants with less than 1 feddan
3) middle peasants with 1-5 feddans
4) rich farmers with 5-20 feddans
5) rural capitalists with more than 20 feddans

Abdel-Fadil's classification schema can be questioned on a number of points. Byres [*1977: 266*] suggests that the cut-off point for the poor peasantry should be 2 feddans, as suggested by the land reform legislation's redistribution of land in plots of not less than 2 feddans. However, the distribution of plots in this manner was dependent on family size and soil quality. Two feddan plots would have been characterised by either better soil quality or by their distribution to farm households with less than the average number of persons. Most respondents in informal interviews with the author however were certain that three feddans was the minimum size of farm to sustain the average farm household. I have further subdivided the class of farms below three feddans into those below one feddan, which for all intents and purposes are extremely marginal farms, operated by practically landless labourers, and those above one feddan but less than three who can be classed as the poor peasantry proper. Interestingly, as the results show below, while we have high productivity on farms from 1-3 feddans, productivity actually falls off below one feddan. These latter farms are just too small and marginal to sustain high productivity farming.

Abdel-Fadil's category of small peasants is problematic. These he describes [*1975:41-2*] thus: "They usually operate on a family basis, and in most cases manage to raise most of their subsistence food requirements. In other words, they are under somewhat less pressure to resort to 'consumption loans', and hence are less indebted to money-lenders". However, as Byres [*1977:267*] points out, these are surely the middle peasants identified in the classification schemas of Lenin and Mao, as well as those of Alavi and Wolf. We have classified the farms between 3 and 5 feddans as middle peasants.

Finally, Abdel-Fadil's middle peasantry with 5-20 feddans: "Having somewhat larger holdings than that of the 'small peasantry', this group is usually more prosperous and employs permanent wage labourers to some extent. These peasants produce mainly for the market and their crop-mixes normally cover a wider and more profitable variety of crops (i.e. cash crops and vegetables). In general, their holdings are 'technically' more efficient in terms of the use of better irrigation facilities, improved seeds and more intensive use of bullock labour and farm equipment.

"They generally enjoy a surplus over and above their consumption requirements after meeting other fixed money obligations. Often these 'middle peasants' are also engaged in other gainful activities such as retail trade and money-lending. In other words, these farmers have a fallback source of income in case of low yields" [*1975: 42*].

As Byres states [*1977: 267*]: these appear to be full-blooded, archetypal rich peasants, the same stratum as Abdel-Fadil's rich peasants with identical class interests. Indeed Abdel-Fadil's mispecifications, as pointed out by Byres, may be structured around the mis-identification of rich peasants as capitalist farmers. As we have seen in our discussion of the Indian mode of production debate, rich peasants are not the same as capitalist farmers, although the transformation of such a class into a capitalist class is a central process of a successful transition to agrarian capitalism. But that transformation has to be demonstrated and not simply asserted.

A central hypothesis of this thesis is that within the uneven development of the Egyptian countryside, these rich peasants are in many cases not "technically more efficient" based on their use of modern technology. On the contrary, in those areas of relatively backward agriculture, rich peasants are using essentially the same traditional technology as the poor and middle peasants, thus generating the circumstances under which an inverse relationship arises. Only in those areas where the rich peasantry have transformed themselves into a class of capitalist farmers will they be more efficient, and produce the conditions for a breakdown in the inverse relationship.

10.2 An inverse relationship village in Giza

Giza is a large governorate west and south of Cairo, with an estimated 1990 population of 4.265 million and covering an area of 85,153 square kilometers. The northern part is a sprawling suburb of Cairo, but rural Giza stretches some 750 km down the Nile valley. The village chosen was Shubak al-Sharqi in al-Saff district, around 35 km south of Cairo (and some 12 km south of the Hilwan industrial complex on the east bank of the Nile. To the west of the village is the Nile and the main road to Giza and Cairo (on the west bank). On the east is the Saff-Cairo road. Al-Tabbin, the nearest town, is 5 km to the north, and to the south is the Minya-Shubak road.

The total village population is around 50 thousand. Shubak comprises 711 *ha'izeen* (farm holdings). About half the population are landless, and the number working in farming has decreased in recent years. Many work in the local cement factories and foundries which surround the area, while others with greater means run private businesses. The *mushrif zira'i* (agricultural supervisor) estimates the proportion of village population who actually own and operate land at 15 percent, based on an average of 9.5 persons per holding. This of course does not include landless agricultural labour.

Many people work full-time in the local factories. A floor cleaner can earn LE 40-50 a month. The mushrif was of the opinion that a person without land is better off with a factory job because they pay regularly, but the agricultural work is seasonal, and there are long periods when the farm labourer does not work. Some villagers have gone for work abroad in the Gulf, most of them aged under 40.[4] Those with artisanal skills, such as plasterers or coppersmiths, tend to commute and work in Cairo.

There is a *suq* (market) in the village every Thursday for animals, vegetables, and fruit. There are around 500 shops in Shubak. There are further trade relations between the local villages. Every group of villages in the locality has a market with one in al-Minya and Shurafa every Sunday. Ikhsas and Ghamaza villages hold a joint market south of Shubak. On the average, there is one *suq* for every two or three villages. A large number of people from Shubak own land in other villages. Some rent tractors to farmers in other villages.

The local institutional infrastructure in Shubak includes an *i'timan* (credit) cooperative or village bank. There are currently only two cooperative staff members, one having died recently. The director is located in al-Saff, the district centre, some 25 km further south. There is a local government unit in the village, headed by an engineer, and there is also a local council, elected to serve Shubak and Minya. The Minya unit is fairly large, but the *zimam* (cultivated area) is smaller than that of Shubak, and most of the land there is unsuitable for cultivation due to sewage outflow. There is a veterinary clinic in the cooperative building, but no government machine centre. There is one at Saff, and the engineers are located there. The irrigation system is supervised by the department in Hilwan.

There is a medical clinic in the village and a hospital in al-Saff. Education is catered for by one primary school and one intermediate school, and there is a religious college attached to al-Azhar. There is no secondary school in the village, but there is one in Ikhsas and in Saff. Most of the houses have electricity, and 60-70% have piped drinking water. The rest have to use the village pump.

The *mushrif* explained that the village population were originally bedouin migrating from the Hijaz in Saudi Arabia. Prior to the 1952 revolution, the land used to belong to a small elite of feudal landlords in large *'azab* (estates). One large landlord used to own over 300 feddans for example. In 1952, the land was divided up into smaller plots and distributed to smallholders who bought land.

There are still important families in the village of long standing, such as the Dawud, Azzam, Maliji and Zeid clans. The Dawuds and Azzams were large landowners prior to the revolution, and many members of these families hold prominent positions locally. Of the cooperative officials in Shubak, one is from the Azzam family (the *mushrif* himself) and the other is from Cairo. The director of the local council is Dr. Mohsein Azzam, and includes members of the other families.

The village *zimam* (cultivated area) is just over 1,185 feddans, out of a total village land area of around 2,100 feddans. The non-cultivated area is accounted for by factory sites and the rest of the area is covered by the mudbrick and breeze block houses of the village population. A main road runs down through the centre of the village which for the most part is unsurfaced and turns into a muddy concourse in the rain.

The village exhibits the size-class land distribution shown in Table 72, Appendix A. This compares well with the governorate level distribution shown in Table 73. As can be seen from the table, over 92% of the farms (658 out of 711) are less than 3 feddans. Three feddans is generally regarded as constituting the minimum feasible size in terms of subsistence income. Of these, 263 or 40% are less than one feddan. Over 76% of the small farms are owner operated (503 farms), and 155 are rented. The former account for 77% of the operated area (917 feddans out of 1,185). The 3-5 feddan farms or middle peasant farms account for just over 6% of the holdings (44 out of 711 with 36 or 82% of them owner operated). These account for 189 feddans or 16% of the operated area, of which 81% is owner operated. The farms above 5 feddans or rich peasant farms are 9 in number or 1.26% of the total farms. These farms account for nearly 7% of operated area. Note the difference between those 5-10 feddan farms and the one farm above 10 feddans. Of the former, half are owned and half are rented, with just under half the operated area rented in. The 15 feddan farm is wholly owned.

Note that this 15 feddan farm, which belongs to the village *shaykh*, the most important village notable, is not the farm used in the regression equations or data survey. Unfortunately, the *shaykh* had been hospitalised for some time before the survey period and was unavailable for interview. A close family member did provide some approximate indications of farm size and output over the year, but was unable to provide any details of input costs or other expenses. These indications pointed to relatively high output per acre, but as the figures were only indicative, and not significantly robust, it was decided to exclude them from the survey. The ten feddan farm included in the survey is not officially registered as ten feddans. It belongs to an important family in the village consisting of two brothers and a sister. The land is thus registered in three parcels, but it is operated as a single and contiguous production unit, with the respondent in overall control.

The cropping pattern in Shubak prior to the revolution was dominated by cotton, but 25 years ago after construction of the High Dam, the village moved to the current cropping pattern. The predominant cropping pattern in the village is three season. The winter season (November-February) cropped area is almost entirely accounted for by birseem (54%), potatoes (30%), and vegetables (14%) including tomatoes, eggplants and haricot beans.[5] The summer crops (March-August) include maize (60%) and vegetables (26%), mostly tomatoes. The short nili season[6] (September-October) is devoted to millet which is cut green for animal fodder (89%). Only 60% of the net sown area is planted in the nili season, predominantly small farms producing their own fodder. Birseem is an important animal fodder crop. Poor farmers prefer to grow their own birseem as purchased fodder is very expensive.

One group of farmers grow potatoes both in summer and winter. The summer potatoes are put in the cold store and planted 4 months later. Summer potatoes have to be bought in from outside. If potatoes were not cultivated in the previous year, the farmer cannot get seed potatoes on credit. Those who do not grow summer potatoes can obtain seed potatoes only from other farmers who have extra bought from the cold store. They cost LE 600-700 per ton, while the normal price for harvested potatoes is only LE 100-200 per ton. A small group of farmers prefer the purchase of improved seeds from outside which give better yields than the normal red potatoes. These are the yellow Diamond variety potatoes. Small farmers do not have enough land or enough capital to cultivate potatoes in this way.

With help from the officials in the village cooperative, a stratified sample of 69 farm households was drawn, based on the size distribution given in the 1981 Agricultural Census for Saff district in Giza governorate. This represents approximately a 10% sample. The district distribution was a close fit to the village distribution which was not available at the beginning of the survey. The sample was not random, in the sense that landless households were excluded unless they were renting in some operated area. The sample was limited to those heads of household whose principal occupation was *fellah* (peasant) or *muzari'a* (farmer). Furthermore, care was taken to avoid farms with significantly below or above average soil fertility. We discuss this below when we come to the question of soil quality in the village.[7]

OLS regression of net yields on farm size, without logarithmic transformation, for all 69 farms in the sample shows no clear relation across farm size. However, following Rudra and Patnaik, it is important to examine the data graphically, i.e. in scatterplot form, in order to present the underlying pattern of the data visually. This indicates a kinked U-shaped average curve, with the small farms between one and three feddans and the one large ten feddan farm exhibiting high yields.

Seven outliers were excluded from the subsequent regression exercises. These were identified on the scatterplot of net yields against farm size. Detailed examination of the residuals and computation of Mahalanobis and Cook statistics confirmed that these observations unduly distorted the underlying pattern.[8] The outliers included the ten feddan farm (see below for a fuller discussion of this exceptional case), two farms which lost their entire tomato crop due to pollution from a nearby cement factory, and four highly capitalized farms growing two improved variety potato crops per year. Their cropping pattern was significantly different from the rest of the sample, with very high yields. Their inclusion would have unduly strengthened the inverse relationship. Thirty farms in the sample grew a winter potato crop, but only 14 grew a summer crop, 13 of which grew both a winter and a summer crop. Four of these used improved Diamond varieties rather than the normal red potatoes.

Thus, only 62 of the farms surveyed were included in the regression exercises. Exclusion of the ten feddan farm was based on the grounds that it is a single observation, it is significantly different in terms of soil quality, and, looking more closely at the data, is a very different type of farm, highly capitalised and commercialised. This is also true of four of the farms which grow two Diamond potato crops which have very high yields and are highly capitalised. Exclusion of these outliers produces a scatterplot displaying a quasi-rectangular hyperbolic curve, similar to an isoquant, with many of the observations lying in towards the origin. This suggests some form of target revenue curve.

We also tested for any disjunction between farm size categories and those relating to economic scale which according to Patnaik are better proxies for class location. We computed Spearman rank correlation coefficients (r_s) between farm size and gross annual output, total annual income, total capital assets, machine stock and stock of all productive assets as various indicators of economic scale.[9] The results obtained show that despite the existence of a small group of highly capitalised farms which would tend to support the Patnaik argument, farm size and economic scale are closely correlated for all definitions of economic scale, as far as the village samples are concerned. Thus, we continue to use farm size as the relevant stratifying variable in our analysis.

OLS regression equation R.1, Table 74, again without any logarithmic transformation of the data, but excluding the outliers identified above, shows a significant inverse relation between net yields (total value of crop output per net cropped area) as the dependent variable and farm size.[10] The relation is significant at the 5% level of confidence. Net yields on the 5-10 feddan farms are less than two thirds those on the smaller farms. This result confirms prior expectations. Regressing gross yields (total value of crop output per gross cropped area) on farm size, the relationship is insignificant as expected, suggesting higher cropping intensities on the smaller size farms (see equation R.2,

Table 74. This is further supported by the regressions of physical yields for individual crops on farm size. Equation R.3 for winter potatoes shows no relationship between yields (measured in qantars per feddan)[11] and farm size for the 26 farms which cultivate this crop. Likewise, summer maize (ardebs per feddan)[12] and summer potatoes (qantars per feddan) show no relation across farm size in regression equations R.4 and R.5. Only nili maize (ardebs per feddan) in equation R.6 shows a significant inverse relationship (within the 10% level) between physical yield and farm size, but given the use of this crop as animal feed on the small farms, such productivity comparisons are misleading. However, cultivation of a nili crop has significant implications for the inverse relationship as we shall see below.

The regression of cropping intensity (the ratio of gross cropped area to net sown area) on farm size in equation R.7, Table 74, shows clearly that small farms do have significantly higher cropping intensities than large farms in Shubak, falling from an average of 2.72 on the smallest farms and 2.44 on the farms between 1 and 3 feddans to 1.59 on the 5-10 feddan farms (see Table 75, Appendix A). There is also some evidence of greater land-use intensity during particular seasons (see Table 76). The smaller farms have a stronger tendency to triple crop and intercrop summer and winter vegetables. The results confirm the existence of a significant inverse relationship between farm size and productivity in terms of crop output, the proximate cause being significantly higher cropping intensities on the smaller farms.

10.3 The roots of the inverse relationship in Shubak

But what factors explain the higher cropping intensities on the small farms? To begin with, we can dispense with the arguments relating higher cropping intensities to higher irrigation ratios on the smaller farms. While this factor may be important in the Indian context, it is irrelevant in rural Egypt. All arable land in Egypt has been characterised by 100% irrigation ratios since the shift to perennial irrigation with an extensive network of canals and tanks from basin irrigation after the completion of the High Dam at Aswan in the 1960s. Shubak al-Sharqi has historically had access to perennial irrigation, and there is a well developed hire market for irrigation pumps in both survey villages.[13]

There is no evidence to support the variant hypotheses that small farms have better soil quality or that small farmers possess inherently superior management abilities. Soil type does indeed differ between the different *ahwad* (basins).[14] The best soil is in Hawd al-Gezira, situated west of the Nile, an area of about 400 feddans. The land on the eastern outskirts of the village and near the factories is poor. Poor land is used for birseem and good land for potatoes. On the east bank, there are three poor *ahwad* due to their elevation, and yields are weak. Some of the land is near the cement factory, and the dust from the plant affects the vegetable crops. For two seasons, tomato yields have been poor. A qirat of good land can be bought for 3,500 pounds. Saline or weak land would only cost LE 600.

However, care was taken to exclude land which was characterised by very low or very high fertility from the regression equations, in order to isolate this effect. We wanted to compare small and large farmers on the same quality of land. Regression equation R.8, Table 74, and Table 75 show no relationship between land value per feddan (as a proxy for land quality) and farm size. Neither is there any relation between family members per feddan and land value per feddan as one might expect to find if Sen's demographic scenario were operative at the micro level. Despite the existence of partible inheritance, families tend to operate plots as a single farm, as is the case with the ten feddan farm in the sample. The results show that there is no clear pattern of land fragmentation over farm size. More significant however than the number of fragments per farm is the intensity of fragmentation or fragments per feddan. This decreases steeply as farm size increases which invalidates this as a causal factor behind the inverse relation (see Table 75). Further, if small farmers did have better land quality, this would be expected to show up in the physical yields of individual crops. As we have seen, this is clearly not the case.[15]

The same finding undermines the hypothesis that small farmers possess inherently superior managerial aptitudes. If this was the case, we would expect to see higher physical yields of individual crops. Questions of scale, complexity of organisation, and supervision costs do not really enter the picture here given the relatively small range in farm sizes. There do not appear to be any hidden transactions costs involved in hiring or supervising labourers, given the control of the farmer over the labour force.

Generally the winter and summer seasons are the busiest for wage labour, particularly September when preparation for potato planting takes place. The majority of wage labourers are from the village. They are supervised directly by the landowners. One large farmer interviewed said: "Every week I hire 3 or 4 kids (less than 12 years old). They pick the vegetables: beans, aubergines, tomatoes. But for the main work on the land I hire adults. Children's wages are around 2 or 3 pounds. In the potato season they might get paid in kind: 10 kg of potatoes at the end of the day. Adults are paid 6-7 pounds a day, 5 for shorter days. Many people are available for work. The men who work are in need of money. They work in factories, but work extra time in the fields. I get in touch with the workers the night before. I know them, so I go to their homes and ask them if they can make it. They are not relatives or friends. Some change from year to year. As people get older I have their sons. If they are busy I go to others until I have enough."

Clearly then, we can say that the suggested qualitative differences in factor endowments do not appear to have much explanatory power with regard to the inverse relationship between farm-size and productivity. The small farms do not appear to possess land with better soil quality, nor are they blessed with superior management aptitude. At the other end of the scale, large farmers do not appear to suffer from diseconomies in terms of farm management or problems associated with labour recruitment and supervision.

The higher cropping intensities on the small farms do appear to be associated however with the intensive application of labour inputs on the smaller size-holdings.[16] Regression equation R.9, Table 74, and the figures in Table 75 show a highly significant inverse relation between labour input intensity (standardised man-days per feddan per year) and farm size. Labour input intensity falls from 369 man-days per feddan per year on farms less than one feddan to 116 on the 5-10 feddan farms. These results would appear to present clear evidence for a labour-based explanation of the inverse relationship: higher labour input intensity on the small farms leads both to higher cropping intensities and higher net yields.

However, while we have found strong inverse relationships between output per feddan, cropping intensity, labour input intensity and farm size, the relationship between labour input intensity and output per feddan is positive, but statistically insignificant. There is a much stronger positive relationship between cropping intensity and output per feddan (see regression equations 7 and 8 in Table 76, Appendix A).

The Sen hypothesis which rests upon cheap family labour is not supported by the data. Small farm labour supply is 96% family labour as opposed to only 17% on the largest farm which depends for 83% of its labour supply on hired labour (see Table 74, Appendix A). However, note the relatively narrow range of variation between farms of less than one feddan and 5-10 feddan farms with respect to labour use. Although there is a clear difference in terms of the nature of labour utilization between the small farms and large farms, as can be seen in Table 74 with regard to the use of family and hired labour, in fact, there is no relationship at all between family labour input over the year, the ratio of family labour to total labour, or family labour intensity and output per feddan (see Table 76, regression equations 9, 10 and 11).

If we disaggregate crop output on a seasonal basis, we find that for winter and summer crops, there is no statistically significant relationship between yields and size, nor between yields and labour intensity (see Table 76, regression exercises 1 to 6). In other words, despite the higher land use and application of labour by the small farmers during the winter and summer seasons, these farms do not achieve higher output per feddan. This would tend to suggest that these farmers are in fact rather inefficient.

The reason we have then higher output per feddan on the small farms is because these latter overwhelmingly utilise the land to squeeze in a third seasonal crop, during the nili season. It is cropping intensity that determines labour use and higher output per acre.

It might be argued, at one remove, that the additional cropping season is a manifestation of the availability of cheap family labour on the small farms, but this would be to obscure the strong economic compulsions which force these poor peasants to intensify cropping and produce an extra nili crop in a struggle for income. As can be seen from Tables 77 and 78, Appendix A, the very marginal economic circumstances of poverty and debt compel poor peasants to intensify cropping intensity and therefore labour use. In Table 77, net income (the difference between income earned from all sources, including total farm output, wage earnings and other income, and paid-out costs) rises from an average of LE 1,786 on the farms below one feddan to well over LE 14,000 on the large farm over 10 feddans. The increase on a per capita basis is even steeper, rising from only 227 pounds on the smallest size class to over 2,000 pounds on the ten feddan farm. The deficit or surplus is calculated in relation to the World Bank poverty line for rural Egypt of 365 pounds. We see that the poor and marginal farmers operate, on average, deficit farms, whereas middle peasants and rich farmers enjoy a surplus. Farms below one feddan are too small to support a family, and these farms show a much higher proportion of income earned off-farm (43%), either in agricultural labour or in a factory job, as opposed to the rich peasants who earn only 4% of their income off-farm (see Table 78).

Turning to Table 79 on average levels of farm debt, the average size of loan borrowed on the smallest size class is around 1,000 pounds for one year. This represents 50% of income and 75% of net income. Note that the ten feddan farm actually has a longer term, 3 year loan, so that on an annualized basis, the loan represents only 19% of income and 37% of net income. As we can see from the last two columns, the smallest farm size and the largest have very similar levels of debt to asset ratios and debt per feddan, the difference being of course that the larger farmer has a higher and more consistent capacity to repay.

Clearly, the levels of absolute poverty and debt in which the poor peasants exist compel them to intensify cropping intensity and labour use. But there are also indications in the data of other forces at work. Table 80, Appendix A, presents data on levels of rent paid. Thirty of the 69 farms rent in land. The data show that small peasants on average rent in about half an acre or 80% of their operated area. Notice however, that rents per feddan are significantly higher on the smaller farms than on the larger. The official land rental price is around LE 180 per feddan which is what the rich farmer actually pays. The small farmers are forced into the illegal private land rental market at much higher levels of rent. A feddan for tomatoes, for example, can cost between LE 500 and LE 1,000. Animals can also be rented on a seasonal basis. A farmer with many animals might rent a piece of land to grow birseem, the rent varying with the price of birseem. The rental contract is an oral agreement between the owner and the tenant. The cooperative would not be informed. Again the need to pay that rent, either in cash or in kind as in sharecropping, forces the poor peasant to intensify land use and labour intensity.

The fieldwork data is somewhat atypical in that it under-represents sharecropping arrangements. There are only four farms involved out of 69 in the sample, but one respondent confirmed in an interview that sharecropping arrangements were a common feature of land rental transactions: "If I rent land to someone, I would do it under the sharecropping system. The returns are higher. If the tenant pays money then he might claim rights to the land under the land reform laws. But under sharecropping you can get your land back easily. I can change the sharecropper from year to year depending on the output per feddan. If we share half-half, we share half the costs and half the returns. With vegetables or tomatoes though, seasonal rent might be used because of the high returns, compared to wheat. I need to be with the sharecropper in everything. I can't leave him on his own. I supervise every stage: ploughing, fertilising, and I work with him to harvest the crops (to avoid cheating). The sharecropper will accept such deals because he doesn't own any land of his own. Even somebody with three feddans with many children will go in for sharecropping. I decide all the steps. I supervise. I bring the fertilisers, not him."

Land rents on sharecropped land do indeed offer high returns to the landowner. In Shubak, one middle peasant, owning 3.25 feddans, rented out one feddan for 300 pounds for the year. At the other end of the scale, one poor peasant operating 23 qirats or 0.96 feddan was paying the equivalent of 495 pounds for half a feddan. Another, operating 0.66 feddan, and renting half of that on a sharecropping basis for about 140 pounds, was thus paying 420 pounds per feddan. These compare to cash rentals of somewhere between 180 and 300 pounds.[17]

Finally, we also have some evidence, presented in Table 81, Appendix A, of forced commerce and market domination by merchants. In terms of the marketed output data, we can see that the farms in the smallest size class are marketing a larger proportion of their crop output, and total output which includes animal products, than the next two size classes, and almost as much as the rich peasants above 5 feddans. Clearly the ten feddan farm is highly commercialized, marketing some 94% of output.

One respondent explained in an interview: "Generally the smaller farmers will see a trader who will take the crops from them. Many merchants come here every year. For transport to market, after harvest, the merchant will come with big sacks to collect them, and camels take them to the main road. Then vans take them to market. For farmers growing potatoes, the merchant will come and check the quality of the crops. Sometimes though, a farmer keeps crops at home, for crisis situations. In a crisis he can sell it. But when they sell it quickly, the price certainly drops. If I have 100 ardebs of wheat, and the market price is LE 80, I would go to the merchant who would take it for probably 70 pounds. A small farmer in crisis will even sell an animal."

There also appears to be a flourishing parallel market in cooperative supplied inputs such as seeds, fertilisers and fodder which the large farmers can take advantage of. The same respondent explained: "The cooperative will distribute improved seeds. Sometimes its obligatory to plant them, but we don't always do so. Small farmers in bad financial conditions, might sell them on the black market for need of money. If a farmer doesn't have enough seeds or fertiliser he would buy from the black market. The prices are very high. For example, a bag of fertiliser is 8 pounds at the cooperative, but 16 outside. Fodder is about 300-400 pounds, but 500-600 pounds outside."

Another explained: "There are farmers who buy from the coop and then sell privately. The same for insecticides. It is more expensive outside. Farmers if they need money can get insecticides from he coop and then sell them. We get forage through the cooperative. I might buy 30-40 bags. If someone has a goat I sell him 2 or 3 bags for cash. Big traders can buy in bulk and charge extra on the price."

Clearly then the poor peasant is suffering not only deep poverty, living at or below subsistence levels, but is also subject to heavy indebtedness. He is often further locked into exploitative relationships with landlords, moneylenders and merchants. Given then these economic compulsions, the poor farmers intensify land use and labour input in order to achieve a minimum subsistence income and to pay back cash obligations.

The fact that the inverse relationship is evident, means that the larger farmers have not yet achieved higher yields through the application of modern technology. There is no clear relationship between HYV seed use and farm size[18] nor between the use of machinery (owned and hired)[19] and farm size (see Table 75, Appendix A). The 5-10 feddan farms have a very low percentage of gross cropped area under HYV, but there is no systematic variation across farm size overall. While the ten feddan farm does have significantly higher machinery inputs, again there is very little variation across farm size. The main implements used in agricultural production on all farm sizes are the *fa's* (hoe) and *sharshara* (sickle). The *fa's* is used for a variety of cultivation tasks such as bunding and furrowing. They cost around 15 pounds in the village, about the same as a sickle. Every year the farmer will buy new ones. The traditional plough which can last up to 10 years is also very common, particularly for potatoes. It costs LE 100-150. A local carpenter fits the ploughshare to the wood.

Twenty-five years ago, irrigation was carried out using the *tunbur* (Archimedean screw), but is nowadays overwhelmingly carried out using diesel irrigation pumps. There are 79 irrigation pumps in the village (32 fixed and 43 mobile), all of them 7.5 hp, and all privately owned. Only ten fixed pumps existed prior to 1960, eight were bought between 1960 and 1965, twelve between 1965 and 1970, another fifteen between 1970 and 1975, and 34 since then.

There is a lifting station from the Nile and it flushes the water through the branch canals. The water level is kept high throughout the year. The fixed lifting pumps are in Hawd al-

Gezira. The others are mobile, serving small areas. The landowners, both large and small, own the fixed pumps, but the large have more. In Gezira, the farms are better off, owning the machines than rather than renting them. The owners control the use of the pumps, and will rent them out to smaller neighbours with 1/4 or 1/2 feddan. The big fixed pumps that feed the canals control the irrigation, not the private pumps.

Locally, there are only 8 Romanian-made tractors, 2 of them 65 hp and 5 of them between 70 an 100 hp. One was purchased prior to 1970, two between 1970 and 1975, and five were bought since 1975. The *mushrif zira'i* explained: "Tractor rental is through the Qabdshiya service station as the Hawd al-Gezira is nearer than the Saff centre. Tractors are rented by feddan: LE 30 per feddan from private families, but from the service station it is only LE 20. The tractor comes with a plough. The difference in price is due to the fact that, certainly for the families, they intend to make more money which is not the case for the government which intends to help the farmer."

One farmer explained that he rents a tractor once a year, from local people who own it. The owner supervises the tractor, and drives it and maintains it. He pays LE 1.5 per qirat or LE 36 per feddan for ploughing and LE 8 pounds per qirat for cutting up??? the earth, as it takes longer. He stated that he would not hire the government tractor: "It's not cheaper and it makes for better relations if I hire locally from individuals." He also hires once a week a medium size irrigation pump at LE 2-3 per hour for 6-8 hours.

The above data suggest that all farm size classes are utilising essentially the same techniques of production, and thus the large farms in the middle and lower rich ranges have not been able to capture any productivity advantages from the use of new technology. Further, as we shall see below, and in Table 84, Higaza al-Qibli, where no inverse relationship is present, has significantly higher levels of such input use than Shubak, particularly as far as the top two size classes (5-10 and over 10 feddans) are concerned.

