THE PROCESS OF INNOVATION IN THE SUBSISTENCE AGRICULTURE OF NORTH-EAST THAILAND WITH PARTICULAR REFERENCE TO THE LAM PAO IRRIGATION AREA, CHANGWAT KALASIN

by

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ABSTRACT

The fieldwork for this thesis was carried out as part of the Lam Pao Socio-economic Survey of the School of Oriental and African Studies of the University of London. This thesis is concerned with the process of innovation in the subsistence agriculture which characterizes the relatively backward north-eastern region of Thailand and is exemplified by the Lam Pao Irrigation Area. Research was carried out in seven sample villages.

In the first chapter the regional and systematic background is delineated. The salient features of the economy of Thailand are outlined and reasons sought for the country's lack of development. Secondly, the peculiar regional problems of the north-east are described and explanations for these problems offered. The systematic background involves two frameworks. On the one hand it involves an assessment of agricultural development theory; on the other hand it involves a study of origin, adoption and diffusion of innovations. Both these theoretical frameworks are critically assessed.

The next chapter outlines the importance of irrigation as a 'catalyst for innovations' in Thailand. It then describes the field-work area and assesses the common and peculiar features of the study villages. Finally, methods and techniques of study, both in and out of the field, are described and the major problems encountered are listed.

In Chapter 3 the subsistence nature of the Lam Pao Sample is investigated. A wide variety of indices are used, both separately and in a composite index, to determine that the area is overwhelmingly subsistent. Next, two other variables crucial to the process of innovation and development are analyzed, viz. the population pressure

and the degree of unemployment, be it real or disguised.

The subsistence crop of the area is glutinous rice. In Chapter 4 the traditional cultivation of this crop is assessed and then innovations in rice cultivation are analyzed. These include the commercial instead of the subsistence cultivation of rice, the cultivation of non-glutinous rice and the introduction of new strains of rice.

In the next chapter new crop innovations in the area are discussed and the potential and appropriateness of each crop is assessed.

In subsequent chapters livestock innovations and technical innovations are analyzed and assessed. Then the interrelationship between individual innovations is determined by the use of the Guttman scale. Education, organization and experimentation are critically considered as stimulators to innovation. Finally, conclusions are reached and the relevance of the research findings assessed.

ACKNOWLEDGEMENTS

Following the 1957 session of the Economic Commission for Asia and the Far East in Bangkok, the Mekong Committee was established by the governments of Thailand, the Khmer Republic, Laos and the Republic of Vietnam with the express function "to promote, co-ordinate, supervise and control the planning and investigation of water resources development projects in the Lower Mekong Basin".

The Geography Department of the School of Oriental and African Studies of the University of London undertook to conduct a five year socio-economic survey of the Lam Pao Irrigation Project Area, which is a tributary project of the Mekong River Project and is situated in Kalasin province, north-east Thailand. The Lam Pao Socio-economic Survey is part of the contribution of the government of the United Kingdom to the Mekong Project. As a member of the SOAS team working on the Lam Pao Socio-economic Survey, I was given the opportunity to carry out individual research for a higher degree.

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However, the interpretations, views and conclusions expressed in this thesis are entirely my own.

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Standard Abbreviations of Periodicals Quoted in the Text

AER	American Economic Review
Asian Surv.	Asian Survey
BBMR	Bangkok Bank Monthly Review
Bot. Bull. Acad. sin.	Botanical Bulletin Academia Sinica
Columbia J. Wld Busin.	Columbia Journal of World Business
Ec	Economica
EDCC	Economic Development and Cultural Change
EJ	Economic Journal
Foreign Agric.	Foreign Agriculture
Hum. Org.	Human Organization
IJE	Indian Journal of Economics
Ind. Fmg.	Indian Farming
Int. Lab. R.	International Labour Review
JDS	Journal of Development Studies
JFE	Journal of Farm Economics
J. mod. Afr. Stud.	Journal of Modern African Studies
JRSS	Journal of the Royal Statistical Society
J. soc. Issues	Journal of Social Issues
JSS	Journal of the Siam Society
JTRS	Journal of the Thailand Research Society
Malay. Agric. J.	Malayan Agricultural Journal
Nat. Hist. Bull. Siam Soc.	Natural History Bulletin of the Siam Society
Neth. J. agric. Sci.	Netherlands Journal of Agricultural Science
OEP	Oxford Economic Papers
PhEJ	Philippine Economic Journal
QJE	Quarterly Journal of Economics

Rur. Sociol.	Rural Sociology
Wld Crops	World Crops
W. Pak. J. Agric.	West Pakistan Journal of Agriculture

Standard Abbreviations of Organizations Mentioned in the Text

ACC	Agricultural Credit Co-operative
ACI	Allied Chemical International Corporation
AID	Agency for International Development
ANU	Australian National University
ASPAC	Asian and Pacific Council
ASRCT	Applied Scientific Research Council of Thailand
CIAT	Centro Internacional por Agricultura Tropical (Colombia)
ECAFE	Economic Commission for Asia and the Far East
EEC	European Economic Community
FAO	Food and Agricultural Organization of the United Nations
IRRI	International Rice Research Institute
NEDB	National Economic Development Board
NEDECO	Netherlands Development Corporation
NSO	National Statistical Office
RID	Royal Irrigation Department
RTG	Royal Thai Government
TACI	Thai Agricultural Chemical Industries
TPI	Tropical Products Institute
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational,Scientific and Cultural Organization
USOM	United States Operations Mission

NOTES

I. Changes in the Name of the Nation under Study

The Kingdom of Thailand, originally known as Sayam, was changed in the 1850's to Siam and so known until 1939, when the name of Thailand was adopted. The name reverted to Siam from 1945 to 1949 and then changed back to Thailand, by which name the nation is now known. In this thesis when historical references are made, the country is referred to by the name it held at the particular period to which reference is made.

II. Changes in Provincial Boundaries

At present there are 71 provinces in Thailand. In 1971 Yasothon province was created from part of Ubon Ratchathani province and Bangkok and Thon Buri provinces were amalgamated. In this thesis the maps show the old provincial boundaries. Similarly, statistics of north-eastern provinces used in this thesis are broken down according to the old provincial boundaries, since these were the boundaries in existence up to the year of study and since data broken down on the basis of the new boundaries was not available.

III. Rural Administration in Thailand

The country is divided into 71 provinces or changwat, each of which is under the control of a governor or kha luang, who is appointed by and responsible to the Minister of the Interior. Each province is subdivided into districts or amphoe and in some cases sub-districts or king amphoe. Each district is under the charge of a district officer or nai amphoe, who reports directly to the provincial governor. The sub-district is headed by an assistant district officer. Each district is subdivided into 8 to 12 communes or _tambon_, each of which is headed by a chief or _kamnan_. The commune is subdivided into villages or _muban_, each of which is led by a village headman or _phu yai ban_. The village headman is selected by the villagers. The commune chief is chosen from among the headmen of the villages that constitute the commune.

IV. Thai Units of Measurement

Thai units of measurement are used throughout this thesis, as they are used invariably in daily business, official publications and academic literature. This list is not meant to be exhaustive but merely refers to units of measurement mentioned in the text.

Volume:

1 tang	=	20 litres		

Area:

1 rai	=	1600 sq.m.	=	1,914 sq. yards.
2.53 rai	=	1 acre		

Currency:

20.80 Baht	=	1 U.S. dollar
48.35 Baht	=	£1 sterling

(This was the rate of exchange quoted by Lloyds Bank at the time of writing).

100 satang	=	1 Baht.

V. Transliteration of Thai Names

The system used in this thesis for the transcription of Thai characters into Roman is the Royal Institute's "General System of Phonetic Transcription of Thai Characters into Roman" (_JTRS_, Vol.XXXIII, Parts 1-2, March 1941). This system was deemed to be more suitable for a geography thesis than the Royal Institute's "Precise System of Transliteration of Thai Characters into Roman" (_ibid._). This system is used for all Thai words with the exception of place names, personal names and certain words, chiefly units of measurement, which are so frequently used in English as to have an accepted English spelling. Thus "Baht" is invariably spelt thus, although in both the "General System" and the "Precise System" it would be spelt as bat.

Names of changwat, amphoe and king amphoe are written as transcribed by the Royal Institute and given in the Royal Gazette for 23rd June, 1967 (information derived from ASRCT Editorial Notice No. 10/2, 1st September 1967). Exceptions to this occur where a place name occurs in the title of a book or article, in which case the spelling used by the author of that book or article is presented in this thesis. Also where place names occur in the names of soil series, the spelling used by the author of the particular work on soils is used in this thesis.

Personal names are transcribed according to the bearer's preference.

In the Thai language nouns do not have a plural form. In transcription some scholars denote the plural of the word in the English method by suffixing 's'; others leave the word unchanged in its plural form. For aesthetic reasons, both on the printed page and in the spoken word, the writer has not used a plural form for transcribed Thai nouns. Thus, for example, the nouns, changwat, amphoe and Thai, may be either singular or plural.

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CHAPTER ONE

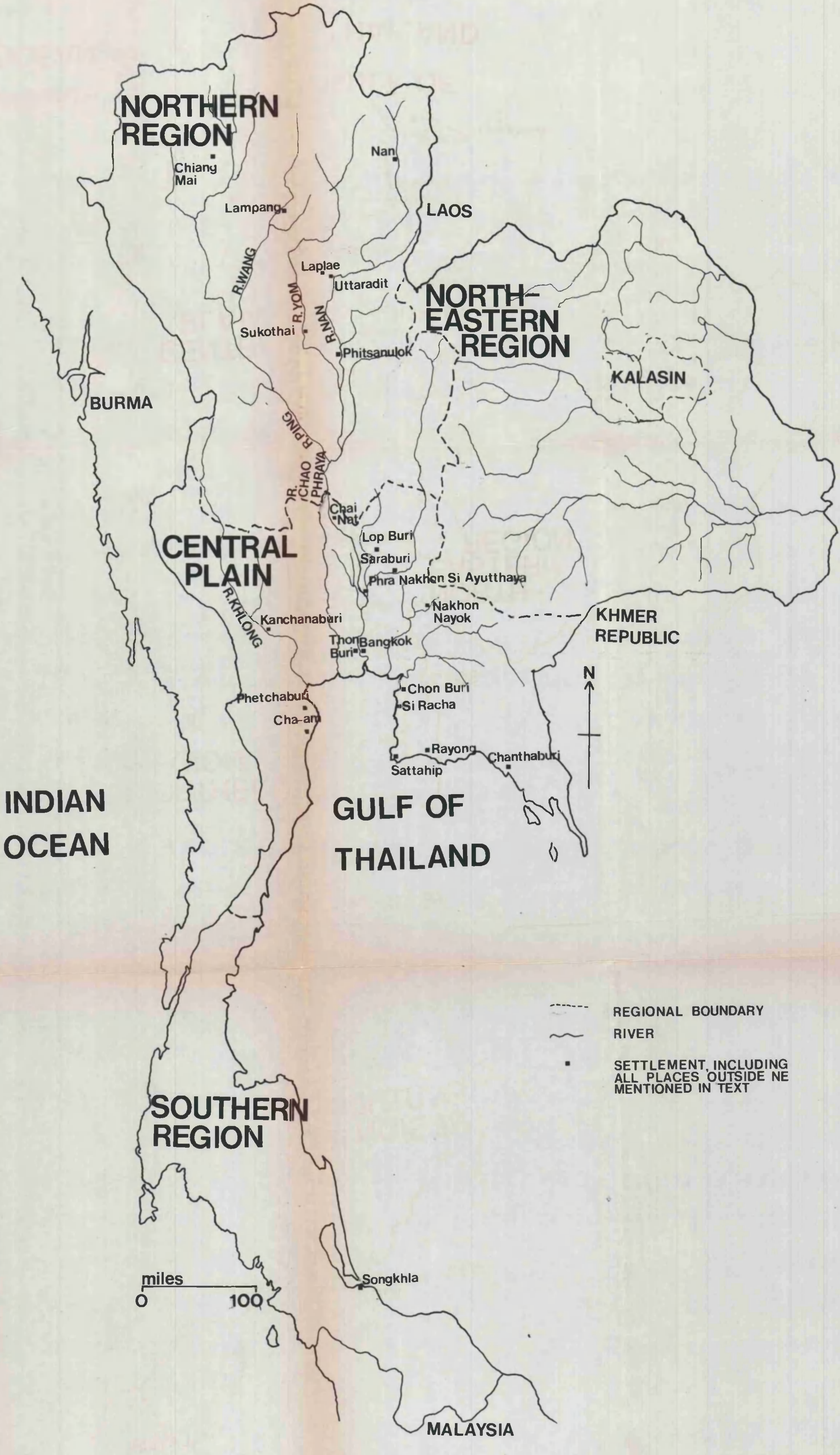
INTRODUCTION

I. Thailand: an Underdeveloped Economy

The problem of development in the so-called Third World is one which is of considerable human and political importance (both domestically and internationally), as well as meriting academic scrutiny. How one defines development varies according to both academic training and political stance. None of the possible indices, such as Gross Development Product or Gross National Product, per capita income, calorie intake, the industrial/agricultural ratio, the urban/rural population ratio, the level of literacy (this list is not exhaustive) are foolproof. Yet the crucial problem is one of perception: it is the consciousness of inequalities within the world. Among the wealthy nations this consciousness produces a mixture of guilt and fear; in the poor nations it produces shame, frustration and anger. Moreover, there are few bodies of opinion in the world to-day that would attempt to justify the existence of these inequalities, whereas until comparatively recently and throughout much of history over much of the earth, inequalities have been regarded as just, even pre-ordained and sacrosanct.

The causes of underdevelopment have likewise been widely sought, ranging from climatic determinism, racial characteristics, "non-dynamic" religious and cosmic views to the terms of international trade, strongly biassed in favour of the industrialized powers, the political decisions of the Great Powers and the economic decisions of great industrial corporations. Case studies of individual countries

Map 1.1 Thailand General



reveal the difficulty of world-wide generalizations.

The solutions forwarded have been equally diverse: emphasis upon state or private enterprise, regional development or metropolitan concentration, capital- or labour-intensive industries, promotion of agriculture or promotion of the industrial base with relative neglect of agriculture.(1)

It is far from certain which sector of the economy should be the "leading sector" in the drive to achieve what Rostow has termed "take-off".(2) Analogies with developed countries do not prove fruitful. However, most developing countries see it as one of their aims to make more productive and efficient their traditional agricultural sector, if only because a considerable proportion of their population resides in this sector. Such an aim is even more vital in the case of an underdeveloped country whose economy is based primarily upon the produce of this traditional agricultural sector rather than upon valuable mineral resources or large plantations. Such a country is Thailand.

The traditional Thai economy is based upon the production of rice for export, with teak, tin and rubber the other traditionally most important primary products. Table 1.1 shows the area under the principal crops in Thailand in 1969 and the percentage change in area since 1959. It shows a steady expansion in the area under rice, but more noticeable

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(1) The case for agriculture is argued by Balogh and Johnston and Mellor.
Balogh, T., The Economics of Poverty, Weidenfeld and Nicholson, 1966.
Johnston, B.F. and Mellor, J.W., "Agriculture in Economic Development", AER, 51, No.4, 1961.
The opposing case is argued by Livingstone and Ewing.
Livingstone, I., "Agriculture versus Industry in Economic Development", J. mod. Afr. Stud., Vol.6, No.3, 1968.
Ewing, F.A., "Industrialization and the U.N. Economic Commission for Africa", J. mod. Afr. Stud., Vol.2, No.3, 1964.
Nath succintly states the theory of "balanced growth".
Nath, S.K., "The Theory of Balanced Growth", OEP, Vol.14, 1962.

(2) Rostow, W.W., The Stages of Economic Growth: a non-Communist Manifesto, Cambridge Univ. Press, 1960.

Table 1.1 — Area under principal crops in Thailand (000 hectares)

Crop	% increase 1959-'69	1959	'60	'61	'62	'63	'64	'65	'66	'67	'68	'69
Rice	26%	5,363	5,643	5,656	6,191	6,354	5,971	5,960	6,949	5,601	6,259	7,000
Maize	246%	199	285	298	321	388	541	562	590	674	707	690
Sugar cane	23%	148	158	124	102	149	162	141	125	150	182	-
Soya beans	186%	21	22	23	27	32	34	18	66	57	57	60
Mung beans	335%	46	52	37	50	101	101	121	134	133	200	-
Groundnuts	14%	98	116	83	85	82	87	95	154	101	101	112
Cotton	27%	48	55	33	58	70	66	72	79	88	81	61
Kenaf	636%	44	139	190	112	152	215	373	498	343	112	324
Castor beans	35%	28	32	37	46	45	39	36	43	48	38	-
Sesame	57%	21	21	14	17	17	16	25	25	23	33	-
Tobacco	36%	61	58	41	41	40	51	70	83	62	83	83
Watermelons	400%	10	20	17	18	25	25	27	39	38	50	-
Cassava	117%	62	72	99	123	140	105	101	129	124	135	135
Kapok	-6%	54	58	38	37	53	54	56	53	51	-	-

(Source: Statistical Yearbook for Asia and the Far East, 1970).

is the considerable increase in the area planted to maize, soyabeans, mung beans and kenaf, which are categorized as "field crops" or "upland crops".(1) Less significant in area but important is the rate of increase of the area under cassava and watermelons. Table 1.2 shows the production of principal crops and the percentage change in production since 1959.

Even though Thailand has had a growth rate of 7.5% for the last two decades, which is the highest in south-east Asia and has the largest monetary reserves of any non-industrial country, viz. approximately 1,000,000,000 U.S. dollars in 1968,(2) its economy remains bound to the production and export of a relatively few primary products, as Table 1.3 shows.

Of particular importance is the growing importance of maize in this list. From 1961 to 1970 the total value of rice as an export decreased by 30%, the total value of rubber and teak as exports increased by 5% and 19% respectively, whilst tin increased by 162% and maize by 210%.

The principal market for Thai produce is three-fold. On the one hand, the rice, poultry, meat and processed foodstuffs find a steady

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(1) Traditional agricultural land-use in Thailand is divided into three categories, viz. paddy (na), upland (rai) and garden (suan). Paddy is by definition used for wet rice cultivation (there is some dry or "upland" rice grown in Thailand). "Upland" is defined as land unsuitable for wet rice cultivation either because it is too high or too steep, although the actual degree of elevation or relief involved may be very slight, i.e. just sufficient to prevent the land being naturally inundated during the wet season. The crops grown on the upland are referred to as "upland crops" or "field crops". The suan is the area surrounding the village in which the individual farmers have a few fruit trees and grow vegetables. However, the term suan is also used for a "plantation" - the context, however, makes the meaning clear.