10.4 A positive relationship village in Qena

The evidence from Higaza al-Qibli in Qena governorate presents a striking difference. Qena governorate, in which the second village survey was undertaken, lies some 700 km south of Cairo in Upper Egypt. Qena is a narrow ribbon of fertile land running down both sides of the Nile from Nag Hammadi in the north to Esna in the south, a distance of about 200 km. It supports an estimated 1990 population of 2.5 million and covers an area of 1,851 square kilometers. The village chosen on the basis of the ILO survey was Higaza al-Qibli in Qus district, halfway between Qena town and Luxor. Higaza is situated about 14 km east of the Nile near to the desert plateau. There are nearly 14,000 households in the village. Higaza is a narrow village which runs for 1.5 km along the lower edge of the plateau. It is around 40 km from Luxor and 12 km from Qus.

The total village population is approximately 60,000. Some 60% of the households are landless, and around 80% of the latter are wage labourers. The *mushrif* explained that most of the young people work outside the village. Agricultural work by itself would not be sufficient to buy certain expensive commodities. In the seventies, many people went to Iraq or the Gulf to work, and labour shortages occurred during that period. Labour hirers had to book labour up to one month in advance. Nowadays, however, landless labourers queue up for work.

The local institutional structure is dominated by the cooperative. It supplies both agricultural inputs and credit, and is responsible for the village and its surrounding area. The Qus district centre manages 24 cooperatives, including Higaza (there were 28 cooperatives 4 years ago). Each cooperative centre is headed by a director, and a number of agricultural supervisors. Higaza has three supervisors, one supervisor for each 1,200 feddans. Other smaller cooperatives would normally have one supervisor for each 300 feddans. There is a general veterinary centre and three machinery workshops for repairs. The latter are all privately owned. A workshop attached to the cooperative centre is under construction which will cover the whole area. The irrigation department is in Qus.

Each village, including Higaza, has one small medical unit. There are some 20 primary schools, 2 intermediate and one secondary school. Drinking water is available to every house. The pipe system was put in by the government. Electrical power comes from the High Dam, and is regarded as being the most important development in the village. The main market is held every Saturday at Higaza. Traders arrive from all the surrounding villages with their merchandise. There are around one and a half thousand shops, around 600 of them licensed.

The history of Higaza goes back some 400 years when people arrived from Hijaz (in Arabia) where they were facing starvation. The tribes first arrived at Be'ess. They had problems with the local people, and so they moved nearer to the edge of the plateau, which was unpopulated. The Harb and Jouheinah families came from Arabia. The Christian families are much older. In the 19th century, during Muhammed Ali's period, the local bedouin settled down.

The structure of landholdings was feudal. The whole district of Qus was owned by only 4 families. One of them was Christian and they owned around half of all the land. In 1952, some land was distributed under the reform legislation, with a ceiling of 500 feddans, and later 100 feddans for individual landowners. The largest family are the Al Esheish. This family still owns around 2,000 feddans. The *'umda* (village headman) is a member of this family and a member of the *majlis al-shaab* (People's Assembly). There are three other important families. The large Christian landlords sold their land to the Al Esheish. They bought estates in Cairo and moved there. The major families tie together some 15 villages in the area, and many own land in more than one village.

The important actors in the village are the *'umda* and the member of the *majlis al-shaab* who is the uncle of the Higaza cooperative supervisor. The latter is a farmer. There is one member of the family in the *majlis al-shaab* and one member in the *majlis al-shura* (local consultative council). Ten people are elected to the local *majlis*, one from each family.

Higaza comprises some 2,080 registered operational holdings, but these are actually owned by some 1,650 *ha'izeen*. The operated holdings have a size-class distribution of land much more skewed toward the larger farms than in Shubak (see Table 82, Appendix A). As can be seen from the table, 84% of the farms are below three feddans, farming 55% of the *zimam* (cultivated area). Again as in Giza, three feddans are regarded as the minimum feasible size of farm. Nearly half of the holdings (43%) under one feddan are rented on a cash basis. The middle peasant category operates 181 farms (9%) accounting for 18% of the cultivated area. The rich peasants operate 141 farms (7%), 16 of which are above 10 feddans, and account for 27% of the land. Note that the distribution of land is further skewed by the fact that the rich peasants actually farm a proportion of the small rented plots in the table. As this distribution was unavailable at the start of the survey, we used the statistically similar distribution of operated area in Qus district in order to draw our sample.

A stratified sample of 71 farms was selected (or a 4% sample of the 1,650 ha'izeen) on the basis of the farm land distribution given in the 1981 Agricultural Census for Qena governorate (see Table 83). This distribution is more heavily skewed towards the larger farmers. Three outliers were identified in the survey returns and 68 entered in the regression exercises. One of these outliers was a small farmer with 0.67 feddan whose land was right in amongst the residential area of the village and suffered from particularly low fertility. The two others (0.67 and 2.25 feddans) had responses that were clearly well outside the range of possible yields, but we were unable to return to the respondents for correction.

The cropping pattern in Higaza is essentially two season, but with a very short nili season overlapping the end of summer and beginning of winter. Given summer temperatures of 40-50 degrees celsius, the cropping pattern is dominated by sugarcane cultivation which is grown on 42% of gross cropped area all year round (in fact a 13 month crop cycle). Wheat and birseem account for 84% of gross cropped area (not under sugarcane) in the winter season, while maize and millet or sorghum account for 87% of summer gross cropped area. The short nili season is again devoted to coarse grain cultivation and cut green for fodder.

Sugarcane is grown on a 4-5 year cycle. There is spring sugarcane which takes 14 months, and summer cane that takes only twelve and which is in the ground from the end of March to the beginning of April in the following year. A summer crop is cultivated from March and a nili crop in October. The land does not get rested. With fallow, sugarcane yields can increase to around 80 tons. But normally yields are around 50 tons maximum. With copious use of fertilisers, yields can be substantially maintained at high levels.

Note that the returns to sugarcane are longer term, more so than vegetables, for example, which have quick returns. Thus small farmers do not grow sugarcane because they need fast returns, and cannot afford the high levels of fertiliser input. A specialist in sugarcane production at the Cairo Museum of Agriculture also explained that poor peasants do not prepare the sugarcane tops properly in terms of the required washing and coating, and thus suffer lower physical yields. Intercropping takes place on all farm sizes with spring vegetables.

Table 84 and regression equation R.10 in Table 74 show that net yields per feddan increase markedly with farm size. The relation is statistically significant at the 1% level. Net yields are more than a third higher on the large farms than on the small. There has been a clear strengthening of the trend towards higher yields on the large farms. As we saw above, the relationship between farm size and yields was positive, but not statistiscally different from zero in the 1976 ILO survey. In other words, there appeared to be no relation across farm size for the 1976 ILO data. That the relationship has become significantly positive between 1976 and 1990, would lend to support to our thesis that in the dynamic context, the large farmers' access to credit and new technology has allowed them to capture significant economies of scale. We explore this further below.

Gross yields in equation R.11, Table 74, confirm the evidence for a positive relation and suggest the continuing presence of higher cropping intensities on the smaller farms. Table 84 presents figures on cropping intensities and labour input intensities which confirms that these are indeed characteristically higher on the smaller farms, but note that there is a much narrower range of cropping intensities than in the Giza sample. That the large farms do have higher net yields despite the higher cropping intensities and labour intensities on the small farms provides clear evidence that the large farms have achieved important scale advantages of some sort.

Again, there is no variation across farm size with respect to value per feddan which points to relatively homogeneous land quality in the village (see Table 84). The majority of the soil in Higaza, around 3,000 to 4,000 feddans, is *tina safra* (sandy clay). The soil nearer Qus is better quality. The *ahwad* around Higaza are poor because the soil is sandy and takes a lot of water. The *ahwad* nearest to the village have the best soil. All the respondents were selected from *ahwad* within walking distance of the village centre, thus assuring that soil quality was fairly homogeneous in the sample. While fragmentation appears higher than in the Giza village, with generally higher numbers of plots per farm and higher intensities of fragmentation, this could be rather misleading. Plots tend to be contiguous and the cropping pattern has a significant influence. Whereas in Shubak, vegetable and cereal intercropping produces a patchwork effect of tiny plots, in Higaza the cropped area is dominated by vast stretches of land under sugarcane and coarse grains. In Qena, land is cultivated in a consolidated fashion.

Regression equations R.12 and R.13 in Table 74, show results for physical yields of individual crops, respectively wheat and sugarcane. Wheat yields (in ardebs) show no trend across farm size, but interestingly, sugarcane shows a strong positive relationship between yields and farm size. This is highly significant - unlike Giza, where all size classes have a similar cropping pattern, in Qena there is a noticeable skew towards sugarcane cultivation on the larger farms (above 2-3 feddans). We find the same relationship between farm size and the use of family or hired labour as in Shubak, but Higaza shows much higher levels of wage labour utilization, indicating a more dynamic labour market (see Table 84).

A large farmer explained the system of labour hiring: "We hire workers through an agent. We make a deal for cutting and taking the crop away. The poor work as labourers. Sixty per cent of the villagers have no land and 80% of them work in agriculture. They work temporarily for me, not continuously through the year. They work until I tell them they are not needed any more. They get paid by the day. They start around 7.30 or 8.00am until 2.00pm. I never pay them more or less than the going rate. The workers are not happy with LE 5. They say LE 5 doesn't bring them anything. But when they work from 8.00am to 2.00pm with a half hour break, LE 5 is not so bad. They bring their own lunch. I tell them when to take a break and when to have lunch. I don't use migrant labour.

"If someone has many children he takes them to work with him. Children work on stripping the sugarcane, cutting birseem, light jobs. They age between 11 and 15 years. They get LE 3 for stripping sugarcane. Two pounds for normal days. They work the same hours as the adults and work alongside them. The adults cut the sugarcane and the kids strip it down. Loading the rail trucks takes two kids. The chopper takes 1 with 2 to feed it. Two people will be cutting and four stripping. One feddan would need 4 trucks, with seven adults, giving in total 28 men per feddan and 16 children."

The construction of the High Dam at Aswan had a major impact on agricultural production in the Qena governorate. The *mushrif zira'i* explained: "Before the High Dam, land used to be planted with wheat in winter after flooding. No canals existed then and flood irrigation used to take place from August to September. No reforms happened before the High Dam. But afterwards, we were able to cultivate the land 3 times a year. We can irrigate any time. Each village has a set period for irrigation."

The main Qalbiyah canal arrives from Aswan irrigating all the regions. Each region is fed by secondary canal branches, irrigating all the villages. Each of the secondary canals has doors which open in turns. The water is high for 40 days in the year (during winter). Higaza is fed by four canals from the Nile, with two filled with water every other week.

Also of importance is that while HYV use and machinery use do not vary significantly across farm size in the Giza village, the large farms in Higaza (the top two size classes 5-10 and over 10 feddans) use significantly higher applications of HYV seeds and significantly higher machinery inputs than the small farms (and also higher levels than similar large farms in Giza, as comparison of the data in Tables 75 and 84 shows). The large farms have between 51% and 64% of gross cropped area under HYV as compared to around a third for the smaller farm sizes. This compares with 13% and 39% for the top two size classes in Shubak.

The sample data indicates that whereas in Shubak the use of modern agricultural machinery varies little over farm size classes, except for the ten feddan farm, there is a clear positive relationship between machine use and size in Higaza, and overall a higher degree of machine use (see Table 84). Machine use is particularly heavy on the rich peasant farms above 5 feddans. Machine use on the farms above ten feddans is nearly eighteen times the level on the smallest farms. And on the farms between 5 and 10 feddans, machine use is over 6 times that on the farms below one feddan. These ratios can be compared to those in Shubak of 2.5 and 0.9 (cf. Table 75).

Note that in Shubak the evidence would suggest that whereas the above ten feddan farm can be classed as a capitalist farmer (given the indications on labour hire, accumulation and investment in modern equipment, and level of commercial participation) the farms in the 5-10 feddan class are not qualitatively different from the smaller farm sizes. In fact they have practically the same levels of technology use as the small farms. They have remained rich peasants rather than developing into capitalist farmers. The contrast with the Higaza sample is clear. There, both the farms above 10 feddans and those above 5 feddans have high technology utilisation, and in combination with the other indicators, would seem to have become capitalist farmers, earning high returns.

In fact, figures obtained from the village cooperatives show that Higaza does have a significantly higher level of technological development than Shubak in Giza. Whereas Higaza is roughly twice the size of Shubak, it has 65 tractors, 225 irrigation pumps and 25 mechanical threshers as opposed to Shubak's 8 tractors, 79 pumps and no threshers. Of the 225 irrigation pumps, the majority are mobile (213 as against 12 fixed). The twelve fixed pumps are all between 25 and 45 hp. Most (160) of the diesel pumps are less than 10 hp, while 38 are between 10 and 12 hp, and 15 are greater than 12 hp. Prior to 1960, only the 12 fixed pumps were in existence. The first eight diesel pumps appeared in the village in the 1965-70 period, and 80 were bought in the 1970-75 period. The bulk of the diesel pumps (125) have been introduced since 1975. The majority of irrigation pumps are owned by the large farmers. Twelve of the more powerful pumps are owned by farmers with more than 15 feddans, and 213 others are owned by farmers with 5 to 10 feddans.

The 65 tractors in existence comprise 45 Romanian, 12 Russian and 7 other makes. Only one is between 35 and 50 hp, 40 are between 50 and 70 hp, and 24 above 70 hp. All appeared in the village in the early 1970s. The first was introduced by the cooperative. All the rest are privately owned. The first private tractor was bought by a large farmer with over 15 feddans. A farmer with 10 feddans, who guarantees that relatives with 20 or 30 feddans would use it, would buy one. They cost around LE 20,000. Payment is made by instalment over a period of 5 years with a 25% rate of interest.

Small farmers below three feddans hire tractors locally and pay about LE 24 per feddan. Normally, farmers rent a tractor twice a year for each crop. For machine hiring, the owner decides the price and the farmer the use of the machine. The deal is done orally. Larger farmers might rent a tractor three or four times a year depending on the crop. The owner or his son will drive the tractor. Payment for hire can be made up to a year later. A small farmer growing sugarcane can wait until they are paid by the sugar factory to pay for the hire of machines.

One farmer explained: "For ploughing, the first pass costs LE 10-12. The second and third passes are cheaper. Altogether around LE 20-25 per feddan. But the traditional plough costs more - around LE 30 (plus a packet of cigarettes). A traditional plough can do 1 feddan a day, two if the animals are good. But a tractor can do up to 5 feddans a day. Soil preparation might take a day per feddan, and furrowing a day. Irrigation costs about 500 pounds per year. For 1 feddan, hire of an irrigation pumps costs 25 pounds, but if the land is near the canal, it can be cheaper." In Higaza there are also 25 threshers. The people who own the threshers are the same as own the tractors and they are used together. For the thresher, hiring is by the hour (LE 30). One ardeb of wheat might cost LE 10-12.

This superiority in new technology is also reflected at the governorate and district levels: Qena has a 1.4:1 advantage in tractors (in terms of the 1982-3 stock per 1,000 feddans), a 7:1 advantage in modern ploughs, a 3:1 lead in threshers, and a 6:1 lead with respect to irrigation pump horsepower (see Table 61, Appendix A). In terms of farm use,[20] Table 85a shows that Qena has a 1.6:1 advantage in tractor use, a 2.8:1 advantage in the use of irrigation pumps, and a 2.3:1 lead in the use of threshers. The differences are more striking at the district level. Qus district in Qena has an advantage in farm tractor use of almost 2:1, in threshers of almost 2:1, and a massive lead in irrigation pump use of over 13:1 over Saff district in Giza. In terms of the number of operational units the ratio between Qus and Saff is only 1.3:1.

The ownership of agricultural machinery in Higaza is more heavily concentrated in the larger size classes above 5 feddans (see Table 85b). The 1981 Agricultural Census shows that 72% of tractor owning or sharing farms are located in the above 5 feddan size classes in Qena as opposed to only 55% in Giza. With regard to irrigation pumps, 52% of owning or sharing farms are above 5 feddans in Qena, and just 29% in Giza. And 72% of mechanical thresher owning or sharing farms are above 5 feddans in Qena, as opposed to only 42% in Giza. Clearly, the rich peasant farms in Qena have been able to accumulate and invest in new technology to a much greater extent than in Giza.

The two areas can be contrasted in terms of their level of commercialisation too (see Table 85). Whereas in Saff district, 58% of the tractors and 67% of the irrigation pumps are rented in the private sector (the rest are hired through the cooperative system), the respective figures for Qus district are 98% and 92%. Some 97% of the threshing equipment is hired through the private rental market in Qus as opposed to 80% in Saff. Thus Qus has a significantly more developed private rental market for agricultural equipment than Saff district.

10.5 The emerging comparative picture and a conclusion with regard to the inverse relationship

These results provide us with enough evidence to form a picture of what is going on. In an area like Giza, with a relatively low development of the forces of production, and with all farm sizes using more or less the same techniques of production, the higher cropping intensities of poor peasants (less than three feddans) which imply higher labour use intensities and higher value yields, produce the inverse relationship. Rich peasants (above five feddans) have not yet achieved significant scale advantages, although they may be expected to do so in time (as can be seen for the ten feddan farm which is making some progress).

It might be said that the Qena village, Higaza al-Qibli, shows the Giza village an image of its own future. Here, the significantly advanced level of the productive forces has allowed the rich peasants to reap important scale advantages which more than counteract the still higher labour and cropping intensities of the poor peasant farms. Included here in the development of the forces of production is the significantly different cropping pattern as well as use of modern inputs.

Some indication of how such rich peasants were able to do this can be seen in terms of rich peasant domination of the cooperative and village bank system as well as land resources. As we have seen above the leading members of the cooperative are large landowners themselves. The sample data (see Table 84) shows that, in Higaza, the top two size classes, representing 8% of farm households, own 48% of the land, control 91% of credit disbursements in 1989-90 and 39% of cooperative supplied inputs. In the Shubak sample, they represent 5% of the farms, own 33% of the land and dominate 56% of credit disbursements and only 14%

of cooperative supplied inputs. The mean per capita wealth for large farms over ten feddans is fifteen times that of small farms in Shubak, but over thirty times in Higaza.

One large farmer described how large farms have easier access to credit facitiies: "I have a calf and a cow for milk. The calf gets fed with birseem. A cow or *gamusa* costs LE 800-1,000. Not all farmers can own animals. Only big farmers could keep a calf. To purchase an animal, I borrow from the bank. Big farmers with a lot of land could even borrow to buy a tractor. It's easier to borrow money."

While Giza may perhaps represent something of an anomaly, a semi-rural/semi-urban governorate producing high value fruit and vegetable crops for urban markets such as Cairo, Taylor [*1984*] corroborates the results of the above analysis. She writes that land is highly fragmented in the region. Despite investment in irrigation pumps and livestock, differentiation of farms along capitalist lines has not occurred. Indeed there has been an expansion of the peasant sector which she defines as that composed of family household production, as opposed to wage-labour farming. The nature of the local political economy has meant that accumulation of land has been prevented by rapidly rising land values while tenants have been able to establish security of tenure with low fixed annual rents. Labour migration too has hindered the development of a wage-labour market in the region.

The almost counter-intuitive findings of the above analysis are also corroborated by evidence produced by Esfahani [*1988: 157*]. He notes that while one would expect mechanization to advance earlier and faster in areas near urban centres, the evidence shows that the urban and semi-urban governorates are characterised by a lesser degree of mechanization than all other regions in Egypt and that their mechanization process has started rather late (see Table 86, Appendix A).[21] Upper Egypt, on the other hand, is characterised by relatively higher degrees of mechanical power, more chemical fertilizer use, and less organic manure use than other regions. He explains that this unexpected pattern of mechanization is mainly due to the differences in regional cropping patterns and in policies toward different crops: "the expansion of sugar cane in Upper Egypt was strongly supported by heavy use of fertilizer and machinery from the beginning, while the change in the input composition of other crops came more gradually. In particular, the development of horticulture in the UG [urban governorates] did not require much machinery and could more easily use manure in place of fertilizer".

Waterbury [*1979: 132-4 and 216-8*] too has noted the concentration of investment projects in Upper Egypt, and PBDAC figures [*1989: 71, table 10*] show that the distribution of investment loans by governorate on a per feddan and per farm basis have favoured Qena more than Giza: Qena farmers received LE 130 per feddan and LE 270 per holding whereas Giza farmers received only LE 92 per feddan and LE 145 per holding in 1985-6. The latter source [*1989:*

8] also mentions a study by El Shohna [*1970*] which shows that Qena and Aswan governorates in Upper Egypt enjoyed a considerable share of subsidised cash loans throughout the 1960s due to the vast plantations of sugarcane. Adams [*1986: 60*] mentions that sugarcane is regarded as a large farm crop and that credit advances favour the cultivation of sugarcane: a feddan of cotton gets a cash loan of only LE 17, but a feddan of sugarcane gets LE 45. Moreover, if the sugarcane grower plants more than 10 feddans, cash loans rise to LE 160 per feddan from the sugar mills.[22]

A noticeable trend in the cropping pattern in Upper Egypt during the post revolution period was the rapid expansion of the sugarcane crop at the expense of other crops [*Esfahani, 1988: 137*]. Sugarcane is a major industrial crop and its area expanded rapidly from 96,000 feddans in the early 1950s to 220,000 feddans in 1975 [*Ikram, 1980: 192*]. The area planted under sugarcane increased rapidly under state control by 29% in 1970-3 to 1978-81, due to the increased availability of summer water in Minya, Qena and Aswan [*Radwan, 1986: 157*].

But sugarcane cultivation in Egypt has a longer history. In areas of Upper Egypt, the creation of perennial irrigation in the 19th century led to the cultivation of sugarcane on a large scale. Low population density and the availability of irrigation water for a year-round crop like sugarcane gave rise to a pattern of large estates (at first royal, then later private). This development of agrarian capitalism required more labour for the new cash crops, and labour was recruited from the sedenterizing Bedouin population in estate villages built up by the landowners for this purpose [*Hopkins et al, 1981: 9-10*].

Most sugarcane was grown under contract to local sugar mills. The joint effort by farmer and mill requires a high level of technical efficiency and support services (sugar production depends not on tons of cane but on sugar content) [*Ikram, 1980: 192*]. In the 19th century, local (baladi) varieties were superseded by improved Roumi varieties and in the early years of the 20th century, the Compagnie des Sucreries introduced a new variety no.105 from Javanese strains [*Foaden and Fletcher, 1908: 447*]. Also the diffusion process for sugar extraction in mills took over from the crushing process in hand mills [*Foaden and Fletcher, 1908: 453*]. Schutz [*1987: 8*] notes that with sugarcane, the sugar company cooperates with the Credit Bank for the supply of inputs and debt is subtracted from payment (for other crops, credit is via the cooperative or village bank).

The government encouraged the expansion of sugarcane cultivation by setting prices higher than international prices: in 1985, the world price was LE 14 per ton, but the procurement price was 20-24 per ton, and in 1988 prices were raised to LE 38-50 per ton [*Sadowski, 1991: 179*]. Returns per feddan to sugarcane are more than 400 times that on cotton, and because of its annual rotation only rich farmers can grow it [*Adams, 1986: 71*]. In addition, rich farmers who plant non-traditional crops like sugarcane or grapes can get government subsidized inputs that small farmer maize and birseem crops cannot (see Table 87). Thus rich farmers are reaping both subsidized inputs and manage to avoid taxed crops [*Adams, 1986: 73-4*].

We are not suggesting here that the results obtained are crop specific.[23] There is a temptation by some agronomists to classify villages according to their main crop ("sugarcane villages" or "rice villages" for example). The rational kernel underlying this is that each crop imposes a certain rhythm and discipline on agricultural production, but it is perhaps too easy to exaggerate the influence of a single crop on the total village structure. Certainly though, the major cropping pattern will imply variations in market involvement and in labour intensity [*Hopkins, 1981: 43-5*]. Thus a major impetus to technical and social change in Qena was provided by the close relationship between sugar capital and sugarcane growers. The sugar mill not only locked rich peasants into commercialised agriculture, but furthered the process of peasant differentiation by favouring the large farms with loans and subsidised inputs.

The sugar factories have a great deal of control over production. The sugarcane factory sets up a cutting plan, giving priority to the areas with older plantings and ending with the new plantings. A farmer growing sugarcane will pay an intermediate agent LE 200 to get all the machines and workers, and take the harvested crop to the factory. Then the farmer gets his money from the sugar factory. Here too then we have some indication of why Qena appears to be characterised by a more advanced agriculture than

Giza, despite the latter's proximity to the Cairo fruit and vegetable market.

Taylor's thesis above that high land values in Giza have blocked the accumulation of land on the part of rich peasants/capitalist farmers can only be one small part of the story. Indeed, it is perhaps the lack of such proximity to the state centre that has benefited the rich peasants of Qena. Not only were they subject to less supervision in the land reform process, but the state had to depend more heavily on the rich peasant/capitalist farmer strata in Qena to organise and administer the cooperative system in that locality. All these factors may go a long way to explaining the relatively advanced agricultural sector in Qena as compared with Giza.

The paths of development of the two survey villages echo those described and analysed by Hopkins [*1987*] which we examined in Chapter VIII. Two paths of agrarian transition in Egypt are delineated: a capitalist path (using hired wage labour and machinery) and a path dominated by petty commodity production with small farmers producing for the market and agriculture becoming increasingly marginalised. These two paths are manifested in variant forms of village development: 1) land reform villages which have moved in the direction of intensification of petty commodity production; and 2) villages in which capitalist agriculture and the emergence of capitalist relations of production based on the use of wage labour and modern agricultural equipment have appeared.

The village of Shubak al-Sharqi falls into the first category. Land reform in Shubak has created a situation in which less social differentiation and elite land accumulation has occurred. Thus, land reform has actually had the effect of slowing down capital accumulation, inhibiting saving and investment. Shubak has been characterised by small scattered land possessions prohibiting the application of modern technology and leading to the fragile formation of capitalism. Land fragmentation has weakened the ability of large farmers to adopt new agricultural methods, slowing down the intensification of capital utilization.

The village is dominated by middle and rich peasant farms which have not developed into capitalist farmers. These farms are not fully commercialised and operate with essentially the same techniques of production as the poor farmers with less than three feddans of land. Clearly, the evidence from Shubak shows us that the larger farmers are not qualitatively different from smaller farmers, but only quantitatively differentiated.

In contradistinction, Higaza clearly falls into the capitalist path category. This village has a relatively greater concentration of land, a larger area and population, and higher levels of new technology use, particularly mechanization. The cooperative system was dominated by the rich peasants allowing the large farms to accumulate land and other means of production such as machinery. Thus, Higaza has exhibited a different outcome with increased social differentiation and the potential disappearance of the small farmer rather than his survival.

Higaza has also benefited from development efforts in the form of loans for machinery and other modern inputs because of its integration into an industrialised agriculture dominated by sugar capital. The mode of production has changed because capital has penetrated the village and changed the system of production instead of being merely externally imposed via market relations. The middle and rich peasant family farms have given way to capitalist enterprises organized by the family, but based on wage labour and capitalist accumulation, manifested in the intensive use of machine inputs.

What implications can we draw from this for the inverse relationship between farm size and farm productivity, and its suggested policy implications such as redistributive land reform? The Egyptian evidence supports the hypothesis that in the static context, the inverse relationship is not the product of superior efficiency on the part of small farms nor is it due to better quality land on the small farms, but arises from the desperate struggle of poor peasants for survival on below-subsistence plots of land in a relatively backward agriculture, and the matrix of exploitative relations within which they operate. Redistribution of land on the basis of the inverse relationship argument therefore, far from alleviating poverty and creating employment opportunities, will only deepen and perpetuate extreme levels of exploitation and poverty.

Furthermore, in the dynamic context of the development of both the relations and forces of production, in the shape of the new technology, the inverse relation is likely to break down and disappear. Rich peasants are able to capture the gains from the new technology, and with increased accumulation develop into capitalist farmers. The evidence from the village of Higaza would tend to support this thesis. Thus, the inverse relationship argument for land redistribution no longer has any rationale in the context of changing production conditions within Egyptian agriculture.

Notes to Chapter X

1. The Egyptian Ministry of Agriculture was very helpful. One assistant was from the Giza Ministry of Agriculture, Statistics Division, and the second, an extension worker from Qus district Ministry of Agriculture. The Village Cooperative and Bank staff were also of immense help. I was present at over 60% of the interviews in Shubak al-Sharqi and 34% of the interviews in Higaza al-Qibli.

2. A trial run was conducted in Shubak before the start of the survey proper in order to sort out bugs in the questionnaire and train the research assistants in obtaining robust responses. Numerous cross-checks were required in different parts of the questionnaire, particularly in the sections on production for both output and inputs. For the section on labour inputs, a negotiated response was often required, given the difficulties associated with the respondent's memory and the concept of "standardised work days". The formal questionnaire sessions were conducted with the head of household, sometimes with other family members present. Most of the Shubak sessions took place at or near the village cooperative building. No cooperative staff were present during these sessions. The sessions in Higaza were either conducted in the household itself or in the field under a tree. Again no cooperative staff were present.

3. Given the main aim of our survey to examine the inverse relationship, we excluded landless labourer households from our survey sample.

4. Return migrants use their savings to build a house or purchase land. The returnee has also earned the financil status to marry. The average bride price locally is around 4-5 thousand pounds.

5. While vegetable cultivation is not subject to price controls with payments direct to the grower, it does suffer from high price instability and crop wastage [*Harik, 1979: 193*].

6. The nili season was historically the Nile flood period. Since the introduction of perennial irrigation, many farmers, particularly the small farmers, now use this period to cultivate extra animal fodder crops. This is of immense importance for the inverse relationship as can be seen below.

7. In fact three such farms crept into the sample and were excluded from the regression equations. See the details of these farms in the text.

8. Cases that have unusually large residuals or atypical values of the independent variable can have a substantial impact on the regression results and need to be identified. Studentized residuals allow identification of outliers. The Mahalanobis distance is a measure of the deviation of cases from average values of the independent variable. Even when a residual is not particularly large, certain observations can influence the regression parameters. Cook's D identifies an influential point by considering changes in residuals when the suspected case is omitted.

9. We computed Spearman rank correlation coefficients to compare ranking of farm size and a set of other variables suggested as being closer proxies for class location: total output, total income, total capital assets, machine stock and total stock of productive assets. This was done for both village samples.

The Spearman rank correlation coefficient (r_s) is computed in the following way: $r_s = 1 - [6.\Sigma d^2]/[n(n^2 - 1)]$, where d is the difference between the ranks assigned to the variable observations being compared, and n is the number of pairs of observations. The values of r_s range from -1 to +1. A value of +1 indicates a perfect association between the variable rankings. If r_s is close to zero, we would conclude that the variables are uncorrelated.

The following results were obtained for both sample villages:

farm size and:	Shubak (r_s)	Higaza (r_s)
1) output	0.89	0.94
2) income	0.77	0.91
3) assets	0.61	0.84
4) machinery	0.64	0.80
5) productive assets	0.71	0.68

10. All the regression results mentioned in the text are presented in Table 74, Appendix A. Size class averages in Shubak al-Sharqi for all the variables used can be found in Table 75, Appendix A.

Crop values are expressed in Egyptian pounds (LE) per feddan. During the survey period the Egyptian pound fluctuated between a rate of LE 4-5 to the pound Sterling.

11. 1 metric qantar = 157.5kg = 308.51b.

12. 1 ardeb (maize) = 140kg = 308.4 lb
    1 ardeb (wheat) = 150kg = 330.4 lb.

13. Irrigation pumps are hired by the hour. The hourly rate is LE 1.5-2. One feddan takes 6-7 hours. The average per feddan cost is then LE 14. In summer, irrigation takes place every 5 to 7 days, and in winter, every 10-12 days. Maintenance and fuel costs are the owner's responsibility and the owner will supervise its use.

14. The cultivated areas (*zimam*) in Egyptian villages are still divided by name into the traditional flood irrigation basins (*hawd*, pl. *ahwad*) used prior to the introduction of perennial irrigation.

15. Rochin and Grossman [*1985: 19*] mention that land was distributed to small farmers in plots of 2-5 feddans depending on family size and productivity of the land. However, given the relatively small impact of land redistribution in terms of the cultivated area actually affected (around 12.5%) this will not have resulted in a strong correlation between small farm size and higher quality soil. In fact, the largest farm in the sample with ten feddans has the best quality land in Shubak. The owner is also a university-trained agricultural engineer.

16. Labour intensity was computed by summing the total male labour input for each season and dividing by cultivated area. These figures of course understate the total labour force and therefore labour input intensity, possibly considerably, as they do not take into account female and child labour force participation. Richards [*1989: 19*] estimates, based on rural labour force surveys, that approximately a third of all crop labour is done by women. Harik [*1979: 67*] estimates that unpaid family labour (women and children) constitute a third of the rural labour force in size and anything from 10-50% of labour time by children and 33% by women. Mayfield [*1974: 32*] writes that average annual working days per man was 286 per year in 1966 (with 188 for women and 159 for children). Other surveys however, (for example, Shepley [*1985*]) have found rather lower percentages: around 10% for female crop labour. Women in Upper Egypt have very low participation ratios, and Harik [*1979: 83*] mentions that female workers have a tendency to drop out of the ranks of field workers before they reach the age of 20.

However, for our purposes, what is important is not the exact number of labour-days per feddan per year, but the general trend of labour input intensity across farm size. Indeed it is likely that the under-reporting of female and child labour force participation would tend to bias the figures against an inverse relationship between labour input per feddan and farm size as the actual participation rates are higher on the small farms than the large farms. On the former, women and children may be compelled to work in the fields, whereas on the rich peasant farms, female members of the household are able to withdraw from the labour force.

17. The rich peasantry had originally supported the rent control components of the agrarian reform: after all, they rented more land than other any other group, usually from poor peasants with less than 3 feddans. Land reform changed their situation from net renters to owners and as land values and incomes rose during the 1970s because of the injection of oil remittances, rent became a smaller proportion of peasant income and rich peasants turned against rent controls which stood in the way of either raising rents or reclaiming plots for sale.

18. There is a generally high level of purchased seed inputs in all size classes. Adams [*1986: 51*] explains that small farms do not normally use own-produced seed anyway: it is too expensive in opportunity cost terms because of their need to use land for fodder crops rather than producing a seed crop.

This is also true for birseem, the main animal fodder crop. Dr. Ahmed Rammah, a forage agronomist at the Agricultural Research Centre in Giza, informed me that 1989 and 1990 marked the beginning of field trials for improved varieties of birseem: Giza 6, Giza 10, Giza 15, Sakha 3 and Sakha 4. These produce yields some 30% above those of *baladi* (traditional) varieties. But only the large farmers with over ten feddans are willing to grow seed crops. For the small farmers, a birseem seed crop would use land cutting into the summer cropped area. This is even the case when the Research Centre supplies new seeds free of charge.

19. HYV seed use was computed by taking the percentage of gross cropped area under HYV crops. The indices of machinery use are the value of rented machinery (pumps, tractors and ploughs) plus ten percent of the value of owned machinery per feddan.

20. The latest available (1981) agricultural census does not have figures for current population of agricultural equipment, but does give figures for the number of farms using such equipment on owned, shared and rented bases. The ratio of farms in Qena to that in Giza is 1.6, suggesting the same overall level of use of tractors. This only points out the high level of aggregation inherent in a comparison of governorates.

21. This finding is based on a cross-sectional comparison of the revenue shares of mechanical power and of fertilizer as measures of the degree of mechanization.

22. Adams [*1986: 60, fn. 11*] mentions that the privately owned cane presses are all owned by rich peasants.

23. While tomatoes are a very labour intensive crop: 192 man-days per year (compared to 65 for wheat and maize or 99 for birseem and cotton) [*Ikram, 1980: 193*], the general assumption that vegetable cultivation is highly labour intensive and unmechanised is not borne out by reality: Hopkins [*1982: 132*] writes: "vegetable farming did not appear appreciably less mechanized than open field farming."

APPENDIX A

Statistical Tables

Table 1 Selected farm indicators by farm size for 15 developing countries

country	CLS	MD-LN	GO-LN	VA-LN	KA-LN	LUI	OFLI
Sudan	< 0.5	328.20	203.20	198.90	115.20	1.00	0.02
	0.5-1	206.50	85.00	82.90	344.20	1.00	0.11
	1-1.5	160.00	94.50	93.00	60.20	1.00	0.15
	1.5-2	161.30	146.80	142.10	219.10	1.00	0.19
	2-2.5	78.90	64.00	62.00	67.30	1.00	0.18
	2.5-3	114.70	69.80	67.60	87.00	0.98	0.24
	3-4	87.80	75.40	73.40	66.30	1.01	0.18
	4-5	88.60	70.80	68.60	52.10	0.99	0.29
	5-6	66.60	59.70	57.70	64.30	1.00	0.25
	6-7	96.90	71.60	68.90	26.80	1.00	0.29
	7-8	52.00	28.70	27.50	21.10	1.00	0.24
	8-10	41.90	47.90	46.70	80.40	1.00	0.34
	10-15	60.20	35.10	33.70	36.50	0.99	0.36
	> 15	51.80	38.20	36.60	32.90	1.00	0.50
Syria	< 0.5	608.90	706.30	300.10	1638.70	1.02	0.49
	0.5-1	169.30	423.30	243.00	273.60	1.06	0.47
	1-2	161.40	337.70	180.10	406.40	1.08	0.53
	2-3	96.40	235.70	125.20	282.60	0.97	0.52
	3-4	96.80	187.70	98.50	229.70	0.73	0.66
	4-5	51.50	140.10	70.40	204.70	0.77	0.63
	5-6	70.60	107.90	59.90	128.70	0.71	0.72
	6-8	56.60	102.30	53.90	90.10	0.71	0.58
	8-10	35.70	91.20	48.30	94.50	0.70	0.61
	10-15	33.70	75.60	36.90	99.30	0.76	0.67
	15-20	20.50	76.20	38.30	73.10	0.71	0.69
	20-50	15.30	43.60	22.40	42.00	0.66	0.79
	50-150	8.20	35.40	19.80	26.00	0.58	0.80
	> 150	8.20	21.80	16.80	9.10	0.09	0.95
Ethiopia	< 1.0	339.70	74.60	69.80	245.30	0.52	0.00
	1-1.5	246.00	159.30	144.30	320.40	0.91	0.02
	1.5-2	220.00	36.40	25.10	56.70	0.78	0.00
	2-2.5	97.00	57.70	47.30	136.40	1.00	0.15
	2.5-3	136.70	63.60	51.20	149.60	1.24	0.05
	3-3.5	185.00	98.10	88.20	240.00	1.00	0.04
	3.5-4	126.70	51.80	42.00	134.80	0.92	0.03
	4-5	62.60	55.30	46.60	75.90	0.87	0.11
	5-6	51.60	42.20	33.30	59.40	0.80	0.01
	> 6	6.11	9.20	8.20	2.70	0.63	0.00
Nigeria	< 0.2	138.40	753.70	595.80	814.50	1.36	0.26
	0.5-1	167.50	542.20	408.50	509.90	1.29	0.39
	1-1.5	133.50	479.40	365.60	319.40	1.57	0.37
	1.5-2	146.70	389.40	286.30	509.50	1.57	0.31
	2-2.5	66.90	393.00	321.10	341.90	1.55	0.38
	2.5-3	56.20	478.00	370.40	149.70	1.61	0.54
	3-3.5	45.70	315.90	170.30	165.60	1.35	0.64
	3.5-4	53.80	375.80	265.70	177.90	1.66	0.44
	4-5	41.90	356.10	270.10	190.80	1.34	0.47
	5-7	52.90	388.50	254.80	156.60	1.82	0.58
	7-10	44.00	367.20	274.20	173.00	1.62	0.59
	10-15	39.10	338.50	274.40	64.80	2.01	0.71
	> 15	15.80	124.60	77.90	494.20	0.86	0.46

Note: All values are expressed in 1970 US dollars; land figures are expressed in hectares. CLS = farm size (intervals expressed in hectares); MD-LN = man-days per hectare; GO-LN = gross output per hectare; VA-LN = value added per hectare; KA-LN = capital stock (land excluded) per hectare; LUI = land use intensity; OFLI = percent of off-farm labour.
Source: Table 2 [Cornia, 1985: 519-23].

country	CLS	MD-LN	GO-LN	VA-LN	KA-LN	LUI	OFLI
Tanzania	< 0.2	1378.20	649.10	904.80	2199.99	1.43	0.00
	0.2-0.4	415.60	361.90	340.80	1616.90	1.29	0.00
	0.4-0.6	208.10	259.90	250.50	390.90	1.03	0.05
	0.6-0.8	238.70	329.40	299.60	636.10	1.02	0.00
	0.8-1	172.30	196.70	186.50	332.90	1.03	0.01
	1-1.5	123.60	168.00	157.80	384.50	0.96	0.01
	1.5-2	114.00	153.60	146.70	180.70	0.97	0.04
	2-2.5	105.30	147.00	139.80	157.60	0.95	0.04
	2.5-3	130.70	135.00	131.80	81.40	0.97	0.05
	3-4	78.30	122.10	117.80	75.60	0.96	0.01
	4-5	74.20	61.00	58.60	91.30	0.85	0.05
	5-6	60.20	59.20	57.80	49.40	0.93	0.13
	6-8	53.40	84.50	82.30	30.50	0.94	0.04
	8-10	47.70	50.20	49.50	82.90	0.97	0.10
	10-15	54.10	83.90	83.00	47.10	0.95	0.26
	> 15	19.50	117.00	117.00	18.10	1.00	0.42
Uganda	< 1	255.70	221.40	194.60	109.50	0.79	0.07
	1-2	192.80	212.50	191.00	160.90	0.78	0.06
	2-3	115.50	146.80	129.30	86.50	0.67	0.03
	3-4	77.40	112.70	98.60	91.20	0.54	0.01
	4-5	91.70	94.50	83.50	140.20	0.51	0.05
	5-6	60.60	73.30	65.80	57.00	0.39	0.01
	6-8	45.80	54.10	48.50	23.00	0.35	0.02
	> 8	35.50	35.50	31.80	28.10	0.33	0.07
Barbados	< 0.1	1560.00	2980.00	2850.00	461.70	2.20	0.00
	0.1-0.2	686.00	2115.40	1777.90	7376.90	0.79	0.10
	0.2-0.3	1058.40	7241.50	2818.80	7335.80	0.72	0.00
	0.3-0.4	448.20	821.50	559.40	9999.99	0.81	0.00
	0.4-0.5	510.20	234.00	120.40	870.60	0.92	0.00
	0.5-0.6	270.40	745.20	440.00	4051.10	0.41	0.09
	0.6-1	505.30	1977.50	1654.50	2565.40	0.30	0.04
	1-2	238.40	979.20	508.70	442.40	0.76	0.05
	2-3.5	146.70	309.70	218.10	1162.00	0.40	0.00
	> 3.5	153.90	1166.70	398.80	1474.70	0.44	0.00
Mexico	< 1	64.80	49.60	49.30	130.40	1.00	0.00
	1-2	32.30	265.00	211.60	107.60	1.00	0.32
	2-3	62.60	95.00	95.00	16.30	1.00	0.00
	3-4	78.50	1292.00	582.50	273.80	1.00	0.00
	4-6	10.60	288.30	268.40	71.60	1.00	0.00
	6-8	29.10	103.30	96.10	194.80	0.98	0.00
	8-10	16.10	74.20	63.50	423.30	1.02	0.07
	10-15	10.80	59.40	48.90	230.60	1.08	0.06
	15-20	16.80	85.60	44.70	258.70	1.27	0.23
	20-30	8.00	104.60	61.50	286.20	1.49	0.27
	30-35	5.60	70.30	34.60	185.50	1.17	0.32
	> 35	2.40	34.50	17.40	28.50	0.92	0.35
Peru	< 1	265.10	194.70	151.00	240.70	1.00	0.13
	1-2	209.20	140.30	111.90	165.90	1.00	0.07
	2-3	104.20	126.90	89.00	123.60	0.92	0.26
	3-4	150.90	145.80	97.30	287.40	0.81	0.46
	4-5	75.60	166.70	105.00	53.00	0.89	0.60
	5-7	47.00	846.70	798.50	117.10	0.80	0.27
	7-10	56.00	237.50	171.50	430.20	1.00	0.75
	10-15	59.50	406.30	293.10	338.10	0.86	0.92
	15-20	63.20	150.50	96.20	63.00	0.59	0.66
	> 20	36.20	135.50	103.20	107.90	0.54	0.76
Thailand	< 1	82.40	152.70	144.50	503.20	1.33	0.17
	1-2	75.10	116.50	99.20	33.00	1.00	0.23
	2-4	87.10	135.10	119.00	98.10	0.99	0.16
	> 4	42.70	87.20	84.60	18.10	0.98	0.49

country	CLS	MD-LN	GO-LN	VA-LN	KA-LN	LUI	OFLI
Bangladesh	< .1	530.00	480.00	350.00	3798.40	2.00	0.17
	0.1-0.2	343.70	275.00	221.80	1586.20	1.80	0.26
	0.2-0.3	382.80	440.00	234.90	1254.20	1.90	0.33
	0.3-0.4	426.80	1270.10	1026.90	1370.70	1.94	0.62
	0.4-0.5	556.50	562.50	350.60	1326.20	1.43	0.29
	0.5-0.6	387.00	589.70	414.10	685.10	1.48	0.36
	0.6-0.7	337.80	426.80	225.10	746.20	1.64	0.61
	0.7-0.8	534.40	365.80	224.10	706.00	1.56	0.60
	0.8-0.9	391.80	455.70	273.90	643.90	1.78	0.66
	0.9-1	530.30	705.80	446.00	739.20	1.69	0.61
	1-1.5	402.60	494.20	392.60	574.50	1.51	0.60
	1.5-2	269.20	454.50	344.10	553.10	1.10	0.61
	2-2.5	472.40	504.50	380.70	504.00	1.61	0.85
	> 2.5	348.20	408.00	384.30	529.70	1.20	0.79
Burma	< 0.5	1029.70	797.30	136.00	397.70	1.00	0.09
	0.5-1	412.20	486.50	167.00	546.30	2.01	0.17
	1-1.5	269.60	240.50	96.10	203.10	1.20	0.21
	1.5-2	276.00	181.70	48.50	219.40	1.09	0.16
	2-3	185.90	189.30	81.80	231.10	1.31	0.28
	3-4	140.30	151.80	58.80	173.10	1.09	0.25
	4-5	159.20	166.50	71.90	192.70	1.15	0.39
	5-6	138.50	234.50	113.30	194.40	1.07	0.60
	6-7	113.90	202.50	87.00	277.40	1.00	0.38
	7-10	190.60	186.00	99.20	223.90	0.98	0.43
	10-13	114.90	188.70	66.90	210.10	0.90	0.50
	> 13	78.30	109.50	26.90	208.80	1.00	0.79
India	< 1	851.10	736.70	180.00	967.90	1.78	0.03
	1-1.5	224.60	501.60	218.00	319.80	2.00	0.10
	1.5-2	335.40	658.90	277.20	514.90	1.89	0.10
	2-2.5	407.10	609.30	209.90	470.70	2.26	0.17
	2.5-3	183.10	702.70	333.80	408.70	1.82	0.05
	3-3.5	253.10	635.40	233.70	448.90	2.50	0.31
	3.5-4	276.90	551.00	244.60	510.00	1.88	0.09
	4-5	162.40	524.40	265.10	324.90	2.00	0.54
	5-6	264.00	368.50	153.10	194.40	2.00	0.24
	6-8	137.20	548.80	253.80	503.20	2.00	0.31
	8-10	177.60	277.00	168.40	361.50	1.92	0.33
Nepal	< 0.2	936.00	792.50	677.50	1345.80	2.57	0.18
	0.2-0.4	1444.10	693.10	492.40	590.50	2.31	0.39
	0.4-0.6	585.00	441.40	365.90	1279.40	1.75	0.68
	0.6-0.8	639.80	583.60	433.80	278.50	1.69	0.22
	0.8-1	1064.70	677.10	503.00	468.40	1.67	0.16
	1-1.5	651.40	399.50	303.40	274.10	1.41	0.12
	1.5-2	537.30	332.40	274.00	152.00	1.42	0.16
	2-2.5	456.20	370.00	282.30	341.50	1.33	0.18
	2.5-3	369.40	256.30	191.80	88.60	1.26	0.15
	3-3.5	474.70	377.20	331.10	284.40	1.59	0.29
	> 3.5	462.70	320.50	250.20	419.80	1.75	0.11
Korea	< 2	192.00	897.10	642.20	1569.70	1.00	0.08
	2-3	143.70	516.00	429.20	437.70	1.00	0.14
	3-4	211.70	258.00	198.80	507.30	0.87	0.15
	4-5	51.80	584.90	545.00	533.70	1.00	0.30
	5-6	37.00	328.70	279.40	248.60	1.01	0.30
	6-7	68.50	303.80	245.00	387.80	1.00	0.21
	> 7	22.70	297.40	232.70	143.80	1.00	0.35

Note: All values are expressed in 1970 US dollars; land figures are expressed in hectares. CLS = farm size (intervals expressed in hectares); MD-LN = man-days per hectare; GO-LN = gross output per hectare; VA-LN = value added per hectare; KA-LN = capital stock (land excluded) per hectare; LUI = land use intensity; OFLI = percent of off-farm labour.
Source: Table 2 [Cornia, 1985: 519-23].

Table 2 The Indian FMS size class data: gross output and farm business income per hectare by size class

	Amritsar and Ferozepur (1954-57)		Karnal, Rohtak and Jind Tehsil (1961-62)	
size	output	FBI	output	FBI
<5ha	496.69	237.32	751.21	452.21
5-10	459.62	205.10	585.65	316.30
10-15	(		548.58	318.77
15-20	(427.50	200.16	506.27	291.59
20-30	(		462.09	291.59
30-50	(380.55	187.80	373.13	205.10
>50	353.37	185.33	259.46	138.38

	Uttar Pradesh (Meerut & Muzaffarnagar) 1954-57		Maharashtra (Akola & Amraoti) 1955-57	
size	output	FBI	output	FBI
<5ha	496.69	237.22	259.07	148.86
5-10	459.62	205.10	219.01	119.35
10-15	427.50	200.16	231.00	122.05
15-20	380.55	187.80	201.25	111.69
20-30	(		207.87	116.36
30-40	(		209.25	120.84
40-50	(353.37	185.33	239.40	129.88
>50	(		226.10	116.66

	Maharashtra (1955-57) Ahmednagar		Maharashtra (1955-57) Nasik	
size	output	FBI	output	FBI
<5ha	226.35	78.33	303.20	53.38
5-10	231.79	100.08	295.54	125.04
10-15	145.30	62.02	158.64	52.63
15-20	362.51	137.64	139.62	64.74
20-25	98.35	45.72	129.24	60.29
25-30	128.99	62.77	146.54	82.04
30-50	172.78	69.44	171.49	56.09
>50	81.55	41.27	104.77	37.81

	West Bengal (Hooghly & 24 Paraganas) 1954-57		Madras (Salem & Coimbatore) 1954-57	
size	output	FBI	output	FBI
.01-1.25	583.18	321.24	(	
1.26-2.50	598.00	316.30	(550.31	86.74
2.51-3.75	573.29	227.34	(	
3.76-5.00	599.16	279.23	(481.12	191.76
5.01-7.50	583.18	294.06	417.12	171.49
7.51-10.0	551.05	321.24	425.52	204.36
10.01-15	400.32	202.63	247.60	88.47
15.01-20	(		175.45	60.05
20.0-25.0	(437.38	239.70	164.82	54.86
>25.00	(		204.11	108.97

size	Andhra Pradesh (West Godavari) output	FBI	Orissa (Sambalpur district) output	FBI
.01-1.25	1280.02	558.47	(	
1.26-2.50	1126.82	415.14	(328.65	185.33
2.51-5.00	894.53	328.65	316.30	180.39
5.01-7.50	746.27	237.22	(	
7.51-10.0	842.64	192.75	(286.65	140.85
10.01-15	939.01	291.59	254.52	96.37
15.01-20	1008.20	271.82	(	
>20.00	921.72	383.02	(311.36	145.79

size	N. Monghor output	C. Monghor output	S. Monghor output
<2.5	474.45	494.22	439.85
2.5-5.0	370.66	476.92	467.04
5.0-7.5	441.33	442.56	(447.27
7.5-10	486.80	360.78	(
10.0-15	363.25	429.97	632.60
15.0-20	528.81	528.81	454.68
>20.0	407.73	575.76	422.56

Bihar (Shahabad) 1960-61

size	output
<2.5	508.40
2.5-5.0	495.06
5.0-7.5	470.34
7.5-10	478.91
10.0-15	482.39
15.0-20	473.69
20-30	452.01
>30	471.65

size	Rajasthan (Pali) 1962-63 output	FBI	Kerala (Allepey & Quilon) 1962-63 output	FBI
<1.0	(		590.40	96.72
1-2.5	(213.22	142.65	890.62	225.87
2.5-5.0	255.67	188.98	689.78	148.85
5.0-7.5	350.78	162.22	(	
7.5-10	190.98	77.91	(807.30	223.06
10-15	216.76	103.78	768.48	225.28
15-20	260.84	107.96	(	
20-25	166.27	76.65	(741.37	235.95
>25	136.42	37.88	503.19	-90.62

Madhya Pradesh (Raipur) 1962-63

size	output	FBI
<1.0	500.73	321.41
1.0-2.0	409.10	257.40
2.0-4.0	391.82	238.01
4.0-6.0	352.94	212.56
>6.0	377.83	216.32

Source: Appendix III [Department of Agriculture, 1966: 105-14]

Table 3 Yield per acre related to size: all crop production, Indian FMS

Region	Year	Constant term	α	Standard error	R^2	F
Punjab	1954-55	2.08	-0.02	0.005	0.79	11.69[b]
	1955-56	1.96	-0.11	0.049	0.83	11.04[b]
	1956-57	2.48	-0.20	0.017	0.96	84.18[a]
West Bengal						
Hooghly	1954-55	2.48	-0.13	0.050	0.55	7.14[b]
24 Paraganas	1954-55	2.40	-0.23	0.145	0.30	2.56
Hooghly	1955-56	2.32	-0.11	0.027	0.72	15.71[a]
24 Paraganas	1955-56	2.31	-0.13	0.057	0.46	5.04[c]
Hooghly	1956-57	2.49	-0.07	0.076	0.12	0.77
24 Paraganas	1956-57	2.35	-0.02	0.066	0.17	0.11
Bombay						
Ahmednagar	1954-55	1.89	-0.30	0.074	0.72	16.28[a]
Nasik	1954-55	2.13	-0.41	0.110	0.71	14.15[a]
Ahmednagar	1955-56	2.02	-0.22	0.166	0.23	1.75
Nasik	1955-56	2.22	-0.31	0.081	0.50	14.69[a]
Ahmednagar	1956-57	2.28	-0.32	0.164	0.41	4.05[c]
Nasik	1956-57	2.28	-0.35	0.089	0.74	16.82[a]
Madras						
	1954-55	2.27	-0.35	0.191	0.36	3.36
	1955-56	2.42	-0.41	0.091	0.75	20.39[a]
	1956-57	2.68	-0.47	0.104	0.75	20.59[a]
U.P.						
	1954-55	2.57	-0.13	0.040	0.75	10.43[b]
	1955-56	2.51	-0.12	0.079	0.43	2.26
	1956-57	2.88	-0.21	0.059	0.67	12.17[a]
M.P.						
Akola	1955-56	2.14	-0.11	0.057	0.38	3.71
Amraoti	1956-57	2.18	-0.08	0.065	0.21	1.50
Akola	1955-56	1.83	-0.02	0.059	0.03	0.15
Amraoti	1956-57	1.69	0.14	0.029	0.02	2.10

Note: [a] *denotes significance at 1 per cent level*
[b] *denotes significance at 5 per cent level*
[c] *denotes significance at 10 per cent level*

Source: Table B.1 [Bharadwaj, 1974: 92].

Table 4 Statistics relating to the inverse relationship

state	year	n	constant	b coeff.	t value	R^2
Andhra	1957-58	104	2.59	0.90	2.11	0.78
Andhra	1958-59	97	2.60	0.80	3.25	0.65
Andhra	1959-60	84	2.60	0.85	1.49	0.48
Bihar	1958-59	98	2.55	0.71	3.77	0.46
Madras	1954-55	198	2.08	0.69	3.14	0.21
Madras	1955-56	181	2.22	0.63	4.24	0.23
Maharashtra	1955-56	160	2.06	0.70	4.31	0.39
Maharashtra	1956-57	160	2.15	0.66	5.10	0.38
MP	1955-56	159	1.71	1.03	0.51	0.70
MP	1956-57	159	2.12	0.86	3.37	0.74
Orissa	1957-58	98	2.15	0.96	0.72	0.76
Orissa	1958-59	100	2.12	0.92	2.35	0.88
Orissa	1959-60	99	2.05	0.90	2.53	0.83
Punjab	1955-56	200	2.28	0.90	2.28	0.70
Punjab	1956-57	200	2.45	0.85	3.88	0.69
UP	1955-56	147	2.55	0.78	5.05	0.68
UP	1956-57	196	2.52	0.85	3.38	0.66
W Bengal	1955-56	190	2.13	1.08	0.99	0.50
W Bengal	1956-57	192	2.33	1.10	1.79	0.67
UP	1955-56	97	2.56	0.76	4.85	0.71
UP	1956-57	96	2.57	0.82	3.44	0.71
UP	1966-67	150	3.55	0.84	3.69	0.71
Punjab	1955-56	100	2.19	0.95	0.81	0.70
Punjab	1956-57	100	2.45	0.84	2.66	0.65
Punjab	1967-68	150	3.28	0.94	0.73	0.49

source: table 1 [Saini, 1971: A79].