(2) Press Release No.27, Permanent Mission of Thailand to UN, New York, January 23rd, 1968.

Table 1.2 — Production of Principal Crops in Thailand (000 metric tons)

% increase 1959–'69	Crop	1959	'60	'61	'62	'63	'64	'65	'66	'67	'68	'69
98	Rice	6,770	7,834	8,177	9,279	10,029	9,559	9,199	11,975	9,595	10,772	13,410
39	Maize	317	544	598	665	858	935	1,021	1,122	1,242	1,466	1,565
-2	Sugar cane	4,988	5,382	3,984	3,154	4,733	5,074	4,480	3,829	4,526	4,846	-
160	Soya beans	23	26	24	30	33	31	19	58	51	51	60
300	Mung beans	46	60	41	54	116	110	125	132	122	184	-
61	Groundnuts	124	152	108	112	113	120	131	217	128	149	200
81	Cotton	37	45	38	41	49	49	60	89	80	88	67
540	Kenaf	50	181	239	134	212	303	529	661	421	140	320
26	Castor beans	34	43	33	44	53	39	32	42	38	43	-
35	Sesame	17	19	12	16	16	13	18	18	23	23	-
25	Tobacco	67	74	48	48	47	63	76	88	70	84	-
32	Watermelons	30	121	117	118	186	171	195	276	244	<u>450</u>	89
84	Cassava	1,083	1,222	1,726	2,077	2,111	1,557	1,443	1,892	1,774	2,000	-
-9	Kapok	382	407	232	186	284	309	310	273	346	-	-

(Source: Statistical Yearbook of Thailand).

Underlined figures are provisional, preliminary or unofficial.

Table 1.3 Total Value of principal exports 1970

Commodity	Export Value (Baht)	Percentage of total value of exports
Rice	2,516,605,273	17%
Rubber	2,249,678,049	15%
Maize	1,856,912,283	13%
Tin	1,618,522,822	11%
Teak	202,209,731	1%
Total exports	14,772,444,225	

(Source: Foreign Trade Statistics of Thailand, December 1970. Department of Customs, Bangkok.

market in Asia, particularly in the increasingly prosperous economies of Malaysia, Singapore, Hong Kong and Japan. Maize largely finds a Japanese market at present. Secondly, the primary products of Thailand, including kenaf and cassava, find an uncertain market in the European Economic Community. Thirdly, there is the U.S.A., which, although it cannot be categorized with respect to any particular commodity, is a vital importer of Thai produce. Table 1.4 lists the principal importers in 1970.

As far as new field crops are concerned, maize is the most significant with a total export of 1,371,474 m. tons in 1970, 47% of which went to Japan and 32% to Taiwan. Also important, however, is kenaf with a total export of 253,905,693 kg. and a total value of 708,856,641 Baht, the principal importers being Japan (27%), Belgium (8%), France (6%), West Germany (2%), Italy (4%) and Spain (5%). Cassava totalled 1,176,074,128 kg. and a total value of 1,009,762,434 Baht. The principal component of this is cassava flour, although cassava meal and cassava pellets are also imported. Canada takes 52% of this flour, Laos 36% and Hong Kong 3%. Groundnuts and groundnut cakes exports totalled 11,292,066 kg. and 10,716,109 Baht, Hong Kong taking 39%, Malaysia 15% and Singapore 15% of the total. Soyabeans and soyabean cake totalled 6,762,624 kg. with a value of 12,279,821 Baht. The principal importers were Malaysia (60%) and Singapore (26%). Kapok is dwindling in importance as an export but totalled 11,286,612 kg. with a value of 17,677,250 Baht, almost all of which went to Japan.(1)

These then are the principal non-rice crops which are diversifying the traditional rice economy of Thailand. With the

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(1) Foreign Trade Statistics of Thailand, Dept. of Customs, Bangkok, Dec. 1970.

Table 1.4 Principal Importers of Thai Products 1970

Country	f.o.b. value (Baht)	% of total value
Japan	3,770,374,507	26
U.S.A.	1,985,526,305	13
Netherlands	1,276,355,447	9
Hong Kong	1,112,808,480	7
Singapore	1,018,078,553	7
Malaysia	768,173,348	5
Taiwan	719,539,123	5
Federal Republic of Germany	533,289,805	4
Indonesia	341,647,482	2
Saudi Arabia	322,453,062	2

(Source: Foreign Trade Statistics of Thailand, December 1970, Department of Customs, Bangkok).

exception of kenaf and cassava they are largely dependent upon a very restricted Far Eastern market, in particular upon the demand in Taiwan, Japan, Hong Kong, Singapore and Malaysia.

Of the other products of the traditional agriculture of Thailand glutinous rice (which is the staple of the north and north-east of Thailand, as of Laos) is an insignificant export, totalling 87,530 m. tons with a value of 169,984,509 Baht in 1970. This was 6.8% of total rice exports and only 1% of total exports. There is a market for this product as a staple food in Laos and as a base for sweets and ricecakes in the rest of the Far East, but clearly this is a limited and not promising market.(1)

The export of livestock and livestock products is one which is at present relatively small, but could increase in importance. The total export of water buffaloes was 35,299 head in 1970, which earned 73,425,287 Baht. The major importers were Hong Kong, Malaysia and Singapore. Swine totalled 15,533 head and earned 10,774,304 Baht, Hong Kong and Laos being the main importers. Live poultry, exported to Hong Kong, Malaysia, Singapore, Indonesia and Japan, totalled 4,535,301 head, earning 838,388 Baht. Fresh, chilled or frozen poultry went mainly to Japan, totalling 1,256 kg. and earning 70,536 Baht.(2) The prospects for expansion in the export of live animals would seem to be fairly limited, but there might be prospects for beef, poultry and poultry products.

The basis of the Thai export economy has remained remarkably uniform for over a century, although at present it is more diverse than at any previous time. Table 1.5 shows the importance of exports of Siam

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(1) Foreign Trade Statistics of Thailand, Dept. of Customs, Bangkok, Dec.1970.
(2) ibid.

Table 1.5 Siam's Exports c.1850

Commodity	Value (Baht)
Raw cotton	450,000
Dried meat	120,000
Rice	150,000
Pepper	99,000
Tobacco	100,000
Sugar	708,000
Total	4,331,000

(Source: Malloch, D.E., Siam, Some General Remarks on its Productions, Calcutta, 1852).

in 1850. Of particular interest is the relatively great importance of sugar and raw cotton at that time. In fact contemporary observers foresaw the Siamese economy becoming increasingly dependent upon sugar cane. However, both cotton and sugar cane have waned, although in recent years there has been some new expansion in both.

Although at an early date rice was being exported from Siam as a royal monopoly, it was the Bowring Treaty of 1855 which first opened the country up to international trade and provided a stimulus to rice production. From 1857-1859 to 1900-1904 the export of rice rose from 990,000 piculs per year to 11,130,000 piculs per year and then to 26,290,000 piculs per year in 1951. (1 picul = 60 kg.)[(1)]

The significance of this historical analogy is that it shows that at some time in the past a major transformation took place in Thai agriculture. A rapid increase in the area under and the production of rice took place to meet the export demands of a money economy. Although the government of the day gave encouragement and assistance to this activity, most of the initiative came from the farming class and the enterprise was wholly Thai rather than Chinese or Western.

At present the Thai economic base is undergoing a further change in which the contribution of agriculture is becoming relatively less important. In the period from 1960 to 1965 the annual growth rate of primary commodity exports was 8.1%, whilst the rate for manufactured and semi-manufactured exports was 11%. However, if these manufactures are analyzed, it is apparent that many of them consist of the processing of local raw materials for a large number of export industries, especially for tin, tapioca, flour and timber. Secondly, there is the export of

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(1) Ingram, J.C., Economic Change in Thailand 1850-1970, Stanford Univ. Press, 1971.

products developed in connection with import substitution, particularly Portland cement and petroleum products.(1) Thus apart from this second category of import substitution products the industrial base in Thailand remains bound to the agricultural economy and cannot develop without the prior development of the agricultural sector.

The question then arises as to why Thailand is still under-developed. Jacobs stresses the institutional reasons: the fairly tightly-closed prebendary hierarchical system and the traditional attitude of the ruling élite to the concept of development, viz. that the countryside existed to provide an agricultural surplus to support the city and state, which, in turn, ruled paternally, sending aid in the form of food, if there were floods, droughts, or crop failures in the countryside, but essentially desirous of maintaining the status quo.(2) Niehoff, however, exonerates religion as a bar to development.(3)

Hoselitz, on the other hand, draws the distinction between "autonomous" and "induced" growth, referring to the nature and degree of government intervention in the growth process.(4) Thus the response to rice production in Thailand following the Bowring Treaty indicates a case of autonomous growth. The Thai farmer has shown himself able to respond to economic incentives, as many anthropological studies testify, notwithstanding the fact that he has many non-economic priorities as well.

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(1) Foreign Trade Statistics of Thailand, op.cit.

(2) Jacobs, N., Modernization without Development: Thailand as an Asian Case Study, Praeger Special Studies in International Economics and Development, 1971.
The Thai traditionally speak of political élites literally "eating the country" (kin mu'ang).

(3) Niehoff, A., "Therevada Buddhism - a Vehicle for Technical Change", Hum. Org., Vol. 23, No.2, Summer 1964.