Table 5 Significance of linear and log-linear regressions of gross value of output per acre (V/A) on farm size (A) and of the rank correlation coefficient between these variates

		linear regression			log-linear			Kendall
vill	n	b	r	t	b	r	t	tau
a) Muzaffarnagar 1955-56								
1	10	-0.2	-0.058	-0.164	-0.006	-0.022	-0.063	-0.067
2	10	-13.2	-0.660	-2.485	-0.385	-0.899	-5.808	-0.556
3	10	-1.1	-0.104	-0.296	-0.084	-0.081	-0.023	-0.111
4	8	2.6	0.250	0.636	-0.030	-0.037	-0.091	-0.077
5	10	-5.9	-0.561	-1.916	-0.452	-0.695	-2.738	-0.467
6	10	-3.4	-0.222	-0.644	-0.130	-0.251	-0.734	-0.244
7	10	-25.4	-0.667	-2.532	-0.459	-0.808	-3.882	-0.644
8	10	-0.8	-0.097	-0.276	0.004	0.018	0.051	0.022
9	9	-4.1	-0.392	-1.127	-0.150	-0.424	-1.240	-0.444
10	10	1.4	0.399	1.230	0.113	0.341	1.026	0.200
all	97	-4.0	-0.288	-2.930	-0.248	-0.456	-4.446	
b) Ferozepur 1955-56								
1	10	-1.5	-0.252	-0.736	-0.163	-0.289	-0.855	-0.244
2	10	-3.9	-0.698	-2.756	-0.468	-0.689	-2.686	-0.600
3	10	-1.5	-0.385	-1.179	-0.143	-0.479	-1.542	-0.333
4	10	1.3	0.452	1.432	0.269	0.622	2.247	0.378
5	10	1.3	0.376	1.156	0.243	0.227	0.659	0.511
6	10	1.8	0.365	1.110	0.232	0.333	0.999	0.244
7	10	-0.3	-0.173	-0.498	-0.068	0.229	-0.664	-0.244
8	10	0.03	0.022	0.061	-0.057	-0.186	-0.535	-0.111
9	10	0.06	0.029	0.081	-0.043	-0.097	-0.277	0.244
10	10	1.4	0.400	1.233	0.102	0.147	0.420	0.156
all	100	-0.03	0.010	-0.098	-0.058	-0.094	-0.934	
c) Muzaffarnagar 1956-57								
1	10	-1.6	-0.390	-1.198	-0.111	-0.414	-1.285	-0.289
2	10	-3.0	-0.395	-1.180	-0.100	-0.412	-1.279	-0.378
3	10	-6.9	-0.529	-1.765	-0.353	-0.573	-1.978	-0.511
4	8	1.3	0.145	0.359	0.004	0.021	0.051	-0.071
5	10	-3.7	-0.546	-1.842	-0.465	-0.704	-2.801	-0.511
6	10	3.8	0.234	0.682	0.017	0.039	0.111	0.111
7	10	-19.3	-0.737	-3.083	-0.262	-0.751	-3.220	-0.294
8	10	-12.4	-0.641	-2.360	-0.217	-0.567	-1.947	-0.511
9	9	-0.4	-0.028	-0.075	0.047	0.092	0.246	0.056
10	9	1.9	0.472	1.417	0.076	0.234	0.637	0.222
all	96	-2.6	-0.216	-2.140	-0.165	-0.326	-3.342	
d) Ferozepur 1956-57								
1	10	-2.7	-0.469	-1.503	-0.098	-0.516	-1.704	-0.333
2	10	-5.2	-0.830	-4.215	-0.341	-0.738	-3.097	-0.378
3	10	-2.6	-0.438	-1.379	-0.162	-0.499	-1.628	-0.156
4	10	0.9	0.317	0.945	0.197	0.435	1.367	0.156
5	10	1.4	0.363	1.101	0.192	0.802	3.802	0.289
6	10	1.7	0.509	1.673	0.178	0.443	1.397	0.289
7	10	-0.3	-0.180	-0.519	-0.120	-0.208	-0.601	-0.111
8	10	0.06	0.034	0.097	-0.110	-0.288	-0.850	-0.244
9	10	-3.7	-0.580	-2.016	-0.276	-0.739	-3.102	-0.467
10	10	0.06	0.040	0.113	-0.008	0.030	0.085	-0.067
all	100	-0.9	-0.193	-1.950	-0.172	-0.275	-2.835	

e) Muzaffarnagar 1966-67

1	10	-80.6	-0.467	-1.494	-0.215	-0.636	-2.333	-0.733
2	10	-267.3	-0.528	-1.757	-0.298	-0.442	-1.395	-0.289
3	10	-556.9	-0.543	-1.830	-0.362	-0.478	-1.538	-0.289
4	10	6.3	0.054	0.153	0.090	0.265	0.777	0.111
5	10	-27.0	-0.128	-0.366	-0.101	-0.268	-0.786	-0.067
6	10	-90.6	-0.570	-1.962	-0.317	-0.596	-2.100	-0.333
7	10	-81.6	-0.320	-0.956	-0.116	-0.384	-1.175	-0.422
8	10	-99.9	-0.627	-2.274	-0.266	-0.613	-2.194	-0.467
9	10	12.4	0.163	0.467	0.030	0.182	0.525	0.200
10	10	-87.6	-0.418	-1.301	-0.197	-0.421	-1.312	-0.289
11	10	-204.7	-0.553	-1.878	-0.332	-0.730	-3.022	-0.511
12	10	-37.8	-0.213	-0.616	0.117	0.134	0.383	-0.156
13	10	-36.5	-0.215	-0.623	-0.128	-0.279	-0.823	-0.156
14	10	18.1	0.132	0.376	0.046	0.148	0.422	-0.067
15	10	-29.4	-0.237	-0.688	-0.055	-0.211	-0.611	-0.156
all	150	-80.4	-0.245	-3.070	-0.135	-0.248	-3.111	

f) Muzaffarnagar 1967-68

1	10	-22.8	-0.118	-0.337	-0.073	-0.171	-0.491	-0.289
2	10	-8.0	-0.051	-0.145	0.047	0.283	0.836	0.044
3	10	-76.7	-0.321	-0.960	-0.098	-0.484	-1.562	-0.200
4	10	-31.1	-0.202	-0.584	-0.019	-0.062	-0.177	-0.067
5	10	-139.7	-0.855	-4.656	-0.180	-0.787	-3.613	-0.556
6	10	2.2	0.009	0.027	0.053	0.100	0.286	0.156
7	10	-227.3	-0.374	-1.139	-0.203	-0.381	-1.168	-0.333
8	10	-159.8	-0.641	-2.365	-0.272	-0.659	-2.481	-0.422
9	10	0.2	0.001	0.003	-0.027	-0.117	-0.333	-0.378
10	10	-268.2	-0.669	-2.543	-0.402	-0.764	-3.345	-0.467
11	10	-233.4	-0.549	-1.857	-0.292	-0.545	-1.840	-0.422
12	10	-32.4	-0.425	-1.329	-0.079	-0.386	-1.182	-0.333
13	10	-81.4	-0.503	-1.647	-0.110	-0.511	-1.680	-0.378
14	10	-145.7	-0.603	-2.137	-0.157	-0.852	-4.595	-0.600
15	10	57.7	0.307	0.911	0.126	0.449	1.419	0.378
all	150	-68.2	-0.260	-3.276	-0.092	-0.245	-3.075	

g) Ferozepur 1967-68

1	10	24.4	0.180	0.519	0.019	0.036	0.102	0.067
2	10	62.7	0.440	1.386	0.154	0.262	0.766	0.244
3	10	-15.2	-0.171	-0.490	-0.097	-0.224	-0.652	-0.022
4	10	4.0	0.061	0.174	0.060	0.144	0.411	0.244
5	10	-3.3	-0.074	-0.209	-0.032	-0.100	-0.284	-0.200
6	10	29.1	0.496	1.616	0.188	0.429	1.343	0.156
7	10	-31.3	-0.350	-1.056	-0.180	-0.393	-1.208	-0.289
8	10	-12.2	-0.125	-0.355	-0.121	-0.242	-0.705	0.022
9	10	-64.3	-0.667	-2.532	-0.507	-0.759	-3.299	-0.644
10	10	17.5	0.350	1.056	0.142	0.339	1.018	0.200
11	10	-2.7	-0.060	-0.149	-0.052	-0.089	-0.243	-0.022
12	10	-8.8	-0.167	-0.479	-0.018	-0.054	-0.152	-0.156
13	10	-7.9	-0.351	-1.059	-0.140	-0.536	-1.798	-0.467
14	10	22.0	0.577	2.000	0.203	0.580	2.016	0.600
15	10	-24.7	-0.324	-0.969	-0.156	-0.486	-1.574	-0.244
all	150	-2.3	-0.029	-0.351	-0.028	-0.046	-0.557	

h) Muzaffarnagar 1968-69								
1	10	-13.5	-0.150	-0.429	-0.094	-0.424	-1.325	-0.467
2	10	25.0	0.286	0.844	0.005	0.050	0.143	-0.022
3	10	-33.0	-0.386	-1.183	-0.021	-0.232	-0.674	-0.378
4	10	-19.8	-0.536	-1.797	-0.053	-0.560	-1.910	-0.511
5	10	17.5	0.373	1.136	0.023	0.271	0.797	-0.244
6	10	-57.1	-0.537	-1.802	-0.119	-0.547	-1.848	-0.378
7	10	-43.8	-0.314	-0.936	-0.067	-0.371	-1.129	-0.022
8	10	3.9	0.062	0.176	-0.008	-0.061	-0.172	-0.067
9	10	-66.4	-0.461	-1.468	-0.140	-0.528	-1.753	-0.378
10	10	-148.1	-0.789	-3.636	-0.215	-0.688	-2.683	-0.511
11	10	-29.1	-0.242	-0.706	-0.044	-0.189	-0.545	-0.111
12	10	-14.7	-0.268	-0.788	-0.059	-0.352	-1.062	-0.289
13	10	-108.9	-0.442	-1.392	-0.149	-0.455	-1.443	-0.067
14	10	-12.2	-0.126	-0.360	-0.002	-0.019	-0.053	-0.333
15	10	4.9	0.056	0.159	-0.009	-0.060	-0.170	-0.022
all	150	-20.5	-0.145	-1.788	-0.042	-0.168	-2.073	
i) Ferozepur 1968-69								
1	10	-6.1	-0.034	-0.097	-0.142	-0.158	-0.454	-0.067
2	10	-83.4	-0.535	-1.791	-0.336	-0.486	-1.575	-0.289
3	10	11.9	0.265	0.777	0.033	0.101	0.287	0.111
4	10	-13.4	-0.161	-0.462	-0.033	-0.074	-0.211	-0.156
5	10	-25.0	-0.453	-1.439	-0.168	-0.346	-1.043	-0.200
6	10	22.9	0.273	0.804	0.203	0.356	1.080	0.244
7	10	6.3	0.095	0.269	0.085	0.298	0.883	0.156
8	10	0.1	0.001	0.003	-0.072	-0.146	-0.418	-0.022
9	10	-27.9	-0.646	-2.393	-0.329	-0.680	-2.624	-0.422
10	10	20.6	0.508	1.670	0.180	0.389	1.161	0.156
11	10	4.9	0.094	0.268	-0.075	-0.110	-0.314	-0.022
12	10	-13.6	-0.162	-0.463	-0.041	-0.083	-0.237	-0.156
13	10	4.3	0.203	0.586	0.061	0.129	0.368	0.022
14	10	5.1	0.149	0.427	0.009	0.035	0.100	-0.289
15	10	-3.5	-0.052	-0.148	-0.082	-0.154	-0.442	-0.289
all	150	-1.4	-0.018	-0.221	-0.027	-0.039	-0.471	

source: table 1 [Bhattacharya and Saini, 1972: A65-66].

Table 6 Yield per acre and size of holding: individual crops, Indian FMS

Region/crop	Year	Constant term	α	Standard error	R^2	F
Punjab						
Wheat irrigated	1955-56	0.74	0.20	0.069	0.75	11.04[b]
	1956-57	2.14	0.17	0.028	0.83	14.92[b]
Wheat-gram irrigated	1955-56	2.36	-0.02	0.09	0.74	9.34[c]
American cotton	1954-55	2.06	0.12	0.039	0.76	9.58[c]
	1955-56	2.04	0.12	0.049	0.79	14.42[b]
Desi cotton	1954-55	0.43	0.28	0.068	0.71	16.51[b]
West Bengal						
Aman paddy Hooghly	1955-56	1.20	0.12	0.037	0.61	9.66[b]
Aus paddy Hooghly	1955-56	0.64	0.47	0.053	0.96	77.77[a]
Pulses: Hooghly	1955-56	0.38	0.23	0.082	0.55	8.14[b]
Mesta: Hooghly	1956-57	0.89	0.18	0.090	0.40	3.97[c]
24 Paraganas	1956-57	0.48	0.69	0.076	0.92	83.73[a]
Bombay						
Irrigated wheat Ahmednagar	1956-57	1.00	-0.28	0.120	0.46	5.43[c]
Dry Bajri Ahmednagar	1956-57	1.89	-0.30	0.074	0.72	16.28[a]
Nasik	1956-57	2.14	-0.41	0.109	0.69	14.15[a]
Dry gram Ahmednagar	1956-57	-0.01	0.33	0.170	0.39	3.82[c]
Irrigated gram Ahmednagar	1956-57	0.18	0.42	0.173	0.49	5.95[c]
Madras						
Paddy season I	1956-57	1.59	-0.17	0.04	0.70	15.30[a]
Paddy season II	1955-56	1.42	-0.10	0.05	0.45	4.85[c]
U.P.						
Wheat irrigated	1954-55	1.20	-0.07	0.03	0.36	4.02[c]
Sugarcane ratoon	1954-55	2.73	-0.23	0.06	0.69	13.51[a]
Wheat unirrigated	1954-55	0.98	-0.13	0.03	0.75	21.26[a]

Note: [a] *denotes significance at 1 per cent level*
[b] *denotes significance at 5 per cent level*
[c] *denotes significance at 10 per cent level*

Source: table B.II [Bharadwaj, 1974a: 93].

Table 7 Intensity of cropping and size of holding, Indian FMS

State/district	Year	Constant term	a	Standard error	R^2	F
Punjab						
Amritsar	1954-55	2.22	-0.04	0.02	0.48	6.75[c]
Ferozepur	1954-55	2.13	-0.05	0.02	0.34	4.25
Amritsar	1955-56					
Ferozepur	1955-56					
Amritsar	1956-57	2.34	-0.07	0.03	0.36	5.34
Ferozepur	1956-57	2.82	-0.19	0.02	0.94	46.65[a]
West Bengal						
Hooghly	1954-55	0.03	-0.03	0.04	0.11	0.76
24 Paraganas	1954-55	0.04	-0.02	0.01	0.30	2.66
Hooghly	1955-56	0.05	-0.09	0.02	0.85	32.09[a]
24 Paraganas	1955-56	0.05	-0.07	0.02	0.64	10.82[b]
Hooghly	1956-57	0.09	-0.51	0.04	0.26	2.11
24 Paraganas	1956-57	0.04	-0.09	0.03	0.55	8.05[b]
Bombay						
Ahmednagar	1954-55	0.08	-0.04	0.01	0.49	6.50[b]
Nasik	1954-55	0.09	-0.03	0.01	0.38	8.35[b]
Ahmednagar	1955-56	0.03	-0.001	0.01	0.02	0.02
Nasik	1955-56	0.19	-0.10	0.02	0.70	14.54[a]
Ahmednagar	1956-57	0.10	-0.04	0.02	0.30	2.62
Nasik	1956-57	0.19	-0.14	0.02	0.83	30.33[a]
Madras	1954-55	2.07	-0.13	0.05	0.37	6.18[b]
	1955-56	0.19	-0.20	0.03	0.90	51.27[a]
	1956-57	0.20	-0.16	0.05	0.66	11.60[a]
U.P.	1954-55	0.23	-0.11	0.02	0.86	38.29[a]
	1955-56	0.18	-0.05	0.01	0.71	15.29[a]
	1956-57	0.21	-0.07	0.01	0.86	42.84[a]
M.P.	Double cropping was negligible in M.P.					

Note: [a] *denotes significance at 1 per cent level*
[b] *denotes significance at 5 per cent level*
[c] *denotes significance at 10 per cent level*

Source: table B.IV [Bharadwaj, 1974a:95].

Table 8 Fragments per acre and size of holding, Indian FMS

State/district	Year	Constant term	α	Standard error	R^2	F
Punjab						
	1954-57	0.50	-0.76	0.045	0.98	282.87[a]
West Bengal						
Hooghly	1954-57	0.64	-0.23	0.040	0.85	33.04[a]
24 Paraganas	1954-57	0.65	-0.50	0.079	0.86	38.72[a]
U.P.	1954-55	0.34	-0.37	0.074	0.79	25.19[a]
	1955-56	0.41	-0.40	0.065	0.85	37.88[a]
	1956-57	0.37	-0.30	0.041	0.90	51.90[a]
Bombay	1954-55	0.30	-0.64	0.102	0.88	39.42[a]
	1955-56	0.17	-0.60	0.065	0.94	92.96[a]
	1956-57	0.29	-0.62	0.088	0.94	49.59[a]
M.P.	1955-56	-0.10	-0.49	-0.31	0.96	244.66[a]
	1956-57	-0.13	-0.48	0.015	0.98	977.92[a]

Note: [a] *denotes significance at 1 per cent level*

Source: table B.V [Bharadwaj, 1974a: 96].

Table 9 Labour days per acre related to the size of holding: all crop production, Indian FMS

State/district	Year	Constant term	α	Standard error	R^2	F
Punjab	1954-55	1.45	-0.10	0.02	0.86	19.40[b]
	1955-56	1.47	-0.10	0.02	0.92	46.16[a]
	1956-57	1.47	-0.15	0.02	0.92	47.32[a]
West Bengal						
Hooghly	1954-55	2.16	-0.11	0.07	0.31	2.75
24 Paraganas	1954-55	1.37	-0.20	0.09	0.44	4.59[c]
Hooghly	1955-56	1.81	-1.13	0.04	0.61	9.62[b]
24 Paraganas	1955-56	1.77	-0.27	0.05	0.81	26.11[a]
Hooghly	1956-57	1.85	-0.04	0.06	0.05	0.29
24 Paraganas	1956-57	1.67	-0.08	0.05	0.31	2.72
Bombay						
Ahmednagar	1955-56	1.79	-0.36	0.09	0.72	16.59[a]
Nasik	1955-56	1.85	-0.36	0.07	0.69	29.92[a]
Ahmednagar	1956-57	1.82	-0.43	0.07	0.83	29.78[a]
Nasik	1956-57	1.89	-0.45	0.04	0.96	101.62[a]
Madras	1954-55	1.95	-0.40	0.125	0.64	10.36[b]
	1955-56	2.07	-0.52	0.10	0.81	27.12[a]
U.P.	1954-55	2.16	-0.49	0.05	0.94	99.62[a]
	1955-56	1.88	-0.18	0.04	0.77	20.93[a]
	1956-57	1.78	-0.01	0.07	0.002	0.02
M.P.						
Akola	1955-56	1.60	-0.22	0.05	0.79	23.74[a]
Amraoti	1955-56	1.51	-0.11	0.09	0.19	1.46
Akola	1956-57	1.15	0.03	0.07	0.02	0.16
Amraoti	1956-57	1.12	0.05	0.13	0.02	0.15

Note: [a] *denotes significance at 1 per cent level*
[b] *denotes significance at 5 per cent level*
[c] *denotes significance at 10 per cent level*

Source: table C.II [Bharadwaj, 1974a: 99].

Table 10 Bullock labour days per acre in relation to the size of holding, Indian FMS

State/district	Year	Constant term	a	Standard error	R^2	F
Punjab	1954-55	1.44	-0.16	0.02	0.88	50.51[a]
	1955-56	1.50	-0.12	0.04	0.76	9.86[c]
	1956-57	1.29	-0.20	0.03	0.77	10.09[b]
West Bengal						
Hooghly	1954-55	1.27	-0.03	0.04	0.08	0.50
24 Paraganas	1954-55	1.37	-0.20	0.09	0.44	4.59[c]
Hooghly	1955-56	1.20	-0.03	0.03	0.09	0.75
24 Paraganas	1955-56	1.23	-0.12	0.04	0.56	7.87[b]
Hooghly	1956-57	1.28	-0.01	0.08	0.00	0.03
24 Paraganas	1956-57	1.22	-0.03	0.06	0.04	0.29
Bombay						
Ahmednagar	1955-56	2.10	-0.75	0.33	0.90	22.31[a]
Nasik	1955-56	1.78	-0.35	0.11	0.64	33.77[a]
Ahmednagar	1956-57	1.68	-0.32	0.08	0.79	5.17[c]
Nasik	1956-57	1.89	-0.41	0.07	0.85	10.49[b]
Madras	1954-55	1.89	-0.47	0.09	0.81	25.88[a]
	1955-56	2.14	-0.67	0.09	0.90	51.69[a]
U.P.	1955-56	0.33	-0.13	0.14	0.22	0.88
	1956-57	1.62	-0.12	0.03	0.86	19.24[b]
M.P.						
Akola	1956-57	1.20	-0.04	0.04	0.13	0.89
Amraoti	1956-57	1.06	-0.01	0.08	0.00	0.02

Note: [a] *denotes significance at 1 per cent level*
[b] *denotes significance at 5 per cent level*
[c] *denotes significance at 10 per cent level*

Source: Table F.1 [Bharadwaj, 1974a: 109].

Table 11 Total inputs per acre related to the size of holding: all crop production, Indian FMS

state/district	year	constant term	α	standard error	R^2	F
Punjab	1954-55	2.53	-0.35	0.24	0.40	2.03
	1955-56	2.43	-0.18	0.03	0.85	31.37[b]
	1956-57	2.57	-0.20	0.04	0.92	36.47[a]
West Bengal						
Hooghly	1954-55	2.49	-0.15	0.05	0.61	9.47[b]
24 Paraganas	1954-55	2.38	-0.32	0.04	0.90	56.99[a]
Hooghly	1955-56	2.26	-0.17	0.05	0.64	10.31[b]
24 Paraganas	1955-56	2.27	-0.18	0.05	0.60	9.54[b]
Hooghly	1956-57	2.49	-0.11	0.05	0.45	4.98[c]
24 Paraganas	1956-57	2.22	-0.01	0.04	0.02	0.11
Bombay						
Ahmednagar	1955-56	2.25	-0.36	0.14	0.52	6.46[b]
Nasik	1955-56	2.25	-0.36	0.09	0.72	15.69[a]
Ahmednagar	1956-57	2.34	-0.48	0.13	0.66	11.66[b]
Nasik	1956-57	2.49	-0.52	0.07	0.90	59.85[a]
Madras	1954-55	2.42	-0.41	0.12	0.66	11.48[b]
	1955-56	2.52	-0.50	0.04	0.96	134.81[a]
	1956-57	2.62	-0.49	0.06	0.90	61.29[a]
U.P.	1954-55	2.74	-0.41	0.04	0.98	102.61[a]
	1955-56	-1.24	1.21	0.25	0.88	23.62[a]
	1956-57	1.04	-0.05	0.02	0.72	7.93[b]
M.P.	1955-56	2.01	-0.07	0.02	0.59	8.66[b]
	1956-57	1.90	-0.08	0.03	0.58	8.08[b]

Note: [a] *denotes significance at 1 per cent level*
[b] *denotes significance at 5 per cent level*
[c] *denotes significance at 10 per cent level*

Source: Table F.IV [Bharadwaj, 1974a: 112].

Table 12 Percentage area irrigated related to size of holding, Indian FMS

state/district	year	constant term	b	standard error	R^2	F
Punjab						
Amritsar	1954-55	1.99	-0.05	0.04	0.28	1.21
Ferozepur	1954-55	2.02	-0.11	0.08	0.40	2.06
Amritsar	1955-56	2.01	-0.02	0.02	0.86	20.62[b]
Ferozepur	1955-56	1.85	-0.01	0.08	0.03	0.08
Amritsar	1956-57	1.93	-0.02	0.02	0.10	0.35
Ferozepur	1956-57	1.96	-0.08	0.07	0.13	0.44
West Bengal						
Hooghly	1954-55	-1.01	-0.09	0.93	0.00	0.00
24 Paraganas	1954-55	1.67	-0.67	0.12	0.83	32.45[a]
Hooghly	1955-56	1.08	-0.34	0.20	0.34	2.99
24 Paraganas	1955-56	-0.68	-0.40	1.04	0.02	0.15
Hooghly	1956-57	1.57	-0.85	0.16	0.81	27.83[a]
24 Paraganas	1956-57	0.04	-0.01	0.26	0.00	0.00
Bombay						
Ahmednagar	1955-56	2.03	-0.60	0.14	0.74	17.35[a]
Nasik	1955-56	1.31	-0.43	0.21	0.41	4.26[c]
Ahmednagar	1956-57	1.77	-0.42	0.13	0.62	9.72[b]
Nasik	1956-57	1.75	-0.57	0.10	0.83	27.54[a]
U.P.	1954-55	1.91	-0.08	0.03	0.62	9.52[b]
	1955-56	1.95	-0.09	0.04	0.50	6.26[b]
	1956-57	1.98	-0.06	0.01	0.81	25.77[a]
Madras	1955-56	1.65	-0.32	0.09	0.68	13.55[a]
	1956-57	1.87	-0.54	0.12	0.75	19.51[a]

Note: [a] *denotes significance at 1 per cent level*
[b] *denotes significance at 1 per cent level*
[c] *denotes significance at 1 per cent level*

Source: Table G.I [Bharadwaj, 1974a: 114].

Table 13 Equations for least square regression lines fitted to behaviour of returns per corrected acre by size of farm (corrected acreage)

gross output per corrected acre and farm size

state	constant	b coeff.	se
Andhra	237.34	0.610	1.7492
Bombay	39.62	0.080	0.2012
MP	69.08	0.040	0.0975
Madras	103.25	-0.860	0.1949
Punjab	44.48	0.850	0.5240
UP	227.77	-0.520	1.4678
W Bengal	184.41	-0.570	0.9780

net farm business income per corrected acre and farm size

state	constant	b coeff.	se
Andhra	76.34	0.537	0.5290
Bombay	16.80	0.049	0.1425
MP	37.08	0.002	0.0583
Madras	54.77	-0.386	0.2276
Punjab	173.70	0.479	0.2914
UP	88.73	0.269	1.0382
W Bengal	95.30	-0.175	0.5577

net profit per corrected acre and farm size

state	constant	b coeff.	se
Andhra	-32.09	1.469	0.2855
Bombay	-4.18	0.173	0.0894
MP	11.05	0.085	0.0479
Madras	2.46	0.190	0.3023
Punjab	-15.88	0.344	0.1000
UP	-7.93	3.220	0.6340
W Bengal	22.84	0.401	0.6500

source: statement II [Khusro, 1964: 71].

Table 14a Topography and major crops of two districts in West Bengal

region	land (% total area) high	medium	low	crops (% sown area) paddy	jute	potato
Hooghly	34.76	26.59	38.65	65.82	15.27	5.58
24 Paraganas	25.16	20.86	53.98	80.47	4.34	0.52

Note: The districts chosen are Hooghly and 24 Paraganas - both essentially wet areas. However, in a comparison between the two, since 24 Paraganas is on the whole in a lower lying area than Hooghly it is generally "wetter" then Hooghly.

source: table 2.5 [Roy 1979: 71]

Table 14b Topographical characteristics and cropping pattern for some selected villages in West Bengal

village	high	medium (acres)	low	paddy	jute (acres)	pulses	potato
Baliadarga	50.34		14.09	37.91	3.39		
Bolsiddhi	43.46	217.28	173.83	366.44			
Bongaon	834.00	442.00	164.43	1100.00	25.00	350.00^{u}	20.00^{i}
Khau			3092.60	2767.07			
Krishnagar			157.01	80.00	20.00		
Satbaria			1044.02	600.00			
U.Akhrabaua			284.07	224.07			
Srinagar	1301.03	144.60		1140.09	130.04	56.82	28.70^{i}
						(41.00)^{u}	

Note: u = unirrigateed i = irrigated

Source: table 2.6 [Roy, 1979: 73]

Table 15 The effect of cropping pattern changes with size group of holding on output per acre (West Bengal)

crop	1	2	3	4	5	6	7	8
aman paddy	68.09		141.56					
aus paddy	1.50		2.62					0.01
jute	18.74		36.30	218.77	100.00	205.13	100.00	to
mesta	2.35		5.53					1.25
pulses	6.01		4.13					
potatoes	3.31		28.63					
aman paddy	67.18	-0.91	139.67					
aus paddy	3.98	2.48	6.95					1.25
jute	14.13	-4.61	27.37	213.82	97.74	205.53	100.19	to
mesta	4.36	2.01	10.27					2.50
pulses	7.53	1.52	5.17					
potatoes	2.82	-0.49	24.39					
aman paddy	73.76	5.67	153.35					
aus paddy	1.74	0.24	3.04					2.50
jute	13.25	-5.49	25.67	209.40	95.71	206.76	100.79	to
mesta	2.95	0.60	6.95					3.75
pulses	6.77	0.76	4.65					
potatoes	1.82	-1.49	15.74					
aman paddy	71.64	3.55	148.94					
aus paddy	3.05	1.55	5.23					3.75
jute	13.40	-5.34	25.96	209.10	95.57	205.38	100.12	to
mesta	2.38	0.03	5.60					5.00
pulses	7.42	1.41	5.10					
potatoes	2.10	-1.21	18.17					
aman paddy	66.11	-1.98	137.44					
aus paddy	5.45	3.95	9.52					5.00
jute	12.80	-5.94	24.79	204.13	93.31	205.26	100.06	to
mesta	4.57	2.22	10.76					7.50
pulses	9.32	3.31	6.40					
potatoes	1.76	-1.55	15.22					
aman paddy	77.52	9.43	161.16					
aus paddy	3.89	2.39	6.79					7.50
jute	9.89	-8.85	19.16	207.66	94.92	205.52	100.19	to
mesta	1.82	-0.53	4.29					10.00
pulses	5.42	-0.59	3.72					
potatoes	1.45	-1.86	12.54					
aman paddy	64.74	-3.35	134.59					
aus paddy	2.21	0.71	3.86					10.00
jute	13.41	-5.33	25.98	192.18	87.84	206.73	100.78	to
mesta	5.92	3.57	13.98					15.00
pulses	13.17	7.16	9.05					
potatoes	0.55	-2.76	4.76					
aman paddy	68.22	0.13	141.93					
aus paddy	1.75	0.25	3.06					15.00
jute	10.54	-8.20	20.42	193.35	88.37	208.93	100.34	and
mesta	1.38	-0.97	3.25					above
pulses	16.56	10.55	11.38					
potatoes	1.55	-1.76	13.41					

Note: 1) percentage area under crop 2) percentage change from first size group 3) value per acre attributable to each crop 4) total value of all crops (per acre) Rs. 5) total value all crops index 6) total value all crops exc. potatoes and pulses (Rs.) 7) total value all crop exc, potatoes and pulses (index) 8) size class
Source: table 2.8 [Roy, 1979: 76]

Table 16 Output per net cropped acre and farm size, Punjab

No.	Districts	a (t value)	b (t value)	F-value	n	R^2
1.	Patiala	1648.85 (10.7)	-32.418** (2.3368)	5.46	75	0.07
2.	Ferozepur	956.551 (16.44)	2.7415 (1.0513)	1.105	127	0.009
3.	Sangrur	1361.06 (15.78)	-22.8683*** (2.752)	7.572	72	0.1
4.	Bhatinda	1249.81 (11.98)	-6.9583 (1.1417)	1.303	101	0.013
5.	Jullunder	1695.15 (10.66)	-3.1751 (0.2031)	0.041	42	0.001
6.	Hoshiarpur	1555.67 (34.39)	-11.3808* (1.6828)	2.831	119	0.02
7.	Kapurthala	1605.6 (15.68)	-7.9832 (0.6303)	0.395	20	0.02
8.	Rupnagar	870.16 (14.92)	-13.8832** (2.241)	5.02	58	0.08
9.	Ludhiana	1797.53 (17.25)	-36.717*** (3.482)	12.121	75	0.14
10.	Gurdaspur	1734.53 (20.12)	-15.921 (1.483)	2.199	61	0.04
11.	Amritsar	1555.99 (26.95)	12.098** (2.1488)	4.617	70	0.06

**** = significant at the 1 percent level*
*** = significant at the 5 percent level*
** = significant at the 10 percent level*

source: Table 5.1 [Roy, 1979: 156].

Table 17 Output per net cropped acre and farm size, Punjab

No.	Districts	a (t value)	b (t value)	F-value	n	R^2
1.	Patiala	823.21 (10.80)	-10.3104 (1.5030)	2.259	75	0.03
2.	Ferozepur	552.99 (15.25)	+6.0306*** (3.7102)	13.766	127	0.01
3.	Sangrur	684.05 (15.37)	-3.7555 (0.4897)	0.767	72	0.01
4.	Bhatinda	706.78 (13.45)	+1.4086 (1.2727)	0.211	101	0.02
5.	Jullunder	830.48 (9.74)	+10.6658 (0.5382)	1.620	42	0.04
6.	Hoshiarpur	795.295 (34.80)	-1.8378 (0.5382)	0.289	119	0.002
7.	Kapurthala	736.297 (12.44)	+13.114* (1.793)	3.212	20	0.15
8.	Rupnagar	512.42 (19.35)	-4.2243 (1.5009)	2.253	58	0.04
9.	Ludhiana	908.309 (18.38)	-14.8715*** (2.9723)	8.834	75	0.01
10.	Gurdaspur	957.078 (22.88)	-6.2100 (1.19168)	1.420	61	0.02
11.	Amritsar	872.37 (35.57)	+6.5506*** (2.7831)	7.744	70	0.01

*** = *significant at the 1 percent level*
** = *significant at the 5 percent level*
* = *significant at the 10 percent level*

source: Table 5.2 [Roy, 1979: 157].

Table 18 Cropping intensity and farm size, Punjab

No.	Districts	a (t value)	b (t value)	F-value	n	R^2
1.	Patiala	1.997 (30.73)	-0.02116*** (3.6263)	13.150	75	0.15
2.	Ferozepur	1.7332 (28.06)	-0.00708** (2.5586)	6.545	127	0.05
3.	Sangrur	1.9799 (36.39)	-0.02462*** (4.6837)	21.937	72	0.24
4.	Bhatinda	1.65299 (31.541)	-0.00907*** (2.9634)	8.779	101	0.08
5.	Jullunder	2.0184 (55.011)	-0.02049*** (5.68018)	32.263	42	0.45
6.	Hoshiarpur	1.9755 (67.53)	-0.01212*** (2.77005)	7.667	119	0.06
7.	Kapurthala	2.1265 (29.68)	-0.0329*** (3.71141)	13.772	20	0.43
8.	Rupnagar	1.6433 (32.154)	-0.01155 (2.1267)	4.522	58	0.07
9.	Ludhiana	1.9574 (57.13)	-0.01155** (2.1267)	4.522	75	0.17
10.	Gurdaspur	1.7994 (32.26)	-0.006104 (0.8784)	0.771	61	0.01
11.	Amritsar	1.7884 (43.16)	-0.000101 (0.0252)	0.001	70	0.00

**** = significant at the 1 percent level*
*** = significant at the 5 percent level*
** = significant at the 10 percent level*

source: table 5.3 [Roy, 1979: 158].

Table 19 Yield per acre of HYV wheat and farm size, Punjab

No.	Districts	a (t value)	b (t value)	F-value	n	R^2
1.	Patiala	8.3968 (7.868)	-0.07417 (0.7796)	0.608	72	0.009
2.	Ferozepur	7.8759 (7.8511)	+0.04262 (1.021)	1.042	108	0.01
3.	Sangrur	9.8501 (22.21)	-0.071003* (1.6757)	2.808	69	0.04
4.	Bhatinda	10.309 (11.213)	-0.002954 (0.0615)	0.317	77	0.004
5.	Jullunder	11.0091 (23.51)	-0.002954 (0.0615)	0.003	42	0.0001
6.	Hoshiarpur	13.645 (30.387)	-0.18726*** (3.0167)	9.10	54	0.15
7.	Kapurthala	1.356 (0.1833)	+1.8265* (2.0428)	4.173	19	0.2
8.	Rupnagar	10.049 (22.64)	+0.00694 (0.1591)	0.024	49	0.0005
9.	Ludhiana	12.7106 (15.45)	-0.23052** (2.787)	7.769	74	0.1
10.	Gurdaspur	9.339 (17.88)	+0.01443 (0.0643)	0.049	57	0.0009
11.	Amritsar	8.4956 (17.87)	+0.0677 (1.44723)	2.167	70	0.03

**** =significant at the 1 percent level*
*** =significant at the 5 percent level*
** =significant at the 10 percent level*

source: table 5.5 [Roy, 1979: 160].

Table 20 Yield per acre of HYV rice and farm size, Punjab

No.	Districts	a (t value)	b (t value)	F-value	n	R^2
1.	Patiala	12.238 (13.58)	0.01995	0.065	35	0.002
2.	Ferozepur	13.662 (9.377)	0.04648 (0.6156)	0.379	44	0.009
3.	Sangrur					
4.	Bhatinda	15.68 (5.135)	-0.2649 (1.792)	3.212	11	0.26
5.	Jullunder	27.7642 (4.4016)	-0.66396 (1.1523)	1.323	9	0.16
6.	Hoshiarpur					
7.	Kapurthala	12.0658 (6.384)	0.52021* (2.12724)	4.525	18	0.22
8.	Rupnagar					
9.	Ludhiana	19.771 (16.83)	-0.24693** (2.347)	5.508	33	0.15
10.	Gurdaspur	12.8018 (13.47)	0.07446 (0.6435)	0.414	55	0.008
11.	Amritsar	15.282 (30.55)	0.18316*** (3.865)	14.939	67	0.19

*** = *significant at the 1 percent level*
** = *significant at the 5 percent level*
* = *significant at the 10 percent level*

source: table 5.6 [Roy, 1979: 161].

Table 21 Percentage area irrigated and farm size, Punjab

No.	Districts	a (t value)	b (t value)	F-value	n	R^2
1.	Patiala	0.9818 (31.05)	-0.005235* (1.839)	3.383	75	0.04
2.	Ferozepur	0.89757 (33.21)	-0.00251** (2.0888)	4.362	125	0.03
3.	Sangrur	0.99464 (43.65)	-0.00339 (1.5541)	2.416	70	0.03
4.	Bhatinda	0.8682 (23.19)	-0.00202 (0.9540)	0.910	94	0.01
5.	Jullunder	0.97363 (48.34)	0.00041 (0.02071)	0.037	42	0.001
6.	Hoshiarpur	1.0277 (105.75)	-0.0123** (5.2852)	2.936	19	0.15
7.	Kapurthala	1.022 (17.22)	-0.00201 (1.7137)	0.383	50	0.008
8.	Rupnagar	0.9078 (27.796)	0.00201 (0.6188)	0.383	50	0.008
9.	Ludhiana	all farms in the sample have 100 percent irrigation			75	
10.	Gurdaspur	1.0066 (176.21)	-0.00165** (2.3501)	5.606	59	0.09
11.	Amritsar	0.9899 (93.855)	0.000083 (0.08116)	0.014	70	0.0002

*** = *significant at the 1 percent level*
** = *significant at the 5 percent level*
* = *significant at the 10 percent level*

source: table 5.4 [Roy, 1979: 159].

Table 22 Various indices of progress for districts of Punjab

No.	Districts	a	b	c	d	e
1.	Patiala	40.7	73.4	20.31	87.79	7.64
2.	Ferozepur	66.3	80.2	23.50	91.17	7.54
3.	Sangrur	51.3	71.6	20.42	86.27	6.91
4.	Bhatinda	55.2	53.6	23.07	89.57	7.03
5.	Jullunder	64.1	77.6	17.81	75.76	6.88
6.	Hoshiarpur	15.1	45.7	17.70	53.51	7.46
7.	Kapurthala	62.1	71.5	15.26	73.76	7.15
8.	Rupnagar	17.0	39.0	15.80	49.11	6.11
9.	Ludhiana	59.3	81.6	17.84	80.15	6.80
10.	Gurdaspur	43.5	68.6	19.02	71.07	8.65
11.	Amritsar	87.2	88.9	20.12	86.67	8.11

a = percentage area irrigated 1960-61
b = percentage area under HYVs and American cotton 1974-75
c = agricultural labour as percentage of male work force 1971
d = percentage area of crops with HYV under HYVs 1976-77
e = annual compound rates of growth 1962-5 to 1970-3

source: table 5.7 [Roy, 1979: 162].

Table 23 Potential effects of land redistribution on agricultural production in five developing countries

	Brazil 1962-3	NE Brazil 1973	Colombia 1960	India 1970-1	Pakistan 1960	Philipp 1960	Muda 1972-3
A	11720	7815	2781	146491	8000	9617	
B	249862	79840	27338	131873	19810	7772	
C		25.5	24.6	2.25	6.19	2.02	0.80
D		$49.4	610 ps	695rs	458rs	407ps	$1660M
E		$27.5	477ps	555rs	415rs	331ps	$1300M
F		1.795	1.28	1.19	1.10	1.23	1.27
G	25	79.5	28	19	10	23	28

Notes:
A=agricultural labour force (1,000)
B=total farm area (1,000 ha)
C=equalizing parcel size (=B/[A/2.5])
D=output per hectare on parcel size
E=overall average output per hecatre
F=Ratio, D/E
G=percentage increase in output from total land redistribution

Source: Table 5-1 [Berry and Cline, 1979: 132-33].

Table 24 Results of "total" land reform based on family units (2.5 adult-equivalent workers). Percentage change of production

sector product	UE1	CAP	size	product	sector	UE1	CAP	size	
Ceara	H	A	20.9	25.6	R.G. rice	H	A	29.0	34.2
cotton	L	A	24.0	22.2	FGV	L	A	30.6	33.3
	H	B	20.9	26.5		H	B	29.0	52.9
	L	B	24.0	19.6		L	B	30.6	51.1
Pernambuco	H	A	15.2	7.7	M.G. corn	H	A	21.9	-3.7
cotton	L	A	17.5	1.7		L	A	23.2	-5.1
	H	B	15.2	2.3		H	B	21.9	11.5
	L	B	17.5	-7.0		L	B	23.2	7.0
E. Santo	H	A	32.3	5.9	S. Paulo	H	A	47.6	27.6
coffee	L	A	36.4	1.5	cattle/gen.	L	A	50.4	25.3
	H	B	32.3	-5.2		H	B	47.6	30.1
	L	B	36.4	-9.7		L	B	50.3	26.8
S. Paulo	H	A	19.3	-9.2	Alagoas	H	A	19.5	-13.2
coffee	L	A	20.4	-10.5	sugar	L	A	22.5	-14.2
	H	B	19.3	-27.7		H	B	19.5	-18.1
	L	B	20.4	-28.5		L	B	22.5	-18.9
Pernambuco	H	A	11.8	63.1	Pernambuco	H	A	13.6	29.4
sugar FGV	L	A	13.6	56.1	sugar IAA	L	A	15.6	23.8
	H	B	11.8	74.3		H	B	13.6	25.7
	L	B	13.6	66.2		L	B	15.6	20.3
S. Paulo	H	A	22.2	22.8	S. Paulo	H	A	27.5	-2.1
cereals	L	A	23.5	20.2	sugar	L	A	29.0	-5.5
	H	B	22.2	9.9		H	B	27.5	0.0
	L	B	23.5	6.7		L	B	29.0	-3.4

Notes:
UE=unemployment assumption as % of employed. High assumption is 19% in NE Brazil, 16% in east, 7% in south; Low assumption is 3.4% in northeast, 2.9% in east, and 1.3% in south

CAP=assumption regarding resource distribution: A= no change in sectoral total capital and seeds. B= post-reform capital and seeds and fertiliser allowed to change such that parcels use inputs according to pre-reform input-size relationship.

Source: table 26 [Cline, 1970: 146-47].

Table 25 Relative land-use intensity: large farms compared to small farms (selected countries)

country	weighted average percent cultivated area: small farms (bottom 20%) A %	B ceiling	large farms (top 40%) C %	D floor	rel. int. E= C/A	size limit F= D/B
Brazil	33.0	91	2.0	1000	0.06	10.99
Chile	41.4	467	6.0	1000	0.14	2.14
Colombia	48.8	38	4.5	525	0.09	13.82
Peru	46.4	263	5.0	1000	0.11	3.80
Uruguay	31.0	320	7.0	1000	0.23	3.13
Venezuela	51.8	452	10.0	1000	0.19	2.21
Costa Rica	43.8	42	17.0	413	0.39	9.83
Nicaragua	43.6	48	9.8	419	0.22	8.73
Panama	67.5	18	11.1	120	0.16	6.67
Ceylon	86.9	1.28	80.6	9.25	0.93	7.23
Taiwan	71.0	0.60	80.2	1.86	1.13	3.10
India	93.9	2.12	87.8	7.95	0.94	3.75
Japan	91.0	0.65	75.4	1.87	0.83	2.88
S. Korea	33.0	0.38	46.3	1.21	1.40	3.18
Pakistan	87.5	2.03	67.5	8	0.77	3.94
Philippines	96.5	2.78	75.3	8.45	0.78	3.04
Thailand	90.4	2.78	85.6	7.2	0.95	2.59
Turkey	97.1	4.34	76.3	15.6	0.79	3.59
Kenya	49.5	7.45	13.0	1000	0.26	134.23
UAR Egypt	99.8	1.21	90.1	5.7	0.90	4.71

Source: table 3-1 [Berry and Cline, 1979: 33].

Table 26 Comparison of agricultural growth rates to average farm size, population growth rates, land concentration, and land endowment (30 selected countries)

country	1	2	3	4	5
Japan	1.18	1.6	1.0	0.411	1.73
Indonesia	1.20	2.7	2.0	0.553	2.18
Taiwan	1.27	3.8	2.9	0.401	0.57
UAR	1.59	0.7	2.5	0.598	0.19
Sri Lanka	1.61	1.9	2.4	0.665	1.00
Korea	2.06	3.9	2.7	0.195	0.57
Pakistan	2.35	4.7	2.7	0.631	1.84
India	2.70	1.9	2.3	0.584	0.90
Uganda	3.29	1.0	2.7	0.485	2.63
Philippines	3.59	2.9	3.0	0.507	1.13
Thailand	3.47	3.7	3.1	0.455	1.86
Senegal	3.63	-2.2	2.1	0.399	6.48
Turkey	5.03	3.4	2.5	0.629	3.18
Dominica	5.05	3.2	3.0	0.798	1.85
Guatemala	8.34	4.8	3.1	0.828	3.40
Morocco	9.82	2.4	2.9	0.640	4.73
Kenya	11.74	2.8	3.1	0.822	3.40
Tunisia	15.40	2.0	3.0	0.645	6.65
Panama	18.81	5.1	3.3	0.737	11.97
Peru	20.37	2.3	3.1	0.935	20.97
Colombia	22.59	4.4	3.2	0.868	11.80
Nicaragua	37.41	5.5	3.5	0.801	11.51
Costa Rica	41.05	6.3	3.3	0.782	6.32
Brazil	74.86	3.6	2.9	0.831	20.95
Venezuela	81.21	4.4	3.5	0.927	32.31
Paraguay	108.53	3.1	3.1	0.938	32.03
Chile	118.32	1.4	2.3	0.933	30.47
Mexico	123.87	3.4	3.5	0.747	8.56
Uruguay	195.26	-0.6	1.3	0.820	36.83
Argentina	371.06	1.0	1.5	0.836	75.11

notes:
1) average farm size (ha)
2) agricultural output growth rate, 1961-71 (%)
3) population growth rate, 1960-70 (%)
4) Gini coefficient for farm land distribution
5) total land area per agricultural population, 1970 hectares
source: table 3-3 [Berry and Cline, 1979: 38-9].

Table 27 Productivity, employment and distribution of land in selected countries

country	year	A	B	C	D
Greece	1961	424	0.50	3.18	0.597
Spain	1962	90	0.09	14.85	0.832
Costa Rica	1963	83	0.09	40.70	
Dominica	1971	129	0.28	8.64	
El Salvador	1961	186	0.38	6.95	
Guatemala	1964	144	0.29	8.17	
Mexico	1960	22	0.04	123.90	
Nicaragua	1963	55	0.09	37.34	
Argentina	1970	18	0.01	270.10	0.873
Brazil	1960	14	0.05	79.25	0.845
Chile	1965	18	0.03	118.50	
Colombia	1960	67	0.10	22.60	0.865
Paraguay	1961	11	0.02	108.70	
Peru	1961	50	0.10	20.37	0.947
Uruguay	1966	14	0.01	208.80	0.833
Venezuela	1961	31	0.03	81.24	0.936
China	1960-1	841	2.05	1.27	0.474
India	1960	172	1.22	6.52	0.607
Indonesia	1963	323	2.17	1.05	
Iran	1960	187	0.32	6.05	0.624
Korea	1970	1085	2.88	0.85	
Japan	1960	1720	1.45	1.18	0.473
Nepal	1960-2	352	2.54	1.23	
Pakistan	1960	240	0.96	2.35	0.607
Philippines	1960	250	1.25	3.59	0.580
Sri Lanka	1962	376	1.12	1.61	
Thailand	1963	166	1.21	3.47	
Turkey	1963	155	0.64	5.03	0.611
Vietnam	1960	355	2.79	1.33	
Botswana	1969-70	168	1.18	4.75	
Egypt	1960-61	681	1.89	1.59	
Kenya	1969	183	1.31	4.20	
Malagasy	1961-2	293	3.32	1.04	
Mali	1960	98	2.06	4.35	
Morocco	1961	144	0.49	4.62	
Senegal	1960	209	1.20	3.62	
Togo	1961-2	189	1.05	2.62	
Tunisia	1961-2	42	0.12	15.41	
Uganda	1963-4	167	0.84	3.29	
Zambia	1960	68	0.67		

Notes:
A=farm GDP per hectare (US$)
B=employment per hectare
C=average size of holding (ha)
D=Gini coefficient of land concentration

source: table 3-5 [Berry and Cline, 1979: 41-42].

Table 28 Northeast Brazil, 1973: Production per unit of available land resource by farm size group

zone	size group	average size	av. Q/ha	zone	size group	average size	av. Q/ha
A	1	3.7	85.92	E	1	3.7	353.03
	2	25.5	30.73		2	26.1	63.88
	3	71.9	16.19		3	72.8	46.64
	4	138.9	8.80		4	143.6	35.24
	5	313.2	5.00		5	283.5	45.81
	6	1178.0	2.20		6	2303.6	7.76
B	1	3.7	78.25	F	1	5.6	173.13
	2	26.6	33.14		2	27.1	243.65
	3	68.8	15.03		3	70.6	268.71
	4	138.9	8.45		4	142.3	314.40
	5	317.2	5.99		5	294.6	253.46
	6	1396.9	4.40		6	620.0	227.49
C	1	4.9	60.41	G	1	4.0	197.11
	2	27.5	35.54		2	26.5	54.49
	3	72.4	28.19		3	73.3	51.34
	4	143.3	18.33		4	143.4	30.49
	5	288.1	15.87		5	299.1	28.88
	6	1059.2	11.14		6	1135.3	10.17
D	1	4.8	21.00				
	2	24.2	52.16				
	3	71.8	47.06				
	4	138.4	13.91				
	5	282.5	14.17				
	6	1210.6	9.80				

Notes:
Zones: A-low demographic density (west of Maranhao, Piaui, Bahia); B-middle north (east of Maranhao, north of Piaui); C-semiarid sertao (portions of Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Bahia); D-semihumid southeast (portion of Bahia); E-humid east (coastal zone of Rio Grande do Norte, Paraiba, Pernambuco, Alagoas, Sergipe, northern Bahia); F-humid southeast (cocoa zone of Bahia); G-Agreste (transitional zone of Rio Grande do Norte, Paraiba, Pernambuco, Alagoas, Sergipe, Bahia).
Size groups:
1 0-9.9ha *4 100-199.9*
2 10-49.9 *5 200-499.9*
3 50-99.9 *6 500 and over*

source: table 4-1 [Berry and Cline, 1979: 46-7].

Table 29 Northeast Brazil: regression results, land productivity by farm size, grouped farm data, 1973

		regional dummies		coefficients				
form	dep var	inter cept	slope	const.	a	b	c	R^2
1	Q/X	no	no	153.3 (34.8)	-44.93 (16.9)			0.1323
2	Q/V	no	no	1.431 (.164)		-0.263 (.041)		0.5061
3	Q/X	yes	no	110.7 (22.7)	-39.91 (7.9)		0.1963 (.046)	0.8137
4	Q/X	yes	yes	141.5 (36.7)	-56.44 -16.3		0.2033 (.062)	0.8856

Notes:
1) dependent variables: Q/X=output per hectare; Q/V= output per unit land value
2) a=log of farm area (ha); b=log of land value; c=land price per hectare

Source: table 4-2 [Berry and Cline, 1979: 49].

Table 30 Northeast Brazil: regression results, land productivity by farm size, farm area basis, and by major product, 1973

product	constant	log of farm area	land price/ hectare	% share-cropped area	R^2
livestock	84.45 (21.1)	-19.33 (3.7)	0.3619 (0.24)	26.58 (81.0)	0.217
rice	63.91 (12.2)	-12.23 (1.01)	0.0447 (.026)	58.97 (15.7)	0.304
cocoa	214.1 (50.3)	-9.87 (9.8)	0.0853 (.019)	-78.9 (182.7)	0.474
sugar	155.6 (18.9)	-20.16 (3.16)	0.0207 (.0196)	264.1 (291.3)	0.277
manioc, corn, beans	75.5 (4.5)	-11.91 (.93)	0.0108 (.0061)	31.45 (14.3)	0.151
other	253.6 (18.8)	-29.41 (3.4)	0.00395 (.0052)	58.86 (36.1)	0.114

Note: dependent variable = value-added per hectare (1973 $US)

source: table 4-3 [Berry and Cline, 1979: 50].

Table 31 Northeast Brazil: regression results, land productivity by farm size, land value basis, and by major product, 1973

product	constant	log of land value	R^2
livestock	5.755 (.696)	-0.5593 (.081)	0.043
rice	9.555 (1.13)	-1.0733 (.145)	0.118
cocoa	2.026 (.413)	-0.1585 (.039)	0.148
sugar	4.548 (.91)	-0.4113 (.098)	0.093
manioc, corn, beans	7.96 (.705)	-0.8991 (.092)	0.087
other	12.996 (1.29)	-1.4067 (.155)	0.081

Note: dependent variable = value-added divided by land value (1973 $US)

source: table 4-4 [Berry and Cline, 1979: 52].

Table 32 Total social factor productivity by farm size group, Northeast Brazil

zone	size group	X	Y	Z	zone	size group	X	Y	Z
A	1	1.134	0.717	0.525	E	1	1.855	1.422	1.142
	2	1.177	0.814	0.622		2	1.201	0.924	0.758
	3	1.173	0.848	0.664		3	1.318	1.082	0.918
	4	0.786	0.632	0.528		4	1.065	0.909	0.794
	5	0.509	0.446	0.398		5	1.218	1.016	0.871
	6	0.601	0.527	0.469		6	0.132	0.130	0.129
B	1	1.254	0.806	0.594	F	1	2.122	1.355	0.996
	2	1.744	1.125	0.831		2	1.412	1.234	1.097
	3	1.445	0.967	0.726		3	0.997	0.944	0.895
	4	1.180	0.900	0.728		4	1.395	1.306	1.210
	5	1.036	0.676	0.676		5	1.132	1.073	1.020
	6	1.215	1.022	0.882		6	na	na	na
C	1	1.316	0.771	0.545	G	1	2.530	1.532	1.098
	2	1.532	1.036	0.783		2	1.157	0.884	0.715
	3	1.492	1.110	0.884		3	1.205	1.007	0.864
	4	0.689	0.600	0.532		4	0.790	0.681	0.599
	5	1.290	1.044	0.876		5	0.698	0.623	0.563
	6	0.977	0.861	0.769		6	0.351	0.298	0.259
D	1	na	na	na					
	2	0.833	0.603	0.603					
	3	1.145	0.981	0.859					
	4	0.381	0.350	0.323					
	5	0.381	0.356	0.335					
	6	0.257	0.249	0.242					

Notes:
Columns: X=zero labour cost; Y=at labour cost one half minimum wage; Z=with labour cost at minimum wage

Zones: A-low demographic density (west of Maranhao, Piaui, Bahia); B-middle north (east of Maranhao, north of Piaui); C-semiarid sertao (portions of Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Bahia); D-semihumid southeast (portion of Bahia); E-humid east (coastal zone of Rio Grande do Norte, Paraiba, Pernambuco, Alagoas, Sergipe, northern Bahia); F-humid southeast (cocoa zone of Bahia); G-Agreste (transitional zone of Rio Grande do Norte, Paraiba, Pernambuco, Alagoas, Sergipe, Bahia).

Size groups:

1	*0-9.9ha*	*4*	*100-199.9*
2	*10-49.9*	*5*	*200-499.9*
3	*50-99.9*	*6*	*500 and over*

source: table 4-7 [Berry and Cline, 1979: 56-7].

Table 33 Land productivity and farm size in Colombia, 1960-61 (values in thousands of 1960 pesos)

farm size	A	B	C	D	E	F
0-3	606.4	1.37	0.75	1.05	0.82	0.45
3-5	150.2	0.86	0.79	1.02	0.41	0.38
5-10	169.2	0.73	0.73	1.04	0.19	0.19
10-50	201	0.44	0.57	0.96	0.12	0.16
50-500	76	0.23	0.38	0.88	0.036	0.06
over 500	6.9	0.13	0.35	0.89	0.008	0.023
total	1209.7	0.285	0.46	0.95	0.08	0.128

Note: farm size in hectares
A=number of farms (1,000)
B=value-added per hectare
C=value-added per effective hectare (physical hectares divided by ratio of land price on farms in group relative to overall average land price)
D=value of crop output per hectare of cultivated land (including fallow)
E=man-years of labour per hectare
F=man-years of labour per effective hectare

source: table 4-8 [Berry and Cline, 1979: 59].

Table 34 Differences in yield by farm size, Colombia 1966

farm size	1	2	3	4	5	6
0-2	94.2	80.5	1.23	1.05	0.87	0.85
2-5	96.8	81.6	1.22	1.03	0.77	0.84
5-10	96.7	79.4	1.27	1.04	0.66	0.82
10-20	100.0	78.5	1.34	1.05	0.56	0.78
20-50	96.8	68.1	1.25	0.88	0.44	0.70
50-200	117.8	68.8	1.50	0.87	0.28	0.58
200-500	140.3	70.7	1.79	0.90	0.18	0.50
> 500	147.4	67.3	1.99	0.89	0.06	0.46

notes: farm size in hectares
1) index value of product per hectare cropped
2) index value of product per hectare cropped and fallow
3) value of crop output per hectare cropped (1,000 pesos)
4) value of crop output per hectare cropped and fallow
5) cropped area as percentage of arable and pasture land
6) cropped area as percentage of cropped and fallow land

source: table 4-9 [Berry and Cline, 1979: 61].