(4) Hoselitz, B.F., Sociological Aspects of Economic Growth, Free Press of Glencoe, 1962.

Muscat proposes a chiefly historical explanation for Thailand's lack of development.(1) The Chinese, as Bowring had observed, had dominated internal trade as early as 1850. Rice and tin had generated a sizable surplus above the adequate subsistence income prevailing at the start of the period, but the investment potential was not realized. The government played a fairly passive rôle and foreign capital was not prepared to invest in manufacturing. Ingram, on the other hand, thinks that the fault lay with the British advisers at the Siamese court and the British government's policies towards Siam.(2)

Certainly, the lack of a colonial experience cannot be suggested as a reason for Thailand's underdevelopment, since countries of south-east Asia that have had such an experience by no means have more favourable economies at present, albeit they have in general populations more politically aware.

Whatever the reason for Thailand's underdevelopment may be, it is clear that compared with many other Third World countries it is in a favourable economic position. Table 1.6 shows that on the basis of per caput income Thailand compares favourably with most developing countries. It is the recipient of considerable aid, it has a principal economic product which is at the same time the food staple of the population (thus fluctuations in the export market for this product cannot cause excessive hardship in the rural population through food shortage), it has the opportunity to establish a wide array of manufacturing industries based upon its primary products and it has a valuable source of income in, on the one hand, the American military presence and the other the increasing

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(1) Muscat, R.J., Development Strategy in Thailand: a Case Study of Economic Growth, Praeger Special Studies in International Economics and Development, 1966.

(2) Ingram, J.C., op.cit.

Table 1.6 Comparative Gross Domestic Products (in £ sterling)

Thailand	£70 (1)	Canada	£1,651
India	£38 (1)	U.S.A.	£1,932
Sri Lanka	£66 (1)	Sweden	£1,812
S. Korea	£82	U.K.	£887
N. Korea	£123 (2)	West Germany	£1,467
Japan	£934	Poland	£427
Taiwan	£161	U.S.S.R.	£596
Burma	£31 (2)	Australia	£1,172
Laos	£46 (2)	New Zealand	£954
Khmer Rep.	£54 (2)	Eire	£539
S. Vietnam	£59 (1)	Haiti	£29
N. Vietnam	£40 (2)	Chad	£23
Hong Kong	£385 (1)	Somalia	£26 (2)
Philippines	£64	Burundi	£22 (2)
Malaysia	£161		
Singapore	£404		
Indonesia	£26		

(1) estimate (2) tentative estimate

(Source: The Times, Monday September 25th 1972 (London).

tourist traffic.

Compared with its neighbours it has enjoyed peace and stability. This stability is, however, somewhat superficial, since Thailand suffers from insurgency on all its borders. Similarly, although the nation is comparatively ethnically homogeneous, a wide variety of ethnic minorities, albeit numerically small, pose threats to either national or regional stability and progress.(1)

It appears, therefore, that Thailand's future development will have to be induced rather than autonomous: it depends equally upon the prevailing political scene in south-east Asia and American commitments in this area, as upon the decisions and priorities of the ruling élite within Thailand.

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(1) O'Reilly, F.D., Problems of Ethnic Minorities: the Case of Thailand, SOAS Geog. Dept. Post-Graduate Seminar, 1973, unpublished.

II. North-east Thailand: a Disadvantaged Region

Although Keyes maintains that "probably history rather than geography should be the focus of attention in studying the backwardness of the north-east",[1] the geographical problems are very real, including remoteness and transport difficulties in the past and edaphic and climatic characteristics which combine to give a physical base, which though not totally adverse, is not suited to its present utilization.

North-east Thailand comprises 170,026 sq.km. (65,707 sq.ml.) of the total land area of the Kingdom and in 1970 had a population of 12,023,000 out of a total of 34,152,000 persons for the whole Kingdom. It is bounded on the north and east by the Mekong River, on the south by the Phanom Dongrek escarpment and on the west by the Phetchabun mountain range.

The north-east essentially consists of the Khorat plateau, a shallow basin, acquiring its flatness through erosion. On the western, southern and eastern margins of the plateau relatively well-cemented sandstone crops out as flat-topped mountains or dissected old peneplain surfaces from 500 m. to 1,000 m. above sea-level. This ridge-forming sandstone dips gently at an angle of 3^{o} to 10^{o} towards and under the centre of the plateau, which contains a monotonous plain, 150 m. in elevation, broken by hills and monadnocks, cuestas and swamps. Immediately north-east of the centre is the Phu Phan range, a series of folded mountains at 700 m. to 1,000 m. in elevation. The other features are two flanking shallow depressions or structural basins, the Khorat Basin and the Sakon Nakhon Basin, and the Chum Phae lowland, a flat, broad valley formed through the degradation of a once broad folded region about 180 m. above sea-level.

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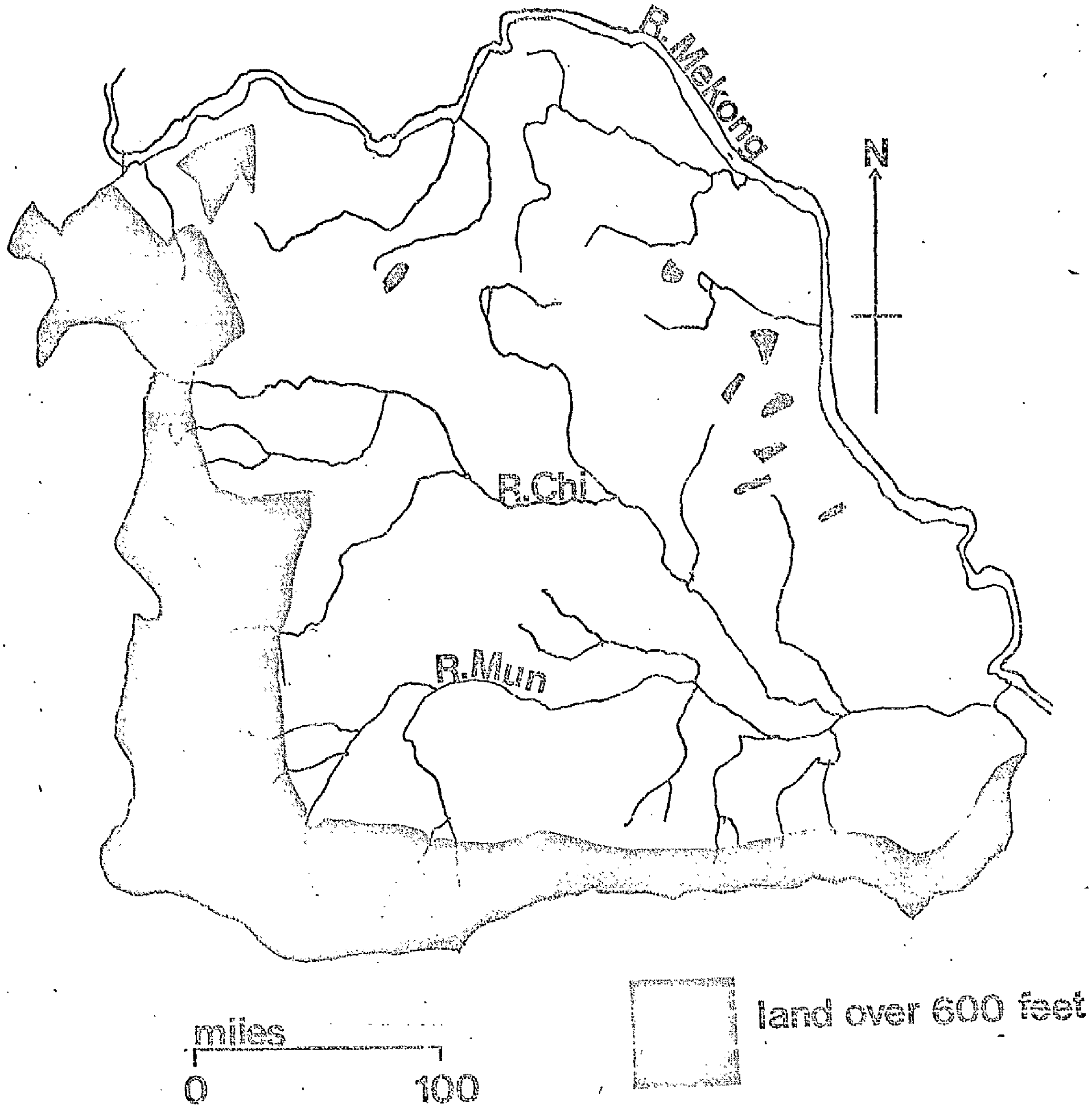
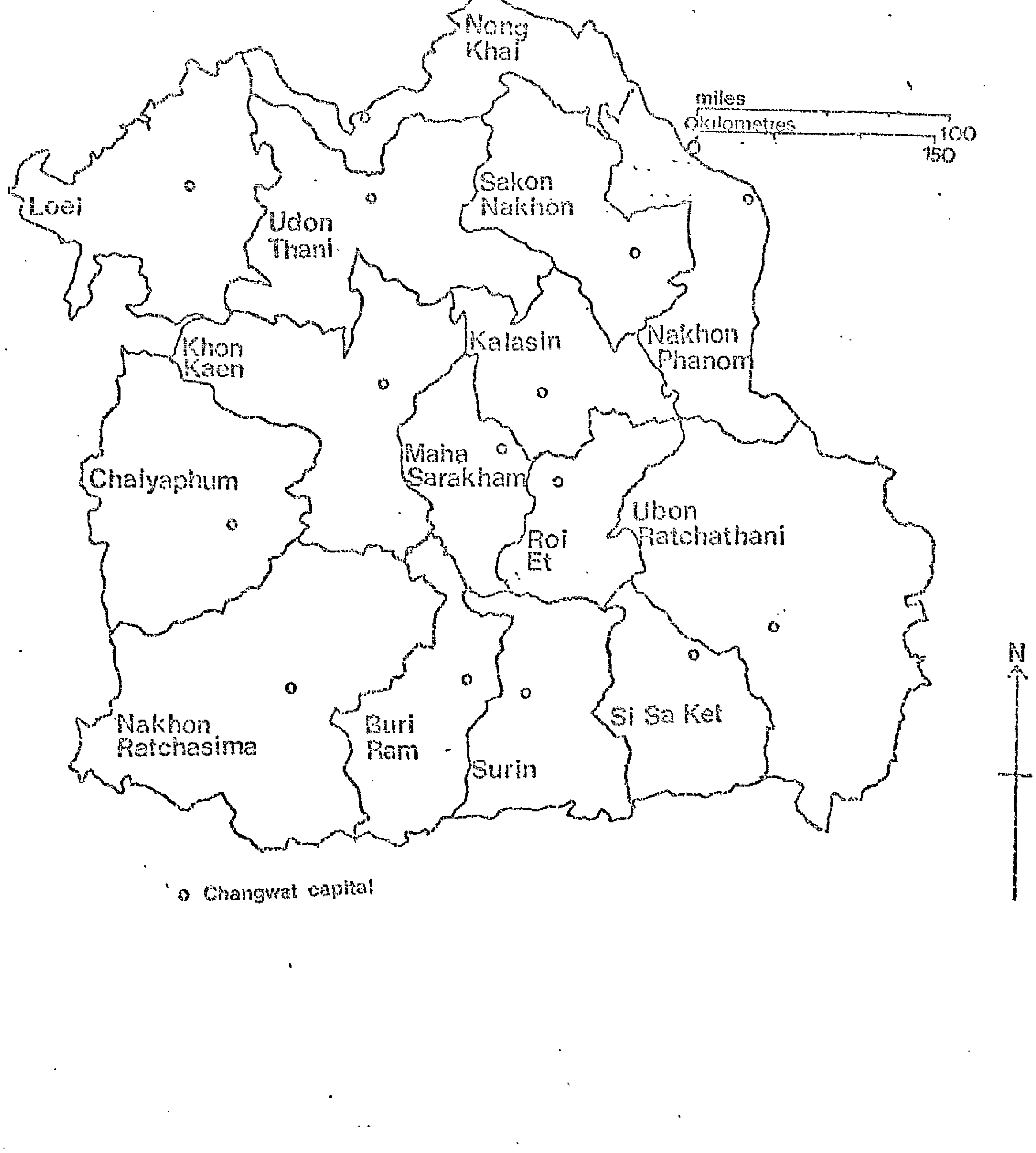
(1) Keyes, C.F., Isan in a Thai State, Cornell, 1965.