Table 35 Colombia: land use in 1960-61 and 1970-71 (%)

farm size (ha)	temporary crops in use	fallow	total	perm. crops	all crops	pasture	other
1960-61							
all	7.14	5.78	12.92	5.54	12.68	53.43	28.11
<5	35.91	10.78	46.69	23.91	59.82	17.65	11.75
5-50	15.96	4.51	25.45	14.91	30.87	36.13	23.51
>50	3.14	4.51	7.65	2.01	5.15	60.06	30.28
1970-71							
all	6.81	10.32	17.13	7.58	14.38	56.4	18.89
<5	29.08	7.99	37.07	29.53	58.61	24.85	9.05
5-50	13.45	14.59	28.04	18.53	31.98	39.15	14.58
>50	4.17	9.42	13.59	3.92	8.09	61.97	20.52

source: table 4-14 [Berry and Cline, 1979: 66].

Table 36 Colombia: characteristics of 474 farm sub-sample of the INCORA borrowers sample, 1969

farm size	A	B	C	D
0-1	14154	10776	16599	15852
1-5	4892	7989	2429	13061
5-10	3641	5909	1021	17311
10-15	2052	4745	696	15171
15-20	2569	7458	872	18197
20-50	1442	5297	509	22835
50-100	1472	8333	961	31799
> 100	671	2043	414	14020
all farms	2652	6057	910	16266

notes: farm size in hectares
A=value of land-based production per hectare
B=value of crop output per cultivated hectare
C=value of livestock output per hectare of pasture
D=income per farm (pesos)

source: table D-4 [Berry and Cline, 1979: 218].

Table 37 Philippines: relationship of value-added per farm area to farm size (pesos per hectare), 1960

size	VA/ha	VA/cult. ha	% area cropped	% area idle	% area pasture	% area forest
0-0.2	9559	953	56.63	2.19	0	1.15
0.2-0.5	1388	478	92.62	2.3	0	0.89
0.5-1	811	380	93.18	3.51	0	0.56
1-2	556	344	92.58	4.73	0	1.16
2-3	443	321	90.58	6.48	0	1.63
3-4	397	321	87.75	8.4	0.003	2.59
4-5	359	323	83.02	7.9	0.01	4.09
5-10	292	329	70.26	18.71	0.35	9.22
10-15	229	338	56.19	25.2	1.39	15.68
15-20	249	374	57.8	23.56	2.58	14.76
20-25	215	358	51.97	25.63	3.87	17.15
25-50	215	330	56.61	21.74	6.36	13.96
50-100	196	298	58.28	17.67	11.38	11.23
100-200	143	207	59.57	13.26	17.12	7.84
> 200	82	196	32.4	11.77	45.17	8.78
all	331	325	71.79	14.35	4.88	7.5

source: tables 4-18 and 4-19 [Berry and Cline, 1979: 70-1].

Table 38 Output per acre by farm size, Pakistan, 1959-60

size	output per acre estimate 1	estimate 2
<1	739.2	668.6
1-2.5	391.4	361.7
2.5-5	277.4	259.2
5-7.5	248.5	236
7.5-12.5	216.3	205.9
12.5-25	179.5	158.5
25.50	136.2	148
50-150	76.9	83.4
> 150	28.4	30.4
all	168.1	168.1

source: table 4-26 [Berry and Cline, 1979: 81].

Table 39 Land productivity by farm size, Punjab 1966-67/1968-69 (based on FAFBS)

size	income per acre (Rs.)
irrigated	
<12.5	467.78
12.6-25	391.51
25.1-50	258.99
> 50	134.35
barani	
<12.5	277.75
12.6-25	172.81
25.1-50	42.69
> 50	40.45

source: table 4-28 [Berry and Cline 1979: 82].

Table 40 West Pakistan: use of fertilisers by farm size, 1960 and 1972

size acres	% farms using fertiliser 1960	% farms using fertiliser 1972	% cropped area fertilised 1972	% net sown area fert 1960
<1	16.2	34	35	58
1-2.5	25.4	44	42	30
2.5-5	32.1	48	42	19
5-7.5	36.6	51	42	15
7.5-12.5	41.2	55	43	13
12.5-25	44	58	43	10
25-50	41.3	53	41	8
50-150	26.6	45	41	5
> 150	13.5	39	49	5
all	32.6	52	43	12

source: table 4-34 [Berry and Cline, 1979: 93].

Table 41 Indices of land productivity, Punjab and Sind by district

size acres	Punjab: output per cropped area, 5 major crops relatively backward (1	2	3	(4	relatively progressive 5	6	7	8	9
<12.5	104.2	94.3	99.3	86.3	89.5	56	76.4	86.1	86.4
12.5-25	90.6	99.6	93.6	92	92.9	65.3	83.4	88.1	91.5
25-50	67.5	103.8	85.7	96.8	97.7	89.8	94.8	91.1	91.3
> 50	50.4	99.2	74.8	113.8	104.4	121	113.1	97.8	101.7

size acres	Punjab: net farm income per cropped area, 5 major crop relatively backward (1	2	3	(4	relatively progressive 5	6	7	8	9
<12.5	102.6	103	102.8	94.6	87.1	57.5	79.7	89	89.2
12.5-25	100	111.4	105.7	98.1	92.6	66.9	85.9	93.8	94
25-50	70	111.4	90.7	97.7	97.5	90.7	95.3	93.5	92.4
> 50	39.4	92.8	66.1	106.1	104.8	119.9	110.3	92.6	99

size acres	Sind: output per cropped area, 5 major crops relatively backward 10	relatively progressive 11	12	13	14	15
<12.5	86.5	84.6	79.8	96.2	86.9	86.8
12.5-25	86.6	96	102.1	98.7	98.9	95.8
25-50	86.6	93.5	95.2	91.3	93.3	91.6
> 50	110.9	106.5	104	104.5	105	106.5

size acres	Sind: net farm income per cropped area, 5 major crops relatively backward 10	relatively progressive 11	12	13	14	15
<12.5	88.4	81.6	87.4	100.4	92.4	89.5
12.5-25	86.8	94.5	95.1	100.9	96.8	94.3
25-50	89.2	92.4	93.1	89.8	91.8	91.1
> 50	109.5	108.1	105.8	104.1	106	106.9

notes:
1) Jhelum
2) Rahimyav Khan
3) average
4) Gujranwala
5) Sahiwal
6) Lyallpur
7) average
8) Punjab
9) Punjab and Sind
10) Jacobabad
11) Larkava
12) Nawabshah
13) Hyderabad
14) average
15) Sind

source: Khan [1975: 54].

Table 42 Changes in intensity of agriculture, 1960-72 West Pakistan

farm size acres	net sown area/cultivable area 1960	1972
<1	81	94.9
1-2.5	82	93.5
2.5-5	83	93.1
5-7.5	84	92.8
7.5-12.5	83	94.1
12.5-25	80	87.6
25-50	72	80.8
50-150	54	57.8
>150	27	48.9

source: table 4-38 [Berry and Cline, 1979: 102].

Table 43 Factor productivity of Muda River farms by size, double-croppers, 1972-73

farm size relong	VA per relong	VA per unit land value	output per relong
<1.5	843	1.18	883
1.5-2.5	454	0.665	535
2.5-3.5	485	0.674	570
3.5-5	392	0.441	473
5-6.5	378	0.362	441
6.5-8.5	378	0.354	467
8.5-10.5	325	0.296	403
10.5-15	302	0.212	376
15-20	312	0.247	379
20-40	287	0.27	360
all	370	0.451	446

source: table 4-48 [Berry and Cline, 1979: 117].

Table 44 Selected empirical estimates of the relationship of farm size to productivity, India, 1968-9 and 1970-1

equation	year	constant	coefficients b	c	d	R^2
i	1970-1	882 (41.6)	-130 (13.6)			0.095
ii	1968-9	918 (37.9)	-168 (15.6)			0.12
iii	1970-1	663 (30.0)	-108 (11.9)	0.07 (15.3)		0.20
iv	1970-1	496 (22.0)	-92 (11.6)	0.046 (11.0)	4.6 (23.8)	0.393

note: t statistic in parentheses
model: $y = a + b \log A + cP + dI$
where y is output per acre, A is farm area, P is price of unirrigated land, I is percent of land irrigated

source: table 4-44 [Berry and Cline, 1979: 112].

Table 45 Regression results: land productivity in relation to farm size by individual crop, 1970-71

crop	n	coefficient on: const	log A	P	I	R^2
rice	761	698 (21.8)	-115 (8.5)	0.06 (9.8)		0.19
rice	761	596 (8.8)	-105 (8.16)	0.046 (8.16)	2.8 (9.91)	0.282
wheat	389	1021 (15.8)	-147 (6.28)	0.025 (2.33)		0.104
wheat	389	605 (9.55)	-128 (6.47)	0.021 (2.32)	6.06 (12.7)	0.367
maize	220	343 (4.8)	-39.6 (1.77)	0.098 (4.3)		0.105
maize	220	199 (3.33)	-17.8 (0.96)	0.079 (4.2)	5.45 (10.4)	0.4
cotton	122	410 (4.33)	-83 (2.95)	0.17 (7.8)		0.371
cotton	122	399 (4.24)	-76 (2.66)	0.13 (4.5)	1.7 (1.64)	0.38
jowar	37	168 (1.36)	0.78 (0.014)	0.14 (4.04)		0.285
jowar	37	46.2 (0.47)	-6.62 (0.15)	0.08 (2.71)	5.5 (5.07)	0.586
sugar	13	1630 (2.85)	-242 (1.24)	0.005 (0.05)		0.02
sugar	13	1446 (2.29)	-228 (1.14)	-0.0008 (0.008)	3.19 (0.77)	-0.06

note: t values in parentheses

model: $y = a + b \log A + cP + dI$
where A is output, P is price of unirrigated land and I is percentage area irrigated

source: table A-3 [Berry and Cline, 1979: 155].

Table 46 Total social factor productivity: sensitivity analysis, India

farm size (acres)	0-5	5-15	15-25	>25	all
I. interest rate on capital=10% labour cost at:					
a) zero	1.39	1.27	1.09	1.03	1.05
b) 0.5 wage	1.00	1.01	0.91	0.83	0.81
c) 0.75 wage	0.88	0.92	0.84	0.76	0.72
d) full wage	0.79	0.84	0.78	0.70	0.66
II. interest rate on capital=15% labour cost at:					
a) zero	0.93	0.84	0.73	0.69	0.70
b) 0.5 wage	0.74	0.72	0.64	0.59	0.58
c) 0.75 wage	0.67	0.67	0.61	0.55	0.54
d) full wage	0.61	0.63	0.58	0.52	0.50

source: table A-13b [Berry and Cline, 1979: 174].

Table 47 Technical characteristics of sample farms: India

farm size acres	cropping intensity	labour days/acre	capital/ labour
0-5	1.38	122	12.2
5-15	1.26	70	13.8
15-25	1.15	51	14.1
>25	1	47	11.7
all	1.15	82	13.1

source: tables A-1 and A-12 [Berry and Cline, 1979: 149 and 171].

Table 48 Average income per acre and HYV area, 1968-69 to 1970-71, India

farm size acres	HYV area % 1968-69	income/ acre 1968-69	HYV area % 1970-71	income/ acre 1970-71	% change	% change HYV area income/acre
0-5	14.6	676	16.5	737	13.0	9.0
5-15	12.8	536	16.3	607	27.3	13.2
15-25	13.1	426	18.5	482	41.2	13.1
> 25	11.1	243	18.1	346	63.1	42.4
all	12.8	426	17.4	499	35.9	17.1

source: table A-16 [Berry and Cline, 1979: 179].

Table 49 Cost and source of capital by farm size and HYV classification

A.

farm size acres	HYV %	non HYV %	all %
0-5	13.9	18.6	17.3
5-15	12.3	14.8	13.8
15-25	11.6	12.7	12.2
> 25	9.7	13.0	11.8
	12.4	15.8	14.5

B.

source	HYV %	non HYV %	all %
government	5.9	1.4	3.6
cooperative	28.6	17.1	22.7
comm banks	2.8	5.2	4.0
moneylender	29.3	69.2	49.6
friends and relatives	33.1	4.9	18.8
total	100	100	100

source: tables A-5 and A-8b [Berry and Cline, 1979: 160 and 164].

Table 50 Farm productivity regressions for 1968-69, 1969-70, and 1970-71, India

		coefficients on:			
year	constant	log A	P	I	R^2
1968-69	607	-139	0.052	4.1	0.292
	(22.07)	(14.1)	(10.1)	(15.3)	
1969-70	558	-128	0.028	6.2	0.454
	(24.9)	(16.1)	(6.66)	(28.5)	
1970-71	496	-92	0.046	4.6	0.393
	(22)	(11.6)	(11)	(23.8)	

note: t values in parentheses

model: $y = a + b \log A + cP + dI$
where A is output, P is price of unirrigated land and I is percentage area irrigated

source: table A-15 [Berry and Cline, 1979: 177].

Table 51 Rice budgets and internal rates of return (LE 1982 per feddan), Egypt

output	unit	quantity small	quantity large	price small	price large	income/cost small	income/cost large
grain	ton	2.56	2.33	130.17	128.45	333.25	299.31
straw	ton	2.63	2.59	9.84	9.22	25.89	23.87
total						359.14	323.18
inputs							
labour	phe[1]	359.14	277.86	0.32	0.32	114.92	88.92
seeds	qirat	2.14	2.2	23.64	21.08	50.59	46.36
fert	kg	79.63	72.19	0.27	0.26	21.5	18.77
machines						48.22	40.48
other[2]						32.63	35.24
total						263.93	231.42
invest							
land opportunity cost[3]						75.71	66.65
IRR						8.16%	11.69%

1) phe = person-hour equivalents per feddan: 1 adult male hour = 2 child-hours or 1.5 adult female-hours
2) saqia and animal-powered irrigation, storage, haulage, interest and depreciation
3) with government rent fixed at arbitrarily low levels, opportunity cost pricing was used. This is derived from foregone income in maize and cotton for the 5 months that land is planted to rice. The opportunity cost is assumed to be the mean value between government rent levels and parallel market rents, plus foregone production of alternative crops. The opportunity cost for rice land is (152.20+29.66+43.26)/3 = LE 75.71 for small farms; for large farms (23.29+43.26)/3 = LE 66.65.

source: Shepley [1985: 24]

Table 52 Wheat crop budgets and internal rates of return (per feddan), Egypt

output	unit	quantity small	quantity large	price small	price large	income/cost small	income/cost large
grain	ardab	9.9	10.25	10.48	10.66	103.75	109.29
straw	ton	4.42	3.82	34.3	45.06	151.62	172.14
total						255.37	281.43
inputs							
labour	phe	165.92	198.09	0.31	0.31	51.44	61.41
seeds	kg	87.2	82.54	0.11	0.12	9.59	10.23
fert	kg	80.41	64.63	0.29	0.285	23.32	18.42
machines	LE					31.8	35.34
other[1]	LE					10.41	15.80
total						126.56	141.20
investment							
land opportunity cost[2]						103.83	109.62
IRR						6.53%	7.52%

1) saqia and animal-powered irrigation, storage, haulage, interest and depreciation
2) with government rent fixed at arbitrariliy low levels, opportunity cost pricing was used. This is derived from foregone income in birseem for the 6 months that land is planted to wheat. The opportunity cost is assumed to be the mean value between government rent levels and parallel market rents, plus foregone production of alternative crops. Thus shadow prices for small farms is (207.57+52.05+51.91)/3=LE 103.87. For large farms, the shadow price is (229.43+47.52+51.91)/3=LE 109.62.

source: table 7.2 [Shepley, 1985: 35].

Table 53 Cotton budgets and internal rates of return (LE 1982 per feddan), Egypt

output	unit	quantity small	quantity large	price small	price large	income/cost small	income/cost large
cotton	qantar	8.39	8.07	59.75	59.48	501.43	480.01
stalks						22.56	15.00
total						523.99	495.01
inputs							
labour	phe	689.76	643.36	0.27	0.27	186.24	173.71
seeds	kg	93.17	125.82	0.04	0.04	3.72	5.03
fert	kg	152.06	198.9	0.35	0.40	53.22	79.56
machines	LE					24.08	23.50
micro nutrients						16.40	17.15
pesticides						21.10	12.01
other[1]	LE					24.53	18.09
total						329.29	329.05
invest							
land opportunity cost[2]						174	174
IRR						2.51%	-1.03%

1) haulage, interest/depreciation, saqia irrigation
2) LE 7.25 per qirat (weighted mean marginal value product of land in birseem and wheat) x 24 = LE 174 per feddan.

source: table 9.4 [Shepley, 1985: 76]

Table 54 Labour utilization per hectare cultivated, by crop pattern and holding size, Egypt

crops	<0.8	0.8-2	2-4	>4
CWM[a]	6615	4246	2754	1965
WM[b]	8184	5298	2373	
cotton[c]	7175	4234	2545	1837
rice[d]	7652	3603	2105	1388
veg[d]	9046	4845	2437	
sugar[d]	8029	4410	5608	1960

notes:

a Cotton-wheat-maize: 15 to 25% cotton

b wheat-maize: over 25% wheat, less than 15% cotton

c rice and vegetables: over 25%

d sugarcane: over 25%

source Wilson 1972: 9 tab 5

Table 55 Yields by farm size, Egypt, 1983

crop	lt1	1-3	3-5	5-10	ge10	all
wheat	1069	1332	1274	1115	898	1215
ssbirs	32	31	32	24	24	29
maize	2303	1568	1213	1209	1350	1439
rice	2320	2670	2623	2855	1914	2541
cotton	796	883	934	765	779	854
lsbirs	91	82	91	72	65	85
potato	0	6035	6009	0	0	6026
onion	5171	5750	7000	2000	5454	4949
tomato	0	6973	2271	2350	4118	4292
fruits	0	860	2927	970	7211	4030

source: Crouch et al 1983: 20

Table 56 Income net of cash costs per feddan, Egypt

crop	<1	1-3	3-5	5-10	> 10	all
wheat	-40.74	53.49	49.33	40.2	39.06	46.19
ssbirs	46.52	37.26	21.53	22.06	21.35	29.88
maize	56.66	60.57	50.04	49.51	30.55	53.73
rice	97.56	110.11	110.76	98.67	61	99.65
cotton	120.13	121.44	137.57	108.36	122.83	122.34
lsbirs	107.42	123.44	164.12	96.5	84	120.53
potato	0	166.82	137.61	0	0	157.09
onion	89	114.54	5.82	-49.72	68.36	49.79
tomato	0	365.27	62.79	72.1	244.81	212.58
fruits	0	128	45.1	62.08	470.46	205.36

source: Crouch et al. [1983: 21].

Table 57 Regression of yields on farm size and regional dummy, Egypt

var	constant	dummy	t	size	t
corn1	1294	349	3.6	-15.7	-2.45
corn2	94.6	-2.8	-0.51	-0.9	-2.45
cotton1	772.6	249	4.56	-7.8	-2.42
cotton2	169.2	64.8	5.03	-1.2	-1.57
rice1	2575	299.9	1.48	-30.6	-2.57
ric2	142.2	32.5	2.84	-2.1	-3.12
wheat1	1394.8	-149.6	-1.71	-13.9	-2.66
wheat2	94.1	0.16	0.03	-0.83	-2.4
all	110.9	29.8	4.33	-0.42	-1

crop1=physical yields primary only
crop2=cash yields primary and secondary

source: Crouch et al. [1983: 22].

Table 58 Regressions of yields on farm size and regional dummies, Egypt

corn1	coef	t	corn2	coef	t
int	1675	17.3		82	14.5
z2	-491	-3.4		-5.3	-0.6
z3	102	0.9		19.4	2.8
z4	-462	-3.3		4.8	0.6
z8	-277	-2.1		22	2.8
z9	-380	-1.9		6.5	0.6
size	-12	-2		-0.7	-1.9
r^2	0.28			0.22	

cotton1	coef	t	cotton2	coef	t
int	981	15.8		217	13.6
z2	-271	-2.7		-72.8	-2.8
z3	170	2.2		49.4	2.5
z4	149	1.7		14.8	0.6
z8	-292	-3.9		-63.6	-3.3
z9	-374	-4.6		-62.3	-3
size	-3	-0.9		0	0
r^2	0.43			0.34	

rice1	coef	t	rice2	coef	t
int	3555	14.2		246.9	19.3
z2	-1668	-4.5		-134.1	-7
z3	-482	-1.5		-74.8	-4.5
z4	-703	-1.9		-99.3	-5.1
z8	-969	-3.2		-105.2	-6.7
z9	-1636	-4.8		-136.8	-7.9
size	-17	-1.6		-1.3	-2.3
r^2	0.22			0.4	

wheat1	coef	t	wheat2	coef	t
int	1285	14.2		91.4	15.1
z2	-452	-3.1		-27.9	-2.8
z3	52	0.5		19.7	2.4
z4	477	3.4		11.7	1.3
z8	-40	-0.3		-3.8	-0.4
z9	-174	-1.4		-11.5	-1.4
size	-8	-1.7		-0.4	-1.2
r^2	0.29			0.25	

all	coef	t
int	153.6	20.1
z2	-46.8	-3.7
z3	-20.4	-2
z4	-38.4	-3
z8	-45.7	-4.9
z9	-70.5	-6.8
size	-0.1	-0.3
r^2	0.23	

note: crop 1 = physical yields and crop 2 = value yields
source: Crouch et al. [1983: 25-2].

Table 59 Regressions of crop yields on selected indicators, Egypt

corn	coef	tvalue	rice	coef	tvalue
int	1212.5	5.5	int	1795.6	3.9
size	8.1	0.9	size	-10.5	-0.6
N	2.3	2.3	N	4.3	1.7
N^2	-1.7	-1.6	N^2	-3.9	-1.3
labour	3.0	0.7	labour	3.0	0.6
SC	-19.3	-0.1	SC	261.1	0.8
cash	-206.3	-1.9	cash	465.6	1.9
NR	-236.3	-2.2	NR	-0.2	0.0
HL/TL	-481.4	-2.2	HL/TL	-184.1	-0.4
r^2	0.23		r^2	0.12	

cotton	coef	tvalue	wheat	coef	tvalue
int	606.4	5.1	int	948.2	4.4
size	-9.4	-2.1	size	-7.9	-1
N	0.7	1.6	N	0.7	0.8
N^2	-0.3	-0.7	N^2	-0.4	-0.5
labour	0.5	1.2	labour	-4.3	-1.1
SC	144.9	1.7	SC	3.2	0
cash	226.4	3.5	cash	186.8	1.9
NR	-136.6	-2.1	NR	192.2	1.9
HL/TL	171.4	1.5	HL/TL	219.6	1.2
r^2	0.22		r^2	0.16	

all	coef	tvalue
int	119.1	7.7
size	-0.2	-0.3
N	0	-0.1
N^2	-0.1	-0.2
labour	1	21
SC	3.2	0.3
cash	2.5	0.3
NR	-2.8	-0.3
HL/TL	-31.8	-1.8
r^2	0.04	

note: int = intercept term
size = farm size
N and N^2 = nitrogen fertiliser application
SC = sharecropping
cash = cash rental system
NR = land reform lands
HL/TL = proportion of hired labour to total

source: Crouch et al 1983: 28-29

Table 60 Crop yields per feddan, 1984 by farm size, Egypt

size feddan	wheat ardab	cotton qantar	rice ardab	maize ardab
0-1	8.97	7.83	18.86	13.37
1-3	7.97	8.27	21.87	12.83
3-5	7.95	8.90	21.07	12.54
5-10	8.20	8.80	22.67	12.81
>10	6.05	9.50	28.33	13.88
all	8.25	8.21	20.87	12.99

source: Commander [1987: 174].

Table 61 Current population of tractors and agricultural equipment per 1000 feddans of crop area, by governorate: 1982-83, Egypt

governorate	tractors	ploughs	sprayers	threshers	trailers	irrig (hp)
Alexandria	6.3	1.3	0.8	0.2	0.4	73.6
Buheira	7.1	5.6	0.2	1.0	1.1	133.3
Gharbiya	9.4	11.2	4.4	2.1	6.4	114.3
Kafr al-Sheikh	5.9	6.4	3.4	1.1	1.1	115.3
Daqhaliya	8.3	10.7	4.5	1.2	4.8	191.2
Dumyat	8.3	5.5	2.9	0.4	1.9	393.1
Sharqiya	6.8	7.0	3.2	1.2	4.8	73.7
Ismailia	9.7	8.9	1.4	0.7	6.5	180.3
Suez	12.7	11.8	1.5	1.5	3.7	379.1
Bur Said						
Menufiya	6.3	5.9	1.7	2.3	1.7	139.8
Qalubia	7.3	8.6	2.7	2.3	6.0	127.4
Cairo	4.4	3.9	0.4		1.4	139.8
Giza	7.7	1.6	0.6	1.5	0.7	129.9
Beni Suef	4.5	1.2	0.4	0.5	0.1	104.6
Fayyum	7.0	5.0	1.1	0.1	2.3	13.5
Minya	6.8	4.2	3.8	1.7	2.1	162.5
Assyut	7.7	10.8	0.2	2.3	9.3	309.5
Sohag	7.7	6.8	0.9	3.1	4.1	266.6
Qena	10.6	7.6	0.4	3.1	4.3	610.0
Aswan	4.3	2.0	0.1	0.1	0.5	30.6
Matruh						
New Valley	6.2	1.0		0.4		139.1
N. Sinai						
average	7.3	6.8	2.4	1.5	3.4	163.9

source: table 9A [Commander, 1987: 295].

Table 62 Mean value of material inputs per feddan: by crop, Egypt 1984

crop	0-1	1-3	3-5	5-10	>10
wheat	16.60	18.00	14.90	17.60	20.00
sh birs	19.20	17.60	17.10	16.70	25.00
lng birs	18.00	15.80	18.60	15.30	22.30
cotton	24.00	23.40	25.10	22.80	27.00
rice	18.90	21.00	21.00	23.20	21.80
maize	20.20	23.50	20.30	20.30	21.50

source: Commander [1987: 292].

Table 63 Developments in landownership in Egypt, 1952-65

(in thousands)

size class (feddans)	before 1952 reform holdings no.	%	area no.	%	after 1952 reform holdings no.	%	area no.	%
small								
< 5	2642	94.3	2122	35.4	2841	94.4	2781	46.6
medium								
5-10	79	2.8	526	8.8	79	2.6	526	8.8
10-20	47	1.7	638	10.7	47	1.6	638	10.7
20-50	22	0.8	654	10.9	30	1	818	13.6
large								
50-100	6	0.2	430	7.2	6	0.2	430	7.2
100-200	3	0.1	437	7.3	3	0.1	437	7.2
> 200	2	0.1	1177	19.7	2	0.1	354	5.9
total	2801	100.0	5984	100	3008	100	5984	100

size class (feddans)	situation in 1961[1] holdings no.	%	area no.	%	situation in 1965[2] holdings no.	%	area no.	%
size class								
small								
< 5	2919	94.1	3172	52.1	3033	94.5	3693	57.1
medium								
5-10	80	2.6	526	8.6	78	2.4	614	9.5
10-20	65	2.1	638	10.7	61[3]	1.9	527	8.2
20-50	26	0.8	818	13.4	29	0.9	815	12.6
large								
50-100	6	0.2	430	7	6	0.2	392	6.1
100-200	5	0.5	500	8.2	4	0.1	421	6.5
> 200	-	-	-	-	-	-	-	-
total	3101	100.0	6084	100	100	6462	6462[4]	100

Notes:
1) after the promulgation of Law No. 127, June 1961.
2) excluding government properties.
3) there is some doubt as to the accuracy of this figure since the average size of ownership in this bracket works out at 8.6 which is clearly inconsistent with the size class of 10 to 20 feddans. The same situation applies to 1961.
4) the increase in the area of cultivated land between 1961 and 1965 is mainly due to large-scale land reclamation schemes.

source: table 1.6 [Abdel-Fadil, 1975: 11].

Table 64 Summary of changes in Egyptian landownership, 1952-65

(in thousands)

size class (feddans)	no. of holdings 1952[1]	1965	change	area owned 1952[1]	1965	change	(a)	(b)
small								
< 5	2642	3033	391	2122	3693 (3353)	1571 (1231)	671[4]	218[5]
medium								
5-10	79	78	-1	526	614	88	-	88
10-20	47	41[2]	14	638	527[3]	-111	-	-111
20-50	22	29	7	654	815	161	-	161
large								
50-100	6	6	0	430	392	-38	-	-38
100-200	3	4	1	437	421	-16	-	-16
> 200	2	-	-2	1177	-	-1177	-875[6]	-302
total	2801	3191	390	5984	6462 (6326)	478 (342)	-204[7]	-

(a) = transfers of land as a result of the land reform programme
(b) = private sales and other transactions

Notes:
1) situation before the implementation of the agrarian reform law No. 178, 1952.
2) adjusted figure (see note to table #).
3) these are doubtful figures. In the absence of firm evidence, Abdel-Fadil assumes that the decrease in this size class was counter-balanced by sales from public organisations to small farmers.
4) this represents the cumulative distribution of land reform land up to 1965.
5) including 110,000 feddans sold by other public organisations to small-holders.
6) this represents the total area requisitioned from 1952 to the end of 1966.
7) this represents the surplus of requisitioned area over the actually distributed land.
8) the number in parentheses under the official figures in the less than 5 feddan size class are Abdel-Fadil's estimates of the effective increase in the total area of small-holdings derived by referring to the annual agricultural survey published by the Ministry of Agriculture in 1961-64. The official figures for this class reflect scheduled rather than effective transfers.

source: table 1.15 [Abdel-Fadil, 1975: 24].