Map 1.2 NE Thailand Physical



Map 1.3 Political divisions of north-east Thailand



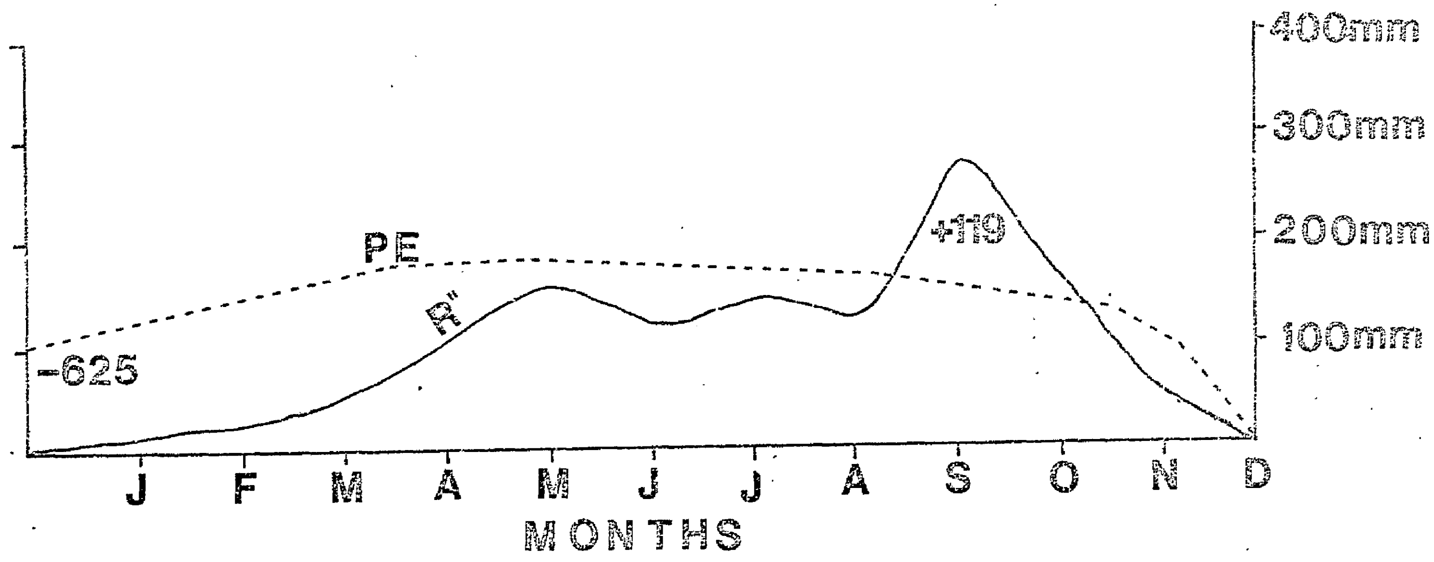
The Khorat Basin is drained by the Mun River system, of which the Chi River is the principal tributary. The plateau is mostly made up of Mesozoic sedimentary rocks known as the Khorat group with the exception of a few places where Tertiary volcanic rocks are present. Rock exposures are generally rare.

The north-east is characterized by three seasons, viz. a rainy season from mid-May or early June to early October, dependent upon the south-west monsoon; a cold season from mid-October to mid-February, dependent upon the north-east monsoon; a hot season from mid-February to mid-May, which is a transitional period from the north-east to south-west monsoon. The average annual rainfall declines from 2,000 mm. in the north-east of the region at Nakhon Phanom to 1,200 mm. in the south-west at Nakhon Ratchasima. Fig. 1.1 shows the annual precipitation and potential evapo-transpiration for Nakhon Ratchasima. Although the rainfall totals are actually higher than in the Central Plain of Thailand, they may be both more concentrated and more variable. During the rainy season many areas are flooded, owing to the low gradient of the rivers. After the rainfall stops and the floodwaters are drained away, most of the areas, which are largely overlain by sandy soils, tend to dry up and the rivers or streams may cease flowing. During the dry months the major rivers are shallow and sluggish.

Apart from hill forest and a small area of savanna, the deciduous dipterocarp forest is the characteristic vegetation of north-east Thailand. This forest type covers about 45% of the total forest area of the whole Kingdom. Ogawa et al. consider it to be a xeric phase brought about or maintained by ground fire in the dry season,(1)