Table 65 Total population and households in ILO sample governorates

governorate	rural population	share of rural population in sample %	number of households in the sample*
Dumyat	0.32	5.6	56
Gharbiya	1.30	22.6	226
Menufiya	1.22	21.2	213
Giza	1.00	17.4	174
Beni Suef	0.72	12.5	125
Qena	1.19	20.7	206
Total	5.75	100.0	1000

*The number of households with valid answers varies since 132 questionnaires were discarded and another two were not usable for some entries.

source: table A2.1 [Radwan, 1986: 21]

Table 66 Number of villages in the ILO sample by size

governorate	large	small	total
Dumyat	0	1	1
Gharbiya	1	3	4
Menufiya	1	3	4
Giza	1	1	2
Beni Suef	1	3	4
Qena	2	1	3
Total	6	12	18

source: table A2.2 [Radwan, 1986: 22]

Table 67 Distribution of the ILO household sample by governorate and village

governorate and village	markaz (district)	population (1976)	total households	households selected
Dumyat				
Meet al-Shiukh	Farskour	2 794	560	56
Gharbiya				
Shubra Blula al-Sakhawia	Kutour	5 378	1 045	89
Atf Abu Gindi	"	1 429	321	24
Kamalia	Mahalla	2 460	386	36
Al-Shaheedi	al-Kubra	4 644	178	77
Menufiya				
Tilwana	Al-Bagour	6 121	1 285	111
Manshat Masjid al-Khidr	"	1 112	220	18
Kafr Mansur	Ashmoun	3 285	631	46
Manshat Abu Zikri	Quesna	4 047	697	36
Giza				
Shubak al-Sharki	Al-Saff	13 176	2 236	151
Salehia	"	1 793	386	23
Beni Suef				
Al-Maimoun	Al-Wasta	9 321	2 080	62
Telt	Al-Fashn	5 141	1 063	33
Beni Ghoneim	Al-Wasta	1 722	375	11
Kafr Mansur	Beba	3 062	671	19
Qena				
Tafnis	Esna	6 921	1 219	44
Higaza	Qus	17 959	3 327	129
Al-Amiria	Abu Tesht	5 021	1 124	33

source: Radwan [1986: 18, table 2.4].

Table 68 All Egypt regression matrix

dep	a	b	t	n	R^2
y1	1.00	-0.068	-3.041***	425	.0214
y2	0.63	0.036	1.417	425	.0047
y3	0.37	-0.104	-7.377***	425	.1140
y4	1.15	-0.256	-7.062***	415	.1078
y5	0.77	-0.146	-4.097***	415	.0392
y6	0.96	-0.050	-2.233**	425	.0116
y7	0.59	0.054	2.203***	425	.0113
y8	0.50	-0.062	-2.254**	218	.0290
y9	0.85	-0.118	-3.352***	348	.0315
y10	1.14	-0.153	-2.235**	104	.0467
y11	0.41	-0.041	-1.763*	220	.0141
y12	0.67	0.019	0.727	100	.0054

source: computed from ILO data

x=independent variable farm size or operated area, calculated as land owned + land rented in - land leased out, and measured in qirats.

y1=output per net cropped area. Net cropped area is taken as equal to farm size as fallow is negligible in land-scarce Egyptian agriculture. Output is measured in value terms and is the simple unweighted sum of the output values[1] of individual crops.

y2=output per gross cropped area. Gross cropped area is computed by the simple addition of the areas planted under the crops listed above. Output is as above.

y3=cropping intensity as the ratio of gross cropped area to net cropped area.

y4=a second version of output per net cropped area computed by Radwan for his regression. This uses net farm output in the numerator, calculated as the (total value of crop sales + imputed value of own consumption) minus total production costs, including the value of own-produced inputs but excluding the imputed value of family labour.

y5=a second version of output per gross cropped area based on net farm output as above.

y6=a third version of output per net cropped area based on Radwan's calculations of total crop value. The latter for the most part agree with my own calculations of total crop value, but there are some discrepancies which may bias the results in favour of the inverse relation hypothesis. In some cases, the total crop values for large farms have been underestimated while for some small farms, total crop values appear to have been adjusted upwards.

y7=a third version of output per gross cropped area based on Radwan's calculations of total crop value.

y8=winter wheat yields in value terms. The data did include physical measures of output for the different crops, but were measured in different physical units for different households. Some by weight and others by dry measure. Producer prices do not vary significantly over farm size.

y9=winter birseem yields in value terms.

y10=summer cotton yields in value terms.

y11=summer maize yields in value terms.

y12=summer rice yields in value terms.

1) Unit farmgate prices were recorded in the original survey. I ran supplementary regressions of producer prices for the major crops against farm size. The results revealed no significant variation in prices across farm size. Indeed the coefficients were weakly negative.

Table 69 Regression results on ILO data disaggregated by governorate (i) output per net cropped area (y1) and farm size

governorate	a	b	t	n	R^2
Gharbia	0.88	-0.018	-0.589	125	.0028
Damietta	1.05	-0.047	-1.08	415	.0828
Menufia	1.06	-0.163	-2.865***	71	.1063
Qena	0.82	0.062	1.328	78	.0227
Beni Suef	0.99	-0.128	-1.442	74	.1067
Giza	1.20	-0.099	-2.933***	74	.1067

*** significant at the 1% level ** 5% level * 10% level

(ii) output per gross cropped area (y2) and farm size

governorate	a	b	t	n	R^2
Gharbia	0.56	0.037	125288	.0133	
Damietta	0.75	-0.047	-1.084	15	.0828
Menufia	0.54	0.014	0.281	71	.0012
Qena	0.58	0.163	3.087***	78	.1114
Beni Suef	0.65	-0.065	-0.682	62	.0077
Giza	0.89	-0.040	-1.082	74	.0160

(iii) cropping intensity (y3) and farm size

governorate	a	b	t	n	R^2
Gharbia	0.32	-0.055	-2.788***	125	.0594
Damietta					
Menufia	0.52	-0.176	-4.661***	71	.2395
Qena	0.23	-0.101	-3.251***	78	.1221
Beni Suef	0.35	-0.063	-1.986**	62	.0617
Giza	0.31	-0.059	-2.271**	74	.0668

(iv) net farm output per net cropped area (y4) and farm size

governorate	a	b	t	n	R^2
Gharbia	1.04	-0.218	-3.706***	122	.1027
Damietta	1.41	-0.291	-3.654***	15	.5067
Menufia	1.34	-0.340	-4.142***	71	.1991
Qena	0.71	-0.042	-0.482	75	.0032
Beni Suef	0.86	-0.170	-1.648	61	.0440
Giza	1.30	-0.204	-2.286**	71	.0704

(v) net farm output per gross cropped area (y5) and farm size

governorate	a	b	t	n	R^2
Gharbia	0.71	-0.163	-3.140***	122	.0759
Damietta	1.11	-0.291	-3.650***	15	.5067
Menufia	0.84	-0.174	-2.050**	70	.0583
Qena	0.46	0.064	0.751	75	.0077
Beni Suef	0.51	-0.109	-1.048	61	.0187
Giza	0.98	-0.136	-1.525	71	.0326

(vi) output per net cropped area (y6) and farm size

governorate	a	b	t	n	R^2
Gharbia	0.90	-0.034	-1.207	125	.0117
Damietta	1.06	-0.054	-1.203	15	.1002
Menufia	0.90	-0.078	-1.041	71	.0155
Qena	0.81	0.062	1.293	78	.0215
Beni Suef	0.88	-0.068	-1.404	62	.0318
Giza	1.21	-0.106	-2.851***	74	.1014

(vii) output per gross cropped area (y7) and farm size

governorate	a	b	t	n	R^2
Gharbia	0.58	0.021	0.798	125	.0052
Damietta	0.76	-0.054	-1.203	15	.1002
Menufia	0.39	0.098	1.486	71	.0310
Qena	0.58	0.163	3.010***	78	.1065
Beni Suef	0.53	0.005	-0.099	62	.0002
Giza	0.90	-0.046	-1.170	74	.0186

(viii) winter wheat yields (y8) and farm size

governorate	a	b	t	n	R^2
Gharbia	0.37	0.016	0.446	82	.0025
Damietta	0.56	-0.205	-1.566	13	.1824
Menufia	0.59	-0.072	-1.637	58	.0457
Qena	0.21	0.107	1.996*	31	.1208
Beni Suef	0.34	-0.034	-0.696	29	.0176
Giza	0.91	-0.357	-2.506*	5	.6768

(ix) birseem yields (y9) and farm size

governorate	a	b	t	n	R^2
Gharbia	0.38	0.028	0.516	113	.0024
Damietta	0.87	-0.134	-2.179**	15	.2675
Menufia	0.76	-0.105	-2.395**	61	.0886
Qena	0.89	-0.012	-0.193	42	.0009
Beni Suef	0.92	-0.148	-1.547	48	.0494
Giza	1.03	-0.042	-1.794*	69	.0458

(x) cotton yields (y10) and farm size

governorate	a	b	t	n	R^2
Gharbia	0.98	-0.585	-1.266	78	.0206
Damietta					
Menufia	-4.86	3.22		2	1.000
Qena					
Beni Suef	1.69	-0.493	-1.868*	24	.1369
Giza					

(xi) maize yields (y11) and farm size

governorate	a	b	t	n	R^2
Gharbia	0.40	-0.031	-0.775	70	.0088
Damietta					
Menufia	0.36	-0.004	-0.069	40	.0001
Qena	0.24	0.052	0.650	18	.0257
Beni Suef	0.20	-0.002	-0.037	32	.0000
Giza	0.48	-0.030	-0.846	60	.0122

(xii) rice yields (y12) and farm size

governorate	a	b	t	n	R^2
Gharbia	0.66	0.014	0.584	43	.0042
Damietta	0.71	0.060	1.075	10	.0816
Menufia	0.76	0.017	0.407	36	.0048
Qena	0.68	0.074	1.001	10	.1112
Beni Suef					
Giza					

Table 70a Average levels of purchased input use by governorate

governorate	C1	C2	C3	C4
Gharbiya	0.1663	0.0880	0.2056	0.1116
Damietta	0.0778	0.0935	0.0952	0.1178
Menufiya	0.2557	0.2111	0.3081	0.2677
Qena	0.2653	0.6955	0.2896	0.8065
Beni Suwayf	0.1465	0.2608	0.1603	0.2916
Giza	0.1926	0.1411	0.2128	0.1601
ALL	0.1980	0.2548	0.2291	0.3001

C1 = ratio of total outlays on fertilizer, pesticides, seeds and fodder total crop value
C2 = ratio of total outlays on fertilizer, pesticides, seeds and fodder to net farm output
C3 = ratio of total cost of purchased inputs to total crop value
C4 = ratio of total cost of purchased inputs to net farm output

source: computed from ILO data

Table 70b Ratios of purchased inputs to own produced inputs by governorate

governorate	fertilizer	fodder	seeds
Gharbiya	3.7423	0.1480	2.5187
Damietta	0.8161	0.0048	2.7900
Menufiya	1.6423	0.1563	1.1011
Qena	8.0911	0.5318	2.5974
Beni Suwayf	4.6338	0.0366	1.6135
Giza	3.1957	0.1650	7.7747
ALL	3.9049	0.1948	3.3954

source:computed from ILO data

Table 70c Average levels of mechanization by governorate

governorate	M1	M2	M3	M4
Gharbiya	0.4088	0.1872	0.0071	0.0024
Damietta	0.0000	0.0000	0.0000	0.0000
Menufiya	0.0140	0.0099	0.0055	0.0025
Qena	0.0744	0.0762	0.0044	0.0016
Beni Suwayf	0.0000	0.0000	0.0000	0.0000
Giza	0.1010	0.0127	0.0026	0.0010
ALL	0.1724	0.0442	0.0043	0.0016

M1 = ratio of value of farm machinery and transport equipment to total crop value
M2 = ratio of value of farm machinery and transport equipment to net farm output
M3 = ratio of machinery fuel cost to total cost of purchased inputs
M4 = ratio of machinery running costs to total value of inputs

source: computed from ILO data

Table 70d Population of tractors and other agricultural equipment per 1,000 feddans of cropped area by governorate 1981-82

governorate	(1)	(2)	(3)	(4)	(5)	(6)
Gharbiya	9.4	11.2	4.4	2.1	6.4	114.3 hp
Damietta	8.3	5.5	2.9	0.4	1.9	393.1
Menufiya	6.3	5.9	1.7	2.3	1.7	139.8
Qena	10.6	7.6	0.4	3.1	4.3	610.0
Beni Suwayf	4.5	1.2	0.4	0.5	0.1	104.6
Giza	7.7	1.6	0.6	1.5	0.7	129.9

(1) tractors
(2) ploughs
(3) pesticide sprayers
(4) threshers
(5) trailers
(6) mechanical power for irrigation

source: Commander [1987: 295].

Table 71 Disaggregated ILO data: by village

	a	b	c	d	e	f
Gharbiya						
Shubra Blula	11	89	57	-1.2	-0.24	-1.67
Atf Abu Gindi	12	22	9	-1.69	0.18	-2.96
Kamliya	13	36	26	2.08	1.18	0.41
Al-Shahidi	14	77	33	-0.88	0.72	-3.08
Dumyat						
Mit Shuyukh	21	55	15	-1.2	-1.2	0
Menufiya						
Tilwana	31	110	36	-1.09	0.19	-1.76
Manshat Masjid al-Khadr	32	18	11	-0.65	0.45	-1.48
Kafr Mansur	33	46	24	-0.12	0.96	-3.2
Manshat Abu Zikri	34	38	1	0	0	0
Qena						
Tafnis	41	44	24	0.5	1.62	-1.92
Higaza	42	129	38	0.09	1.44	-2.16
Al-Amiriya	43	33	16	1.39	0.84	0.73
Beni Suef						
Al-Ma'mun	51	62	33	-0.95	0.27	-1.99
Beni Ghoneim	52	11	1	0	0	0
Telt	53	33	20	-0.48	-0.25	-0.4
Kafr Mansur	54	19	9	-0.18	-0.44	0.94
Giza						
Shubak al-Sharqi	61	151	68	-2.58	-1.02	-1.92
Salehia	62	22	6	-0.93	-0.93	0

a=village code
b=sample size
c=sample households with operated area
d=t value (regression with net cropped area)
e=t value (regression with gross cropped area)
f=t value (regression with cropping intensity).

Table 72 Land distribution by holding size: Shubak al-Sharqi

class	farms	%	owned	%	rented	%
lt 1	263	36.99	216	82	47	18
1-3	395	55.55	287	73	108	27
3-5	44	6.19	36	82	8	18
5-10	8	1.12	4	50	4	50
gt 10	1	0.14	1	100	0	0
total	711	100.00	544		167	

class	land (feddans)	%	owned	%	rented	%
lt 1	172.625	14.56	146.333	85	26.292	15
1-3	744.167	62.79	551.167	74	193.000	26
3-5	188.667	15.92	152.792	81	39.875	19
5-10	64.792	5.47	32.042	49	32.750	51
gt 10	15	1.27	15	100	0	0
total	1185.251	100.00	897.334		291.917	

source: village cooperative, mushrif zira'i.

Table 73 Distribution of farms and land by farm size in Giza governorate, 1981

size	farms	%	area	%
<1	41497	43.46	21041	12.55
1-3	41947	43.93	67416	40.20
3-5	7220	7.56	25390	15.14
5-10	3234	3.39	20829	12.42
>10	1592	1.67	33008	19.68
total	95490	100	167684	100

source: table 1a [Ministry of Agriculture (Giza), 1985: 4]

Table 74 Regression results, 1990 fieldwork

dependent		constant	coefficient	r2	n	t	sig.
R1	NY	1745.3	-95.86	0.0605	62	-1.97	0.0539
R2	GY	609.52	13.68	0.0093	62	0.751	0.4558
R3	PY	107	-5.8	0.01306	40	-0.71	0.4825
R4	PY	8.5	0.3	0.002	58	0.395	0.6944
R5	PY	64	15.7	0.045	10	0.617	0.5547
R6	PY	8.7	-0.6	0.071	43	-1.78	0.0831
R7	CROPINT	2.89	-0.2199	0.2711	62	-4.724	0.0000
R8	VALACRE	13591	922	0.0309	62	1.275	0.2080
R9	LABINT	400	-65.78	0.2285	62	-4.216	0.0001
R10	NY	1162.74	16.163	0.1069	68	2.812	0.0065
R11	GY	603.15	13.3	0.865	68	20.6	0.0000
R12	PY	7.4	-0.006	0.0000	57	-0.021	0.9834
R13	PY	36.9	0.3	0.076	49	1.967	0.0551

**R refers to the regression equations discussed in the text*

The independent variable is farm size in feddans unless otherwise stated.

NFQ=net farm output=total farm output-input costs
GY=value of output per gross cropped feddan
NY=value of output per net sown feddan
PY=physical yield per feddan (see text for unit of measurement)
CROPINT=cropping intensity (gross cropped area/net sown area)
VALACRE=land value per feddan
LABINT=standardized man-days per feddan per year

Table 75 Size-class averages for Shubak al-Sharqi, Giza

farm size	nca	nyield	gyield	cropint	labint	valacre
<1	0.61	1522.86	556.66	2.72	369.41	12793
1-3	1.76	1853.16	772.73	2.44	259.27	16454
3-5	3.45	1419.25	607.84	2.36	165.03	14366
5-10	6.13	921.83	561.08	1.59	115.90	20955
>10	10.00	2566.00	938.76	2.73	90.00	20000

farm size	@hyv	fragment	hhnr0	pcq	pcy
<1	0.23	1.47 (2.41)	8.60	131.61	275.15
1-3	0.36	2.45 (1.39)	10.38	351.18	460.76
3-5	0.40	1.80 (0.52)	8.60	751.98	1033.26
5-10	0.13	1.50 (0.24)	12.50	481.40	824.20
>10	0.39	6.00 (0.60)	7.00	3694.29	3848.57

farm size	pcw	@market	@lfam	@lhired	machine
<1	2427	0.44	0.96	0.04	219
1-3	3515	0.44	0.82	0.18	214
3-5	7840	0.45	0.84	0.16	288
5-10	11783	0.56	0.77	0.23	206
>10	37500	0.94	0.17	0.83	550

source: Giza survey data 1990

nca=net cropped area
nyield=value of output per net cropped feddan
gyield=value of output per gross cropped feddan
cropint=cropping intensity
labint=labour intensity
valacre=land value per feddan
@hyv=percentage gross cropped area under HYV crops
fragment=number of fragments per farm (in brackets, intensity of fragmentation)
hhnr0=number of family members in household
pcq=per capita output
pcy=per capita income
pcw=per capita wealth
@market=percentage of output marketed
@lfam=percentage family labour
@lhired=percentage hired labour
machine=machinery inputs (machine rentals+maintenance costs+10% of owned machinery)

Table 76 Relationship between family labour, labour input intensity and cropping intensity: Shubak al-Sharqi

1) seasonal yields on seasonal cropping intensity

	constant	b	error	n	t
winter	959	-23.4	252	62	-0.093
summer	592	-124.3	161	62	-0.773
nili	84	338	54	62	6.234

2) seasonal yields on seasonal family labour input per feddan

	constant	b	error	n	t
winter	962	-0.3	0.66	62	-0.456
summer	449	0.2	0.4	62	0.482
nili	173	1.64	0.36	62	4.616
all year	1470	0.457	0.357	62	1.28

3) seasonal yields on seasonal labour input intensity

	constant	b	error	n	t
winter	946	-0.097	0.66	62	-0.148
summer	441	0.25	0.4	62	0.59
nili	165	1.64	0.34	62	4.9

4) seasonal yields on farm size

	constant	b	error	n	t
winter	911	16	27	62	1.396
summer	447	-16	23	62	-0.689
nili	373	-46	22	62	-2.026

5) seasonal land use (cropped area/farm size) on farm size

	constant	b	error	n	t
winter	1.02	-0.05	0.012	62	-4.12
summer	1.06	-0.06	0.017	62	-3.44
nili	0.8	-0.1	0.04	62	-2.736

6) seasonal labour input intensity on farm size

	constant	b	error	n	t
winter	119	-15	4.9	62	-3.22
summer	159	-22.7	6.4	62	-3.56
nili	112	-18.5	7.2	62	-2.56

7) annual net yields on cropping intensity

annual	289	511	99	62	5.158

8) annual net yields on labour input intensity

annual	1442	0.52	0.36	62	1.438

9) net yields on annual family labour input

annual	1561	0.11	0.29	62	0.37

10) net yields on percentage family labour

annual	1605	-10.6	394	62	-0.27

11) net yields on family labour input per feddan

annual	1470	0.45	0.36	62	1.28

Table 77 Per capita net income and poverty levels by size class, Shubak al-Sharqi, 1990

CLASS	AVNCA	AVNETINC	AVPCNETY	AVPOVERT
1.00	.61	1786.52	227.15	-137.85
2.00	1.76	3018.11	321.56	-43.44
3.00	3.45	5192.20	599.27	234.27
4.00	6.13	5798.00	472.78	107.78
5.00	10.00	14390.00	2055.71	1690.71

AVNCA = operated area; AVNETINC = net income; AVPCNETY = per capita net income; AVPOVERT = divergence from poverty line of LE 365

Table 78 Average incomes and their sources, by size class, Shubak al-Sharqi, 1990

CLASS	AVINC	AVEXINC	AV@EXINC
1.00	2366.32	1234.47	.43
2.00	4828.73	1148.39	.22
3.00	8886.00	2419.00	.24
4.00	10302.50	4285.00	.39
5.00	26940.00	1080.00	.04

AVINC = average income per household; AVEXINC = average outside earnings; AV@EXINC = average proportion of income earned off-farm Note that one of the farms in the 5-10 feddan class has a high salaried member who works as a civil servant.

Table 79 Average levels of debt by size class, Shubak al-Sharqi, 1990

CLASS	AVLOAN	AVD1	AVD2	AVD3	AVD4
1.00	1177.91	.50	.75	.05	1597.67
2.00	1079.33	.23	.49	.03	643.09
3.00	3450.00	.35	1.06	.05	1076.47
4.00	600.00	.07	.19	.01	120.00
5.00	16000.00	.59	1.11	.06	1600.00

AVLOAN = average loan; AVD1 = debt to income; AVD2 = debt to net income; AVD3 = debt to assets; AVD4 = debt per feddan

Table 80 Average levels of rent by size class, Shubak al-Sharqi, 1990

CLASS	AV@RENT	AVRENTA	AVRENT
1.00	.80	.57	258.37
2.00	.62	1.09	231.59
3.00	.48	1.65	206.90
4.00	.40	2.00	240.00
5.00	.40	4.00	45.00

AV@RENT = average rented area as percentage of total; AVRENTA = average rented area; AVRENT = average rent per feddan

Table 81 Marketed output per size class, Shubak al-Sharqi, 1990

CLASS	AVM1	AVM2
1.00	.55	.50
2.00	.47	.45
3.00	.40	.45
4.00	.59	.56
5.00	.95	.94

AVM1 = marketed crop (%)
AVM2 = marketed output (%)

Table 82 Land distribution by farm size: Higaza al-Qibli

class	owned holdings	area	rented holdings	area	all holdings	area
<1	432	251.75	320	158	752	409.75
1-3	740	1317.34	266	429.5	1006	1746.84
3-5	142	544	39	148	181	692
5-10	120	842	5	31.375	125	873.375
>10	12	158.5	4	42.792	16	201.292
TOTAL	1446	3113.59	634	809.667	2080	3923.257

source: mushrif zira'i, Higaza cooperative

Table 83 Distribution of farms and land by farm size in Qena governorate, 1981

size	farms	%	area	%
<1	55243	39.90	24500	7.58
1-3	52051	37.59	87400	27.05
3-5	16506	11.92	59411	18.39
5-10	10292	7.43	67142	20.78
>10	4369	3.16	84619	26.19
total	138461	100	323072	100

source: table 1a [Ministry of Agriculture (Qena), 1985: 4]

Table 84 Size-class averages for Higaza al-Qibli, Qena

farm size	nca	nyield	gyield	cropint	labint	valacre
<1	0.51	1190	802	1.69	486	11176
1-3	1.85	1225	854	1.51	284	8649
3-5	3.31	1144	839	1.41	185	11329
5-10	6.69	1324	999	1.34	170	10339
>10	26.00	1617	1315	1.23	113	12115
	@hyv	fragment		hhnr0	pcq	pcy
<1	0.29	1.86 (3.6)		5.79	126	177
1-3	0.38	3.96 (2.1)		8.33	329	392
3-5	0.38	5.25 (1.6)		7.50	586	716
5-10	0.51	7.67 (1.2)		10.67	914	994
>10	0.64	5.00 (0.2)		6.50	6853	7031
	pcw	@market		@lfam	@lhired	machine
<1	2616	0.44		0.86	0.14	198
1-3	3918	0.54		0.72	0.28	373
3-5	7446	0.58		0.61	0.39	276
5-10	11445	0.64		0.50	0.50	1193
>10	68512	0.89		0.26	0.74	3543

source: Qena survey data 1990

nca=net cropped area
nyield=value of output per net cropped feddan
gyield=value of output per gross cropped feddan
cropint=cropping intensity
labint=labour intensity
valacre=land value per feddan
@hyv=percentage gross cropped area under HYV crops
fragment=number of fragments per farm (in brackets, intensity of fragmentation)
hhnr0=number of family members in household
pcq=per capita output
pcy=per capita income
pcw=per capita wealth
@market=percentage of output marketed
@lfam=percentage family labour
@lhired=percentage hired labour
machine=machinery inputs (machine rentals+maintenance costs+10% of owned machinery)

Table 85a Farm utilisation of agricultural machinery, 1981

Giza

type	owned/ shared	rented public	rented private	total
small tractors	321	480	5671	6472
large tractors	1657	3398	63344	68399
other tractors	715	739	5384	6838
fixed pumps	3893	247	9379	13519
mobile pumps	4892	248	22514	27654
threshers	695	1357	25277	27329

Qena

type	owned/ shared	rented public	rented private	total
small tractors	149	145	2855	3149
large tractors	2657	2758	98687	104102
other tractors	1468	1283	23606	26357
fixed pumps	4271	2390	33022	39683
mobile pumps	7835	890	64958	73683
threshers	1564	651	59663	61878

Qus district

type	owned/ shared	rented public	rented private	total
small tractors	16	2	444	462
large tractors	196	24	11844	12064
other tractors	34	8	330	372
fixed pumps	476	10	5185	5671
mobile pumps	689	15	7560	8264
threshers	92	11	3506	3609

Saff district

type	owned/ shared	rented public	rented private	total
small tractors	34	80	244	358
large tractors	101	2161	3456	5718
other tractors	40	408	160	608
fixed pumps	204	31	483	718
mobile pumps	77	34	226	337
threshers	28	416	1725	2169

source: table 46a [Ministry of Agriculture, Qena, 1985: 140] and [Ministry of Agriculture, Giza, 1985: 129].

Table 85b Size distribution of owned farm equipment, Qena and Giza

Qena size	tractors		pumps		threshers	
	n	%	n	%	n	%
<1	222	5	587	5	56	4
1-3	444	10	2777	23	186	12
3-5	531	12	2530	21	194	12
5-10	1167	27	3361	28	410	26
>10	1910	45	2851	24	718	46
total	4274	100	12106	100	1564	100

Giza size	tractors		pumps		threshers	
	n	%	n	%	n	%
<1	162	6	740	8	59	8
1-3	569	21	3822	44	201	29
3-5	484	18	1693	19	141	20
5-10	664	25	1369	16	140	20
>10	815	30	1161	13	154	22
total	2693	100	8785	100	695	100

source: table 46a [Ministry of Agriculture, 1985: 129].