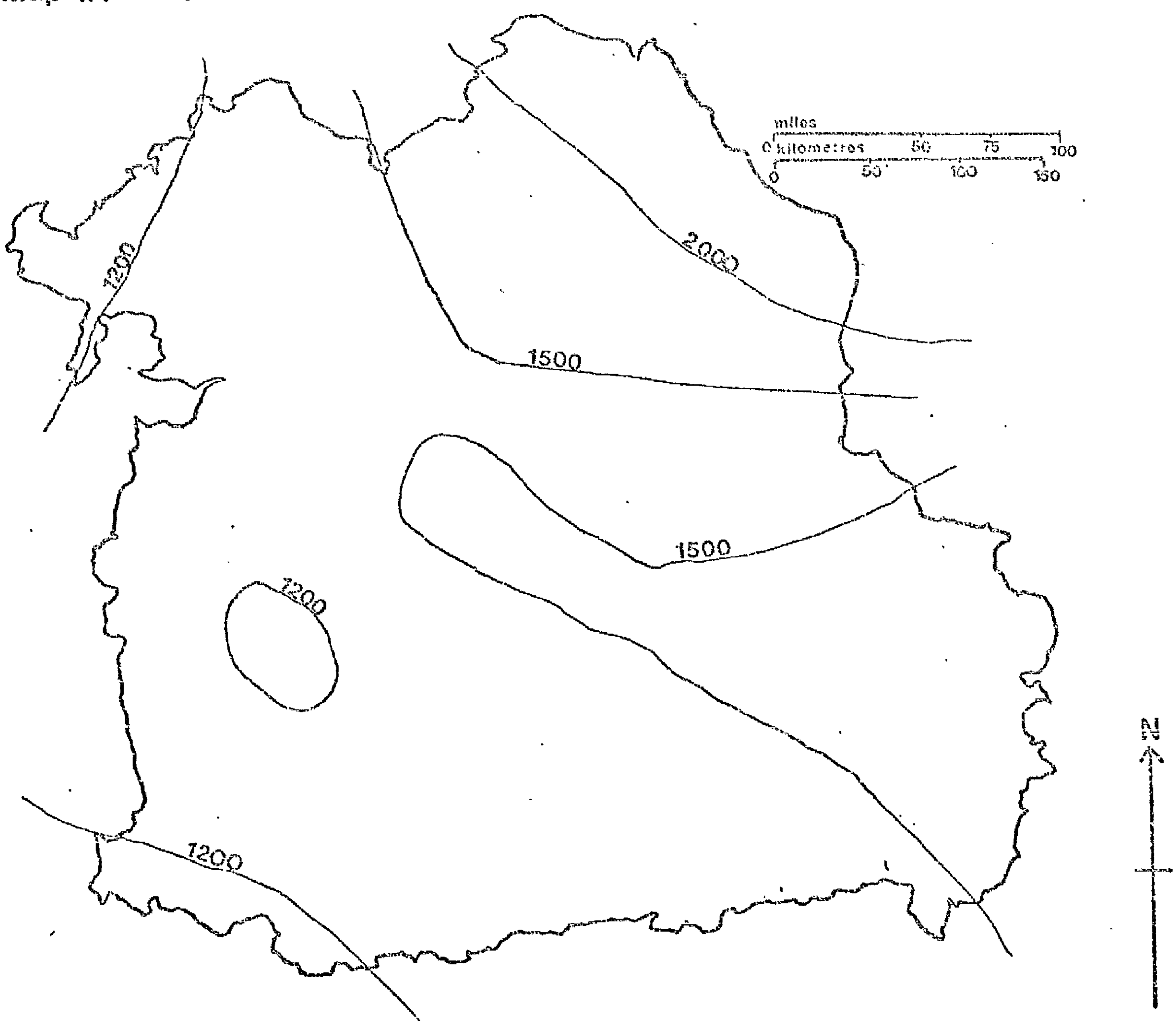
(1) Ogawa, H., Yoda, K. and Kira, T., A Preliminary Survey of the Vegetation of Thailand, Nature and Life in south-east Asia, Vol.1, ed. Kira and Umesao, Fauna and Flora Research Society, Kyoto, Japan, 1961.

Figure 1.1
Annual precipitation and potential evapo-transpiration for changwat Nakhon Ratchasima



PE = POTENTIAL EVAPO-TRANSPIRATION
R" = RAINFALL
Source: Ogawa, Yoda & Kira, "A Preliminary Survey of the Vegetation of Thailand".

Map 1.4 Annual Rainfall of north-east Thailand (mm)



Source: Ogawa, Yoda & Kira. "A Preliminary Survey of the Vegetation of Thailand" whilst Eyre considers it to be an edaphic climax, found on soils where an impediment to root development such as an iron pan is present.[(1)] The floristic compsotion is more or less mixed but simple. It comprises Dipterocarpus intricatus (mai tabaeng), Dipterocarpus tuberculatus (mai phlong), Pentacme siamensis (mai rang), Shorea obtusa (mai teng rang) and Xylia xylocarpa (mai daeng). Although the timber finds a ready use throughout the north-east for construction or fuel, it is not of great commercial value. In fact the forest is particularly resistant to felling and vigorously regenerates itself by means of sprouts from stumps. The north-east landscape is thus dotted with residual trees, which, whilst hampering efficiency, aid in conservation of soil resources.

The available cultivable land in the north-east is as yet by no means fully utilized and most villages have a reserve of forest land, which may be cleared and brought under cultivation as economic incentives dictate (the government is anxious to prevent the depletion of its forest reserves, however). In addition, there is in the north-east "pioneer land", as yet unsettled and uncultivated. Table 1.7 gives an impression of conditions.

The north-east has always been somewhat apart from the rest of the Kingdom and has perforce been fairly self-sufficient, both regionally and locally. Indeed, until the building of the railway, which was opened to Nakhon Ratchasima in 1901, extended to Ubon Ratchathani in 1926 and further extended by branch line to Khon Kaen and Udon Thani in 1955 and the construction of the Friendship Highway with American aid in 1957, the north-east was completely cut off from the

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(1) Eyre, S.R., Vegetation and Soils: a World Picture, E. Arnold, London, 1968.

Table 1.7 Land Classification within Thailand

Type of land	north-east	north	south	centre	total
Farm land	21.2%	7.9%	29.8%	30.0%	23.2%
Forest and grazing land	39.9%	75.2%	53.3%	50.0%	51.5%
Swamps and lakes	0.4%	-	1.4%	0.2%	0.4%
Unclassified	38.5%	27.9%	15.5%	19.7%	24.9%
Percentage	100.0%	100.0%	100.0%	100.0%	100.0%

(Source: Johnson, V.W., Agricultural Development of Thailand with Special Reference to Rural Institutions, Div. of Land Policy, Dept. of Land Devp., Bangkok, 1969).

centre and some parts of the north-east found their market in Saigon rather than in Bangkok. Within the region periodic markets did not exist and daily markets are of recent origin, e.g. the one at Maha Sarakham was founded in 1912. For much of the region commercial contacts were limited to itinerant merchants.

Their physical separation served to re-inforce their sense of ethnic difference. The north-easterner is ethnically and linguistically distinct from the Siamese proper of the Central Plain; he is in fact akin to the Lao. In fact, the north-east of Thailand was not under the suzerainty of the Siamese monarch until 1828 when the Siamese suppressed a revolt of the Lao vassal state of Vientiane and Čampasak. At the present time the north-easterner usually refers to himself and is referred to by others as "Lao" as well as Isan (literally "north-eastern").

The feeling of distinctness is exacerbated by the fact that the north-east is relatively economically underprivileged and, moreover, conscious of the better conditions prevailing both in the city and in the rural areas of the Central Plain. Although Keyes maintains that the Isan or, as he dubs them, "Thai-Lao" identify with Thailand and do not wish to secede or join their kinsmen in Laos in political union,(1) nevertheless the north-eastern region is a politically insecure region. Both the local north-eastern insurgency and the civil war in Laos have made the region of immense strategic value.

Historically, despite its problems, the north-east did contribute to the export of rice following the Bowring Treaty of 1855 and in 1897 Warington Smyth estimated that the total value of the external trade of the Khorat plateau was £120,000.(2) Zimmerman in

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(1) Keyes, C.F., op.cit.

(2) Warington Smyth, H., Five Years in Siam, 1893.

1930 emphasized the essentially subsistence nature of the economy of the region in his study of eight villages, as Table 1.8 indicates.(1) Glutinous rice was then as now the main crop, but some diversification was apparent, although the crop-complex was slightly different from the present one, as Table 1.9 illustrates.

Zimmerman reported at a time when contact was little and trade between Nakhon Ratchasima and provincial towns confined to the dry season. His solution to the north-east's problems was that cotton and tobacco should be grown on the upland in June or early August and that "perhaps the people could learn to eat wheat".

Since that time the economy of the region has become more diversified, as Table 1.10 illustrates. Of particular interest is the increasing importance of maize, kenaf and groundnuts as cash crops. At the same time the north-east has continued to be an important area for the production of cattle and water buffaloes to supply the farms of the Central Plain and these together with chickens are proportionately more important in the north-east than elsewhere, as Table 1.11 demonstrates.

The contribution of the north-east's major products to the total national production of that product are as follow: kenaf 96%, kapok 49%, cattle 47%, water buffaloes 45%, water melons 39%, pigs 38%, rice 33%. Despite this, however, the region remains essentially more subsistent than other regions. The NSO Household Expenditure Survey assessed the north-east as 40% subsistent, compared with 29% in the northern region, 19% in the south and 17% in the Central Plain.(2)

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(1) Zimmerman, C.C., Siam: Rural Economic Survey, 1930-'31, Bangkok Times Press, Bangkok 1931.

(2) Household Expenditure Survey, NSO, 1963.

Table 1.8 Mean Rice Production per family in tang: 1930-31.

Rice produced	Rice kept on farm	Rice sold	% kept	% sold
129.12	101.1	25.62	78.23%	19.84%

1 tang = 20 litres or 4.4 gallons.

(Source: Zimmerman, op.cit.).

Table 1.9 Cash returns and percentages from sales of crops for north-east per family

	Rice	Maize	Tobacco	Areca nut	Other crops	Total
Baht	10.38	0.52	1.38	0.27	4.71	17.26
%	60.14	3.01	8.0	1.56	27.29	100.0

(Source: Zimmerman, op.cit.)

Table 1.10 Gross Regional Production Originating from selected crops 1960-'69 (at current market prices)

	1960	1962	1964	1966	1968	1969
Paddy	2,091.9	3,230.8	2,422.9	5,201.1	4,792.3	4,537.2
Sugar cane	75.3	56.4	90.9	58.9	82.6	93.2
Maize and sorghum	117.1	48.3	53.2	112.4	117.0	216.4
Groundnut	128.2	56.8	75.5	73.3	68.6	75.0
Mung bean	13.9	11.1	6.7	6.8	9.3	9.7
Castor bean	28.4	21.3	27.3	19.5	16.4	15.8
Soya bean	1.8	1.1	0.7	1.9	0.8	0.9
Cassava	10.9	13.8	26.6	27.6	35.2	35.4
Tobacco	163.5	72.5	90.1	121.3	118.9	137.6
Cotton	91.6	42.0	55.1	52.6	96.5	124.8
Kenaf, jute and ramie	460.2	266.3	563.8	1,073.1	436.9	588.5
Sesame	29.1	8.9	10.8	14.2	7.6	7.7
Kapok	67.0	52.0	95.3	61.9	52.1	56.0

(Source: Statistical Yearbook of Thailand, 1967-'69)

Table 1.11 Number of livestock and poultry by regions

	Cattle	Water buffaloes	Swine	Ducks	Chickens
north-east	2,444,264	3,495,783	895,109	2,816,424	11,855,644
Centre	952,272	1,271,786	1,406,461	4,745,936	7,669,925
north	1,115,004	1,693,738	891,893	1,427,475	9,516,693
south	661,121	599,561	949,605	1,497,937	5,998,894
Whole Kingdom	5,172,661	7,060,868	4,143,068	10,487,772	35,101,158

(Source: Statistical Yearbook of Thailand, 1967-'69)

Moreover, although area and production of rice have increased, the average annual yield has declined since the early part of the century, as Table 1.12 shows. Although there has been some improvement since the nadir of the post-War years, yields in 1968 were still lower than in 1920. For rice as for all other crops, including kenaf, the north-east has a lower average yield than that of the whole Kingdom.

Traditionally, the north-eastern agriculture has been less capital-intensive than that of the Central Plain, although not necessarily less so than that of the other regions, as Table 1.13 demonstrates.

This lower investment is reflected in the lower cash returns the north-easterner obtains per rai compared with the mean for the whole Kingdom, as Table 1.14 illustrates, although this gap is narrowing and in the case of cotton the north-eastern farmer achieves a higher than average return.

Accordingly, income per head is lower in the north-east than in any other region. This low figure is, however, produced by the low rural incomes, since in the towns of the north-east income is a little higher than the national average for all towns in the Kingdom.(1) However, in 1960 only 1/12 of the population of the north-east was urban, as against 1/5 to 1/6 in other regions and of the 70,000 people living in towns at that time 1/5 were in the five larger towns.(2) The region also has the largest net loss of population.(3)

In most aspects, therefore, the north-east of Thailand is an underprivileged area and its Gross Regional Product growth rate lags behind the Gross Development Product of the Kingdom as a whole, as Table 1.15 demonstrates.(4)

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(1) Household Expenditure Survey, op.cit.

(2) Silcock, T.H., The Economic Development of Thai Agriculture, Cornell Univ. Press, 1970.

(3) Population Census 1960, Central Statistics Office, NEDB, Bangkok.

(4) Large annual variations, due to climatic conditions, produce large statistical variations. As far as the north-east is concerned, analysis has suggested that the growth rate of paddy production follows closely the population growth rate and this figure has been used by NEDB despite year to year variations.

Table 1.12 Production Yields (kg./rai) for principal crops in the Whole Kingdom and north-east for selected years

	Paddy		Maize		Groundnuts	
	W.K.	N.E.	W.K.	N.E.	W.K.	N.E.
1920		258				
1931-'34		193				
1940-'44		152				
1948-'50		148				
1960	256.9	191	304.7	304.7	206.5	197.2
1964	283.8	211	276.3	250.9	219.6	226.1
1968	274.9	231	274.7	251.1	223.8	199.1

	Tobacco		Cotton		Kenaf	
	W.K.	N.E.	W.K.	N.E.	W.K.	N.E.
1960	201.8	158.8	131.1	116.1	206.7	200.9
1964	196.3	140.7	117.3	127.9	221.9	222.1
1968	187.4	143.9	169.7	166.8	199.5	188.7

W.K. = Whole Kingdom
N.E. = North-east.

(Source: 1920-'50 : Statistical Yearbook of Thailand, 1948-'50.
1960-'68 : National Accounts Division).

Table 1.13 Expenses of farm operation by region (Baht)

	north-east	Centre	south	north
Seeds and plants	14,607	116,109	24,331	29,399
Animals for breeding	151,989	155,130	41,963	84,532
Fertilizer	14,625	217,474	25,535	22,451
Hired labour	267,140	863,101	187,572	265,140
Tractor and Animal hire	68,165	198,804	27,533	60,638

(Source: NSO Household Expenditure Survey, 1963).

Table 1.14 Baht returns per rai for selected crops - Whole Kingdom and north-east 1960-'68 (selected years)

	1960		1964		1968	
	W.K.	N.E.	W.K.	N.E.	W.K.	N.E.
	Baht		Baht		Baht	
Paddy	231.4	167.7	282.1	205.9	236.1	193.3
Sugar cane	484.7	313.9	436.4	308.8	427.4	286.3
Maize	201.7	217.0	179.3	178.0	181.7	163.0
Groundnuts	425.0	438.7	453.3	497.9	505.7	439.0
Tobacco	1,919.7	1,157.0	1,837.4	1,034.5	1,757.6	1,067.9
Cotton	367.8	322.9	328.6	366.1	478.4	480.6
Kenaf	475.2	464.0	510.8	511.0	458.2	420.0

W.K. = Whole Kingdom
N.E. = North-east.

(Source: National Accounts Division, NEDB)

Table 1.15 Historical Growth Rates G.R.P. and G.D.P. at constant 1962 prices North-east Thailand and Whole Kingdom

	North-east (1960-'69)	Whole Kingdom (1960-'69)
Agriculture	3.4	5.0
Paddy	3.4	2.9
Other crops	1.0	5.4
Livestock	3.9	3.0
Fisheries	8.7	19.0
Forestry	4.6	5.1
Mining and Quarrying	42.6	14.7
Manufacturing	6.7	11.0
Construction	19.1	13.5
Electricity and water supply	36.5	21.0
Transportation and Communication	10.7	5.9
Wholesale and Retail trade	8.8	10.5
Banking, insurance and real estate	23.0	16.0
Ownership of dwellings	2.6	3.8
Public admin. and defence	6.7	7.0
Service	10.4	9.3
Population	3.1	3.3
GRP(N.E.) GDP(W.K.)	6.8	8.1
GDP per caput	3.7	4.8

(Source: National Accounts Division, NEDB. Computed on the basis of compound rates using 1960-'62 and 1966-'69 averages).

III. The Theoretical Background

The study of the process of innovation in subsistence agriculture in north-east Thailand involves two theoretical frameworks. On the one hand, since development needs to be induced, and it seems likely that the government is the only feasible inducer, it involves a study of the theory of development and the relative emphasis that should be placed upon different aspects of development. On the other hand, since once projects or policies are put into effect or once opportunities become available, the response of the individual farmer is crucial, it involves the theoretical framework surrounding the origin, diffusion, adoption and rejection of innovations.

i. Rural Development Theory

Rural development is defined by Lewis as "that process of economic and social development activities peculiar to the process of transforming the traditional sector as a whole".(1) Kulp sees this development passing through a sequence of four stages, viz. traditional subsistence agriculture, institution-building development (Malaysia illustrates this stage), institution-based development (exemplified by Taiwan) and capital-intensive development (exemplified by Japan and the industrial nations of the West). In Kulp's fourth stage there is "rural take-off" and development acquires self-sustaining momentum. He thinks that development without modern institutions is impossible, citing cases where farmers have adopted coffee, cocoa and cash perennials, whilst staying within their traditional milieu (in West and East Africa).(2)

(1) Lewis, A., "Economic Development with Unlimited Supplies of Labour", in Agarwala, A. and Singh, S. (ed.), The Economics of Underdevelopment, Oxford Univ. Press, 1963.

(2) Kulp, E.M., Rural Development Planning: System Analysis and Working Method, Praeger Special Studies in International Economics and Development, New York, 1970.

There are various options in the way the structure for carrying out projects may be built up. There may be one agency with one service, one agency with several services, public authorities and corporations, e.g. marketing boards, private firms or farmer-controlled services. Whichever one or combination of these is chosen may determine not only the direction of development, but its pace, efficiency and success.

Similarly, at a lower level, contact with the rural people may be made by multi-purpose workers, village monitors, village volunteers or mobile cadres.

A project may be what Kulp calls an "oilspot" or a "vector" project,(1) whereby the project is started in one district and either helped or left to expand into contiguous districts. Alternatively, it may be an "even spread" project, where, for example, projects may be started in one district of each province. Yet again projects may be concentrated in areas with the greatest production and growth potential for the greatest financial pay-off or in the poorest, most needy areas. Policy might also be determined by the highest bidder or political or strategic considerations.

Then an individual project may be characterized by its simplicity or its comprehensiveness. Thailand in this instance may be contrasted with Malaysia in that Thailand launched fourteen district level associations on the basis of just one innovation, viz. the use of fertilizer, in rice cultivation, whilst Malaysia started with a thorough survey of twelve pilot communes and provided five especially trained cadres to each as temporary management.

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(1) Kulp, E.M., op.cit.

Johnston sees agricultural development facing a choice between two models of development, viz. the Mexican model and the Japanese model.(1) In the Mexican model increases in agricultural output were the result of an extremely large increase in production by a very small number of large-scale, highly commercial farm operators. The benefits of this production then may or may not spread to other operators, but if it does there will probably be a time-lag. Mexico, although it is a country with high development status, is one in which regional disparities are marked. The "Mexican model" is unsuitable for Thailand or any other south-east Asian country, because, in the first place, such large-scale farm-operators do not exist in significant numbers and even if they were to come into being this would only serve to exacerbate the already present regional inequalities and tensions.