Table 86 Input shares in total crop revenue in four regions: 1965-79 (3 year average), Egypt

year	anim	mech	seed	manu	fert	ins	othr	lab	rent	prof	r+p	l+r+p
Delta												
65-67	9.99	0.37	4.66	3.43	5.96	2.62	0.87	19.21	23.59	29.17	52.76	71.97
68-70	7.33	3.94	5.36	3.59	6.82	1.67	0.87	18.34	23.05	29.02	52.07	70.41
71-73	5.02	5.32	4.56	3.25	6.12	1.80	0.84	14.72	19.78	38.60	58.38	73.10
74-76	4.08	5.65	4.13	3.36	4.95	1.32	1.34	15.50	15.82	43.85	59.67	75.17
77-79	3.70	5.33	4.51	3.00	3.89	1.25	1.36	17.36	13.71	45.88	59.59	76.95
65-70	8.73	2.16	5.01	3.51	6.39	2.15	0.87	18.78	23.32	29.10	52.42	71.20
71-79	4.27	5.43	4.40	3.20	4.99	1.46	1.18	15.86	16.44	42.78	59.22	75.08
UG												
65-67	5.97	0.21	3.57	3.86	4.97	1.34	0.88	14.30	19.61	45.28	64.89	79.19
68-70	5.43	2.07	4.10	4.46	6.24	1.27	1.17	16.23	20.74	38.29	59.03	75.26
71-73	3.74	2.12	3.78	4.11	5.32	1.04	0.97	13.10	16.56	49.27	65.83	78.93
74-76	3.27	2.42	4.23	3.58	4.36	0.83	0.95	13.02	13.14	54.20	67.34	80.36
77-79	3.26	3.28	5.97	3.51	3.48	1.01	1.11	15.60	13.72	49.04	62.76	78.36
65-70	5.70	1.14	3.84	4.16	5.61	1.31	1.03	15.27	20.18	41.79	61.97	77.24
71-79	3.42	2.61	4.66	3.73	4.39	0.96	1.01	13.91	14.47	50.84	65.31	79.22
ME												
65-67	4.01	1.20	3.51	3.65	6.51	1.15	1.05	17.16	20.40	41.35	61.75	78.91
68-70	3.97	2.36	3.97	3.79	8.59	1.60	1.26	19.26	23.07	32.13	55.20	74.46
71-73	2.67	2.73	3.77	3.51	7.55	1.32	1.12	15.40	19.43	42.50	61.93	77.33
74-76	2.39	3.25	3.75	3.43	5.62	0.94	1.25	19.54	14.85	44.98	59.83	79.37
77-79	3.07	4.81	4.39	3.12	4.67	0.95	1.41	21.64	13.98	41.95	55.93	77.57
65-70	3.99	1.78	3.74	3.72	7.55	1.38	1.16	18.21	21.74	36.74	58.48	76.69
71-79	2.71	3.60	3.97	3.35	5.95	1.07	1.26	18.86	16.09	43.14	59.23	78.09
UE												
65-67	5.59	7.13	4.82	0.81	7.97	0.77	1.27	18.09	22.85	30.70	53.55	71.64
68-70	5.33	9.96	5.92	1.70	9.41	1.44	1.41	19.79	23.53	21.50	45.03	64.82
71-73	4.06	8.53	5.38	1.42	8.28	0.92	1.32	16.45	18.50	35.13	53.63	70.08
74-76	3.56	6.79	6.00	1.48	6.45	0.74	1.45	21.81	13.86	37.86	51.72	73.53
77-79	5.07	6.51	6.19	1.07	5.57	0.59	1.75	28.01	13.45	31.80	45.25	73.26
65-70	5.46	8.55	5.37	1.26	8.69	1.11	1.34	18.94	23.19	26.10	49.29	68.23
71-79	4.23	7.28	5.86	1.32	6.77	0.75	1.51	22.09	15.27	34.93	50.20	72.29

source: table 10 [Esfahani, 1988: 154].

anim=animals | *mech=machinery*
seed=seed | *manu=manufactured inputs*
fert=fertiliser | *ins=insecticides*
othr=other inputs | *lab=labour*
rent=land rent | *prof=profits*
r+p=rent plu profits | *l+r+p=labour+rent+profits*

Table 87 Lending categories currently implemented for main field crops during 1988, Egypt

crop	lending category sub*1	non-sub
wheat	12	70
bean	15	50
lentil	15	15
onion	8	
garlic	100	100
potato	300	
tomato		150
cotton	75	50
rice	70	50
maize	40	
sugar	650	50
soya	50	

1) subsidized interest rate ranges from 3.5% to 6.5%

source: Ministry of Agriculture, PBDAC, 1989 p.59.

APPENDIX B

Fieldwork questionnaire

مجموعة أسئلة

تاريخ الزيارة :   قرية :

اسم رب العائلة: مركز :

اسم العداد في عملية الاحصاء: محافظة:

... اهل الدار

عدد افراد اهل البيت الموجودين خلال الشهر

ذكور بالغين (فوق ١٢ سنة من العمر)	(9-13)	ـــ	847
انثى بالغين (فوق ١٢ سنة من العمر)	(14-18)	ـــ	848
اولاد (بين ٧ و ١٢ سنة من العمر)	(19-23)	ـــ	849
اولاد (تحت السابعة من العمر)	(24-28)	ـــ	850

٥ (١-٠) رقم ورقة العمل

ـــ (٤-١) رقم القرية

ـــ (٥-٨) رقم اهل البيت

الرقم التسلسلي لافراد اهل البيت VR003	اسماء افراد اهل البيت	الجنس: ذكر 1. انثى 2. VR004	العمر VR005	الحالة الزوجية: اعزب 1. متزوج 2. مطلق 3. ارملة/ارمل 4.	العلاقة برب العائلة[a] VR007	المهنة: الرئيسية VR008	المهنة: الثانوية[b] VR009	التعليم[c] VR010	ملاحظات
(9-10)		(11)	(12-13)	(14)	(15-16)	(17-18)	(19-20)	(21-22)	
01									
02									
03									
04									
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10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

a

١) رب العائلة ٢) الاهل حماة/حمو ٣) الزوجة/الزوج ٤) ابن او ابنة

٥) زوج الابنة او زوجة الابن ٦) حفيد ٧) اقرباء اخرين

٨) خدم ٩) عامل في المزرعة يسكن في الدار ١٠) اخ او اخت

١١) اية اولاد اخرين بعلاقة قرابة مع رب العائلة

b

١) ربة بيت عاملة في البيت ٢) مزارع او عائلة عامل في المزرعة

٣) فاعل في المزرعة ٤) عامل حرفي او صناعي ٥) عامل انشاء

٦) عامل خدمة ٧) موظف حكومة ٨) اخرين ٩) معاق غير قادر على العمل

١٠) الجيش النظامي ١١) التجنيد الالزامي ١٢) طالب

١٣) اولاد تحت ١٢ من العمر غير مقسمين لاية فئة اعلاه

١٤) عاطل عن العمل و يبحث على عمل

c

١) تحت الابتدائي

٢) اكمل او اكملت الابتدائي

٣) اكمل او اكملت الاعدادي

٤) اكمل او اكملت الثانوي

٥) اكمل او اكملت التعليم العالي

١

خصائص العمل لكل فرد اشترك بعمل

تملأ الاستمارة من قبل رب البيت و تراجع مع افراد الدار الموجودين

طبيعة العمل

الرقم التسلسلي لافراد اهل البيت	مزرعة العائلة			مزارع اخرى							خارج المزرعة				اي عمل اخر	هل تعتقد انه لم يصح لك العمل كفاية طيلة السنة الماضية ؟
	ليلي	صيفي	شتوي	عامل ثابت	مؤقت						في القرية		خارج القرية			
					شتوي		صيفي		ليلي							
	عدد ايام العمل			مجموع نقود الارباح السنوية	عدد ايام العمل	معدل اجرة العمل	عدد ايام العمل	معدل اجرة العمل	عدد ايام والعمل	معدل اجرة العمل	عدد ايام العمل	مجموع المخصص	عدد ايام العمل	مجموع الاجرة	عدد ايام العمل	١ - نعم ٢ - كلا
	(29-31)	(26-28)	(23-25)	(32-37)	(38-40)	(41-44)	(45-47)	(48-51)	(52-54)	(55-58)	(59-61)	(62-67)	(68-70)	(71-76)	(77-79)	(80)

رقم ورقة العمل (1-2) 0 2	رقم القرية (3-4) ____	رقم اهل البيت (5-8) ____	

الارض

E00	هل تملكون انت او اي فرد اخر من اهل بيتك اية ارض ؟ (1= نعم 2= كلا)	E00	(9)	1 2
E01	ما مساحة الارض التي تملكها الان انت و/او غير فرد اخر من اهل البيت ؟ (في الفدان و القيراط)	E01	(10-14)	____
E02	(ما القيمة الحالية للارض ؟	E02	(15-19)	____
E03	هل انت او اى فرد اخر من بيتك تقيمون على اكراء اية ارضا الان ؟ (1= نعم 2= كلا)	E03	(20)	1 2
E04	و اذا نعم فما كبرها ؟ (في الفدان و القيراط)	E04	(21-25)	____
E05	ما المساحة التي تم اكرائها تحت ترتيبات الاجار التالية ؟ (في الفدان و القيراط)	E0 نقداً Share Cropping	(26-30)	____
		E06 النصف	(31-35)	____
		E07 الخمس	(36-40)	____
		E08 رهناً	(41-45)	____
E09		E09 غيره (حدد)	(46-50)	____
E10	ما قيمة او مبلغ الاكراء الذي تحصلون عليه سنوياً ؟ (المطابقة لكل فئة عقود الحيازة)	E10 نقداً	(51-55)	____
		E11 النصف	(56-60)	____
		E12 الخمس	(61-65)	____
		E13 رهناً	(66-70)	____
E14		E14 غيره (حدد)	(71-75)	____

رقم ورقة العمل (1-2) 0 3	رقم القرية (3-4) ____	رقم اهل البيت (5-8) ____	

E15	هل انت او اي فرد اخر من اهل البيت تكرئون اية ارضاً الان ؟ (1= نعم 2= كلا)	E15	(9)	1 2
E16	واذا نعم فما كبرها ؟ (في الفدان و القيراط)	E16 من صاحب الملك في القرية ؟	(10-14)	____
E17		E17 من صاحب الملك الغائب ؟	(15-19)	____
E18	ما اكبر الارض (في الفدان و القيراط) التي تحرثوها و التي تم اكترائها تحت عقود الاكراء المختلفة التالية ؟	E18 نقداً	(20-24)	____
		E19 النصف	(25-29)	____
		E20 الخمس	(30-34)	____
		E21 رهناً	(35-39)	____
E22		E22 غيرها (مثلاً نقداً و عيداً)	(40-44)	____

E23 ما قيمة الاكتراء المدفوعة سنوياً ؟	E23 نقداً	(45-49)	____
	E24 النصف	(50-54)	____
	E25 الخمس	(55-59)	____
	E26 رهناً	(60-64)	____
E27	E27 غيره (حدد)	(65-69)	____
E28 هل انت او اي فرد اخر من اهل البيت قد امتلكتم ارضاً في حياتكم ؟	E28	(70)	1 2

اذكر كل العقود بمصر تدخر لسؤال ١٥١

رقم ورقة العمل (1-2) 0 4 رقم القرية (3-4) ____ رقم اهل البيت (5-8) ____

E29 ما اكبر الارض التي حصلت عليها انت او اي فرد اخر من اهل البيت و تم حصولها بطرق مختلفة خلال السنة الماضية	E29 ميراث : مساحة	(9-12)	____
(المساحة في الفدان و القيراط)	E30 ميراث : قيمة	(13-16)	____
	E31 شراء : مساحة	(17-20)	____
	E32 شراء : قيمة	(21-24)	____
	E33 اصلاح الارض : مساحة	(25-28)	____
	E34 اصلاح الارض : قيمة	(29-32)	____
	E35 مصادرة / منع الراهن: مساحة	(33-36)	____
	E36 مصادرة/منع الراهن : قيمة	(37-40)	____
	E37 هدايا : مساحة	(41-44)	____
	E38 هدايا : قيمة	(45-48)	____
	E39 اخر : مساحة	(49-52)	____
E40	E40 اخر : قيمة	(53-56)	____

رقم ورقة العمل (1-2) 0 5 رقم القرية (3-4) ____ رقم اهل البيت (5-8) ____

E41 ما اكبر الارض التي ملكتموها انت او اي فرد اخر من اهل البيت و تم فقدانها خلال السنة الماضية	E41 بيع : مساحة	(9-12)	____
المساحة في الفدان ز القيراط) ؟ (القيمة بالجنيه)	E42 بيع : قيمة	(13-16)	____
	E43 منع الراهن : مساحة	(17-20)	____
	E44 منع الراهن: قيمة	(21-24)	____
	E45 Gifts: هدايا : مساحة	(25-28)	____
	E46 هدايا : قيمة	(29-32)	____
	E47 اخر : مساحة	(33-36)	____
E48	E48 اخر : قيمة	(37-40)	____

رقم ورقة العمل (1-2) 0 6	رقم القرية (3-4) ____	رقم اهل البيت (5-8) ____

E49 ما اكبر الارض التي حصلت عليها انت او اي فرد احر من اهل البيت و تم حصولها بطرق مختلفة خلال السنوات الخمس الماضية

(المساحة في الفدان او القيراط)

E49	ميراث	(9-12)	____
E50	شراء	(13-16)	____
E51	اصلاح الارض	(17-20)	____
E52	مصادرة/ممع الراهن	(21-24)	____
E53	هدايا	(25-28)	____
E54	احر	(29-32)	____

E54

E55 ما اكبر الارض التي ملكتوها انت او اي فرد احر من اهل البيت و تم فقدانها خلال السنوات الخمس الماضية

المساحة في الفدان و القيراط) ؟

E55	بيع	(33-36)	____
E56	اصلاح الارض	(37-40)	____
E57	مصادرة/ممع الراهن	(41-44)	____
E58	هدايا	(45-48)	____
E59	احر	(49-52)	____

E59

رقم ورقة العمل (1-2) 0 7	رقم القرية (3-4) ____	رقم اهل البيت (5-8) ____

E60 ما اكبر الارض التي حصلت عليها انت او اي فرد احر من اهل البيت و تم حصولها خلال طيلة حياتكم

(المساحة في الفدان او القيراط)

E60	ميراث	(9-12)	____
E61	شراء	(13-16)	____
E62	اصلاح الارض	(17-20)	____
E63	ممع الراهن	(21-24)	____
E64	هدايا	(25-28)	____
E65	احر	(29-32)	____

E65

E66 ما اكبر الارض التي ملكتوها انت او اي فرد احر من اهل البيت و تم فقدانها خلال طيلة حياتكم

المساحة في الفدان و القيراط)

E66	بيع	(33-36)	____
E67	اصلاح الارض	(37-40)	____
E68	ممع الراهن	(41-44)	____
E69	هدايا	(45-48)	____
E70	احر	(49-52)	____

E70

Card No. (1-2) 0 8   رقم القرية (3-4) ____   رقم اهل البيت (5-6) ____

ماكينات و الات للمزرعة

اذا امتلكت اي من التالي اعطي التفاصيل:

رقم الماكينة (9-11)	نمط الماكينة	كلياً		جزاً		تغيير خلال السنة الماضية				ملاحظات
						بيع		شراء		
		عدد الماكينات التي تملكها ؟ (12-13)	القيمة المقدرة (14-18)	نصيبك بالماكينات التي تملكها ؟ (19-23)	قيمة نصيبك (24-28)	عدد الماكينات (29-33)	قيمة (34-38)	عدد الماكينات (39-43)	قيمة (44-48)	
	ميكانيكي									
110	حرارة (قوة حصان)									
120	شاحنة									
130	مضخة الري									
140	دراسة نورج									
150	مرشة									
160	اخر									
	غير ميكانيكي									
210	محراث بلدي									
211	محراث افرنجي									
221	ساقية									
222	طنبور									
223	شادوف									
231	زحافة									
232	قصبية									
240	نورج									
250	اخر									

رقم ورقة العمل (1-2) ... رقم القرية (4-3) ...

المواشي

اذا كنت تملك التالي اعطي التفاصيل:

رقم المواشي (9-11)	نمط المواشي	كلياً: عدد المواشي التي تملكها كلياً (12-14)	قيمة (15-19)	جزئياً: عدد المواشي التي تملكها جزئياً (20-24)	قيمة (25-29)	خلال السنة الماضية: قيمة الشراء (30-34)	قيمة المواليد (35-39)	قيمة اضافيات اخرى (40-44)	قيمة البيع (45-49)	قيمة تخفيض اخر (50-54)	ملاحظات
	حيوانات للجر										
111	جاموسة صغيرة										
112	جاموسة كبيرة										
121	بقرة صغيرة										
122	بقرة كبيرة										
130	حمار										
14[illegible]	بغل										
150	حصان										
160	جمل										
	حيوانات اخرى										
210	خروف										
220	ماعز										
230	خنزير										
240	الطيور الداجنة										
250	نحل (خلية)										
260	اخر (حدد)										

الممتلكات الانتاجية غير الزراعية

هل تملك اي من التالي :

رقم (9-10)	نمط الممتلكات	عدد (11-12)	قيمة (13-17)	خلال السنة الماضية * شراء عدد (18-19)	شراء قيمة (20-24)	بيع عدد (25-26)	بيع قيمة (27-31)	الملاحظات
01	سيارة							
02	عربة يد او نقل							
03	دراجة بخارية							
04	دراجة							
05	ماكنة خياطة							
06	مخزن خارج البيت							
07	زريبة (للمواشي) خارج البيت							
08	الات حرفية							
09	اخر : حدد (برج حمام او حظيرة للحيوانات)							

ما عدا الممتلكات التي صنعها افراد اهل الدار *

P01 هل تملك انت او غيرك من افراد اهل البيت مؤسسة صناعية او تجارية او خدمية ؟ — P01 (32)

نعم = 1
كلا = 2

P02 اذا نعم فما القيمة المقدرة للمؤسسة ؟ (في الجديد) — P02 (33-37)

P03 اذا كنت تملك ارضاً غير زراعية اعطي التفاصيل — P03 مساحة(فدان و قيراط) (38-41)

P04 قيمة (£) (42-46)

P05 الشراء خلال السنة الماضية (£) (47-51)

P06 — P06 بيع خلال السنة الماضية (£) (52-56)

P07 ما كانت ارباحك الاجمالية من الممتلكات الانتاجية غير الزراعية المحددة أعلاه خلال السنة الماضية ؟ — P07 (57-61)

البيت

B01	هل تملك البيت الذي تسكن فيه ؟ (نعم = 1) (كلا = 2) و اذا نعم فما شكله و قيمته ؟	B01		(9)	1 2
		B02	طوب احمر	(10-14)	⎵⎵⎵⎵⎵
		B03	طوب اخضر	(15-19)	⎵⎵⎵⎵⎵
B04		B04	كوخ	(20-24)	⎵⎵⎵⎵⎵
B05	ما عدد الغرف ؟	B05		(25-26)	⎵⎵
B06	هل فيه تسهيلات ؟ (نعم = 1) (كلا = 2)	B06	ماء للشرب	(27)	1 2
		B07	كهرباء	(28)	1 2
B08		B08	تواليت	(29)	1 2
B09	هل حصل اية اصلاحات للبيت في السنة الماضية غير ما تم من خلال عمل اهل البيت ؟ (نعم = 1) (كلا = 2)	B09		(30)	1 2
B10	واذا نعم فحدد التغييرات التي حصلت والتكلفات (في الجنيه)	B10	اصلاحات كبيرة (ما عدا المحافظة و اصلاحات صغيرة)	(31-35)	⎵⎵⎵⎵⎵
		B11	اضافة الى عدد الغرف	(36-40)	⎵⎵⎵⎵⎵
		B12	ادخال التسهيلات	(41-45)	⎵⎵⎵⎵⎵
B13		B13	ضرر	(46-50)	⎵⎵⎵⎵⎵
B14	و اذا كنت تملك اكثر من بيت واحد فرجاءاً اعطي قيمة مجموع البيوت الاضافية (في الجنيه)	B14		(51-55)	⎵⎵⎵⎵⎵
B15	ما المدخول خلال السنة الماضية من اجار البيوت التي تملكها ؟	B15		(56-60)	⎵⎵⎵⎵⎵

B16	هل كان هنالك اية ايضافات من خلال بناء البيت او تصليح في المزرعة او تمديدات للري او هل كان هنالك تحسين للبيت من قبل افراد اهل البيت خلال فترة السنة الماضية ؟ (1 = نعم 2 = كلا)	B16	(62)	1 2
B17	و اذا نعم فما تقدر الكلفة في حال لم يقم البناء من قبل افراد اهل البيت	B17	(64-68)	⎵⎵⎵⎵⎵
B18	ما مجموع كلفة المواد التي اشتريتها و كلفة اليد العاملة المستأجرة؟(في الجنيه)	B18	(69-73)	⎵⎵⎵⎵⎵

الموجودات المالية

اذا تملك انت و/او اي فرد من اهل بيتك من التالي فاعطي التفصيلات

(9) رقم الممتلكات	نمط الممتلكات	القيمة (مقدرة) (10–14)	خلال السنة الماضية: ازدياد (15–19)	خلال السنة الماضية: نقص (20–24)	ملاحظات
1	اسهم سندات	ـــــ	ـــــ	ـــــ	
2	حساب المدخرات				
3	حساب البريد				
4	المدخرات (نقداً)				
5	قروض مالية للغير				
6	اخر (حدد)				

ديون مالية

(24) رقم الديون	نوع الديون	القيمة (هذه السنة) (25–29)	القيمة (السنة الماضية) (30–34)	الفائدة (ربح) (35–39)	ملاحظات
1	البنك	ـــــ	ـــــ	ـــــ	
2	الجمعية				
3	قروض مالية من الغير				
4	اخر (حدد)				

بيانات دخل انتاج

رقم ورقة العمل (1-2) 1 3 | رقم القرية (3-4) ___ | رقم اهل البيت (5-6) ___

انتاج المزرعة (غلات كبيرة)

اذا زرعت اي من التالي خلال السنة الزراعية الماضية فاعطي التفاصيل :

(9-11) رقم الغلات (a)	نمط الغلات	(12-16) المساحة (في الفدان والقيراط)	(17) وحدة (b)	(18-22) انتاج	(23-27) انتاج محافظ	(28-32) الايجار عيناً	(33-37) السعر لكل وحدة (as in b)	(38-42) القيمة £	ملاحظات
___		___	_	___	___	___	___	___	

a)

شتوي

101 قمح/حنطة
102 فول
103 شعير
104 حلبة
105 عدس
106 كتان او تيل
107 بصل
108 الترمس
109 حمص
110 برسيم
111 ثوم
112 خضار
113 بطاطس
114 اخر

صيفي

201 قطن
202 ارز
203 ذرة عويجة
204 ذرة
205 قصب السكر
206 فول سوداني
207 السمسم
208 خضار
209 بطاطس
210 اخر

نيلي

301 ارز
302 ذرة عويجة
30.3 ذرة
304 خضار
305 اخر

فواكه

401 تمر
402 برتقال
403 يوسف افندي
404 ليمون
405 ليمون حلو
406 عنب
407 تين
408 جوافة
409 زيتون
410 رمان
411 مشمش
412 برقوق
413 موز
414 مانجة
415 خوخ
416 اجاص
417 تفاح
418 اخر

b) رقم الوحدة

1 = طن
2 = قنطار
3 = أردب
4 = كيلة
5 = ضريبة
6 = كيلوغرام
7 = أقة
8 = قيراط

رقم ورقة العمل (2-1) 1 4 | رقم القرية (4-3) ___ | رقم اهل البيت (8-5) ___

موارد اخرى للدخل

R01	الايرادات من الاكراء	R01	اكراء الارض	(9-12) ___
RC2		R02	اكراء الاعدة و المواشي و الغنم ، و ما اليها	(13-16) ___
RC3	ايرادات اخرى من المزرعة عند البيع	RC3	بيع المحصولات المواشي	(17-20) ___
		R04	الاستهلاك الخاص من المواشي و الغنم و ما اليها	(21-24) ___
		R05	بيع الطيور الداجنة و بما فيها البيض	(25-28) ___
		R06	الاستهلاك الخاص من الطيور و الداجنة (وبما فيها البيض)	(29-32) ___
		R07	بيع العسل	(33-36) ___
R08		R08	بيع موارد اخرى من محصول الزرعة (عيدان القطن ، قش ، سماد أو زبل ، ... حدد)	(37-40) ___
R09	آخر	R09	المبالغ التي قبضتها من المرسلة بالبريد	(41-44) ___
R10		R10	متفرقات	(45-48) ___

رقم ورقة العمل (2-1) 1 5 | رقم القرية (4-3) ___ | رقم اهل البيت (8-5) ___

001	النقود من اكراء الارض	001	(9-12) ___
002	ثمن الاكراء عيناً و لا نقداً	002	(13-16) ___
003	شراء العلف	003	(17-20) ___
004	قيمة العلف الخاص الذي تم انتاجه	004	(21-24) ___
005	كلفة تشغيل الماكينات		
	(i) الوقود (£)	005	(25-28) ___
006	(ii) الصيانة (£)	006	(29-32) ___
007	(iii) الايجار (£)	007	(33-36) ___
	شراء السماد		
008	(i) الكيماوي (£)	008	(37-40) ___
009	(ii) الطبيعي (£)	009	(41-44) ___
010	قيمة السماد الطبيعي الذي تنتجه	010	(45-48) ___

رقم ورقة العمـ (1-2) 1 6 رقم القرية (3-4) ____ رقم اهل البيت (5-8) ____

011 (9-12) ____
012 (13-16) ____
013 (17-20) ____
014 (21-24) ____
015 (25-28) ____

016 شتوى (القيمة) (29-32) ____

017 اجرة العمل اليومي (£PT)(33-36) ____
018 صيفي (القيمة) (37-40) ____
019 اجرة العمل اليومي (£PT)(41-44) ____
020 نيلي (القيمة) (45-48) ____
021 اجرة العمل اليومي (£PT)(49-52) ____
022

011 مبيد الحشرات (£)
012 شراء البذور (£)
013 قيمة البذور التي تنتجها
014 ضريبة الارض (£)
015 المدفوعات ، نقداً و عيناً ، للأيد العاملة المستأجرة في الزرعة و من ذوى اهل البيت

016 المدفوعات ، نقداً و عيناً ، للأيد العاملة المستأجرة غير من اهل البيت

021
022 آخر (ضريبة الماء) £

رقم ورقة العمل (1-2) 1 7 برقم القرية (3-4) ____ رقم اهل البيت (5-8) ____

خدمات الجمعية

هل تنتمي انت او غيرك من افراد اهل البيت للجمعية ؟ C00	C00 (9)		1 2
كلا = 2 نعم = 1			
C01 اذا حصلت على اي من الخدمات التالية خلال السنة الماضية ، أعطي التفاصيل:	C01 القيمة (في الجمعية)	(10-16)	____
	C02 المدة (عدد الاشهر)	(17-18)	__
1) قروض (المالية)	C03 الربح (%)	(19-22)	____
	C04 القصد a)	(23)	_
C05	C05 ديون معلقة	(24-30)	____
C06 2) المواد بذور (1)	C06 رقم الوحدة b)	(31)	_
	C07 الكمية	(32-34)	___
C08	C08 سعر الوحدة	(35-40)	____
C09 بذور (2)	C09 رقم الوحدة b)	(41)	_
	C10 الكمية	(42-44)	___
C11	C11 سعر الوحدة	(£PT)(45-50)	____
C12 سماد	C12 رقم الوحدة b)	(51)	_
	C13 الكمية	(52-54)	___
C14	C14 سعر الوحدة	(£PT)(55-59)	____
C15 مبيد الحشرات	C15 رقم الوحدة b)	(60)	_
	C16 الكمية	(61-63)	___
C17	C17 سعر الوحدة	(£PT)(64-68)	____
C18 العلف	C18 رقم الوحدة c)	(69)	_
	C19 الكمية	(70-72)	___
C20	C20 سعر الوحدة	(£PT)(73-77)	____

a) ١) (بذور ، سماد ، مبيد الحشرات ..)

٢) شراء المواشي

٣) شراء الماكينات الزراعية و الآلات

٤) انشاء (سقيفة ، تسهيلات الري ، مخازن)

٥) شراء الماكينات و آلات لتصنيع منتجات زراعية (آلات معمل البان ، عسل...)

b) رقم الوحدة

رقم = 1 كيلوغرام = 2 رطل = 3 غرامات = 4

كيلة = 5 اردب = 6 علبة = 7 لتر = 8

ضريبة = 9

(5-8) رقم اهل البيت House

(3-4) رقم القرية 711

(1-2) 1 8 رقم ورقة العمل

a. [redacted]	C21 رقم الغلة	(9-11)
b)	C22 رقم الوحدة	(12)
	C23 الكمية	(13-15)
	C24 سعر الوحدة	(£PT)(16-21)
a)	C25 رقم الغلة	(22-24)
b)	C26 رقم الوحدة	(25)
	C27 الكمية	(26-28)
	C28 سعر الوحدة	(£PT)(29-34)
a)	C29 رقم الغلة	(35-37)
b)	C30 رقم الوحدة	(38)
	C31 الكمية	(39-41)
	C32 سعر الوحدة	(£PT)(42-47)
a)	C33 رقم الغلة	(48-50)
b)	C34 رقم الوحدة	(51)
	C35 الكمية	(52-54)
	C36 سعر الوحدة	(£PT)(55-60)
	C37 الاجرة	(£PT)(61-65)
	C38 اتعاب عصوية	(66-70)
	C39 اجر التسويق	(71-75)
	C40 آخر	(76-80)

C21 (3) التسويق

غلة 1:

C24

C25 غلة 2:

C28

C29 غلة 3:

C32

C33 غلة 4:

C36

C37 4) خدمات اخرى

اكراه الماكينات

C38 اعطي قيمة المصاريف التي دفعتها خلال السنة الماضية

C40

-)

شتوي		صيفي		فواكه	
101	قمح/حنطة	201	قطن	401	تمر
102	فول	202	ارز	402	برتقال
103	شعير	203	ذرة عويجة	403	يوسف افندي
104	حلبة	204	ذرة	404	ليمون
105	عدس	205	قصب السكر	405	ليمون حلو
106	كتان او تيل	206	فول سوداني	406	عنب
107	بصل	207	السمسم	407	تين
108	الترمس	208	خضار	408	جوافة
109	حمص	209	طماطس	409	زيتون
110	برسيم	210	اخر	410	رمان
111	ثوم	نيلي		411	مشمش
112	خضار	301	ارز	412	برقوق
113	طماطس	302	ذرة عويجة	413	موز
114	اخر	303	ذرة	414	مانجة
		304	خضار	415	خوخ
		305	اخر	416	اجاص
				417	تفاح
				418	اخر

b) رقم الوحدة =

رقم = 1   كيلوغرام 2   3 = رطل   4 = غرامات

كيلة = 5   اردب = 6   7 = علبة   8 = ليتر

ضريبة = 9

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