The "Japanese Model" is rather more relevant, especially since the traditional agriculture of Japan, in the past, based on small, semi-subsistence rice plots, is comparable to present conditions in Thailand. Moreover, a good many agricultural economists or technicians in Thailand have received their training in Japan or Taiwan (where the "model" is the same).(2) For these reasons it is worthwhile to consider the Japanese model in greater detail.

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(1) Johnston, B.F., "The Japanese Model" of Agricultural Development: Its Relevance to Developing Nations, International Conference on Agriculture and Agricultural Development, Tokyo, 1967.

(2) The entry of the People's Republic of China to the UN and the consequent expulsion of Taiwan has meant that international agencies operating in Thailand can no longer send Thai personnel to Taiwan for training. Accordingly, they are being sent increasingly to Japan at considerably greater cost.
Personal communication from FAO Experimental Farm, Huey Si Thon, Kalasin.

Ohkawa sees three stages in Japanese agriculture.[1] From 1855 to 1919 was the traditional phase. From 1919 to 1954 inputs in agriculture increased, chiefly in the form of fertilizer, owing to the development of the chemical industry - in other words agricultural and industrial development in Japan were concurrent and complementary. He considers that the introduction of fertilizer was the single most important event in producing development in Japanese agriculture; seed improvement and progress in cultivation techniques were soon to follow. At the same time the central and prefectural governments were considerably facilitating the diffusion of knowledge of improved practices, personal savings and investments were increasing among country people and farmers' associations and co-operatives were becoming widespread.

In the third phase from 1954 onwards changes in the relative prices of the factors of production "induced" technological change. Only quite late did mechanization take place in Japanese agriculture and Japanese industry became a major innovator, producing small-scale machinery for the unique problems of the relatively small-scale rice farmers.

The important point is that in each phase of agricultural growth in Japan the pattern was closely associated with the pattern of non-agricultural growth. In contrast, however, in countries like Thailand the investment requirements for agricultural expansion are so large that, according to Hayami and Ruttan, a net flow of capital from the industrial sector may be required.[2] In other words, agricultural development must perforce be consequent to industrial development rather

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(1) Okhawa, K., Phases of Agricultural Development and Economic Growth, International Conference on Agriculture and Agricultural Development, Tokyo,1967.

(2) Hayami, Y. and Ruttan, V.W., Agricultural Development: an International Perspective, Baltimore and London, 1971.

than responsible for it or concurrent and complementary.

The only other country which is relevant to Thai development is Taiwan, where development was initiated under Imperial Japanese rule during the Meiji period and has proceeded along similar lines to Japanese development, although at the present the government is still closely involved in agriculture in Taiwan, which is not the case in Japan.

Thailand's neighbours in south-east Asia share broadly similar problems of underdeveloped agriculture and thus can offer no model of development. Nevertheless, experiences and results obtained in research in these countries may be relevant to Thailand.

ii. Innovation Theory

An "innovation" is defined by the Oxford English Dictionary as "the introduction of novelties, the alteration of what is established by the introduction of new elements or forms" and "a change made in the nature or fashion of anything, some thing newly introduced, a novel practice". Thus in its broadest sense an innovation may refer to thoughts and patterns of behaviour as well as to material objects. For the purpose of this thesis a re-definition was necessary. Accordingly, the writer defines "an agricultural innovation" as "a change in or modification of an existing agricultural technique or the introduction of a new technique, the introduction of new inputs in agriculture or the provision of new services for agriculture, the introduction of new enterprises within agriculture or a change in emphasis within the existing crop and animal complex". (This last proviso is important, because it is only rarely that a crop or animal is completely new in an area).

"Diffusion" is therefore "the spread of innovations between persons and between geographical areas". There is a wealth of literature concerned with the diffusion of innovations. Foremost among these is Hägerstrand's work.(1) He analyzed the spread of innovations, both agricultural and non-agricultural, in Sweden in a situation where all innovations were diffused from a single source - the port. Such work was possible in Sweden with its long history of data collecting, but hardly feasible in many developing countries. Moreover, in reality there may be several sources for a single innovation or an innovation may be deliberately transposed in many different areas. Radio and the press may make it possible for awareness of an innovation long to precede its appearance.

Rogers suggests that farmers go through a definite sequence in relation to an innovation, viz. awareness of the innovation, interest in it, evaluation of it, trial and then adoption or rejection. The spread of adoption depends upon both the characteristics of the innovation and of the individual farmer. As far as the economic attributes of the innovation are concerned, the lower the initial and operating costs and the larger the rate of return on capital, and effect upon farm income, the more rapidly will the innovation be adopted. If the innovation is technically complex, adoption will be slow. Likewise, if it is indivisible, as capital innovations are, this does not permit the farmer the possibility of controlled experiments to evaluate the worth of the innovation. Moreover, if it is to be diffused rapidly, it will have to be compatible with the farmer's existing production techniques. Finally, he considers that the prestige value of the innovation is of importance: thus in all

(1) Hägerstrand, T., The Propagation of Innovation Waves, Lund Studies in Geography, Lund 1952.

societies a tractor has more prestige value than a water pump. As for the characteristics of the farmer, Rogers thinks that in all societies there will be "true innovators", who will take risks or even initiate innovations themselves,[1] the early adopters, the bulk of the population, the late adopters and the laggards. He further postulates that earlier adopters are younger in age than late adopters, have higher social status, have a more favourable financial position, have more specialized operations and "have a different mentality, possessing more urban values".[2] This last point may indeed be true but is difficult to assess.

Schumpeter claimed innovations as the basic elements of increments of economic development and involved in his definition a new product, a new technique, a new resource or a new market.[3]

Mosher listed five essentials and five accelerators for innovation.[4] The essentials are those factors which must be present for even one farmer to adopt an innovation; the accelerators are the factors which may be necessary for the innovation to be adopted by all the farmers of the region to which it is suited.

The essentials are as follow: there must be a market for the farm products (there must be a demand, a system of distribution and farmers' confidence in the demand and the system); there must be a

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(1) In the writer's opinion it should be noted in this context that the status of and attitudes to the innovator vary considerably from society to society.

(2) Rogers, E.M., Diffusion of Innovations, Free Press of Glencoe, 1962.

(3) Schumpeter, J.A., The Theory of Economic Development, Harvard Univ. Press, 1934.

(4) Mosher, A., Getting Agriculture Moving: Essentials for Development and Modernization, New York, 1966.

constantly changing technology; there must be a local availability of supplies and incentive (the price must offset the uncertainties and the risk); finally, there must be adequate transportation.

The accelerators for an innovation are that there must be education for development (both general and specific), credit, group action by farmers, improving and expanding agricultural land and national planning.

The number of accelerators is determined by the nature of the innovation: a highly novel or complex innovation may require much group action and planning to back up education; an innovation requiring substantial capital inputs will require credit and may require planning and substantial group action, but, on the other hand, if an innovation offers substantial returns farmers will adopt it without institutional credit and other accelerators.

He further divides innovations into four types. These are basic cultivation innovations, which are new inputs to raise the productivity of already existing enterprises, e.g. chemical fertilizer, improved seed, cultivation equipment and cultivation practices. Of these he considers fertilizer to be the core element. The other types are marketing innovations, the introduction of new enterprises and the improvement of the land.

He considers that an innovation should be backed up by field service units in the front line, which are given further backing by supervisory and supporting personnel, and that for each innovation there should be a definite programme with policy, strategy and routines. (It is true that in many countries institutions do not have a definite or fixed policy on an innovation, nor an idea of how it should fit into the overall agricultural development programme).

In the study of society it is difficult to formulate laws of the type found in the natural sciences. The theoretical framework of rural development and innovation therefore by no means provides a straitjacket in which the individual society must fit. It should rather be used as a yardstick in assessing the statistical normality of a society and highlighting and thence explaining the peculiarities of that society which distinguish it from others. Intensive study of any rural society reveals the complex interrelationships of factors which determine its responsiveness to innovation and development. This is not to deny that there will be certain common features in the responses of rural societies throughout the world. From these common features "Laws" may be derived. However, these "laws" cannot then serve as the standard explanation of any particular rural society's responses or be used as a basis for planning: this is the rôle of intensive case study. Similarly, an individual scholar cannot from research in one particular rural society thereby prove that any particular "law" formulated by another scholar in another rural society is valid or invalid. Moreover, researchers often reach divergent conclusions about the same rural society, since findings may often be skewed by the size of the sample and the techniques of and time allotted to research.

CHAPTER TWO

AREA, SCOPE AND TECHNIQUES OF STUDY

I. The Importance of Irrigation

Irrigation has an undisputed rôle in enabling increased agricultural productivity. Fig. 2.1 indicates the relationship between yield of rice and the percentage of total paddy land irrigated for certain major rice-cultivating nations. Of course, the relationship is not clear-cut, since those countries which have the highest proportion of irrigated paddy land, Japan and Taiwan, are precisely the countries which have the most technically advanced agriculture.

On a smaller scale Behrman claimed that irrigation is second to land characteristics and far more important than labour or purchased inputs in accounting for most of the explicable variations in levels and in rates of growth of rice production and rice productivity across fifty changwat of central and north-eastern Thailand.(1)

Irrigation in Thailand has a long history. In the northern region there is a seven hundred year old tradition of irrigation, whilst the Central Plain had a canal system by 1850, which was expanded by King Mongkut, also called King Rama IV (1851-'68).(2) However, irrigation as a significant factor of production in the north-east is

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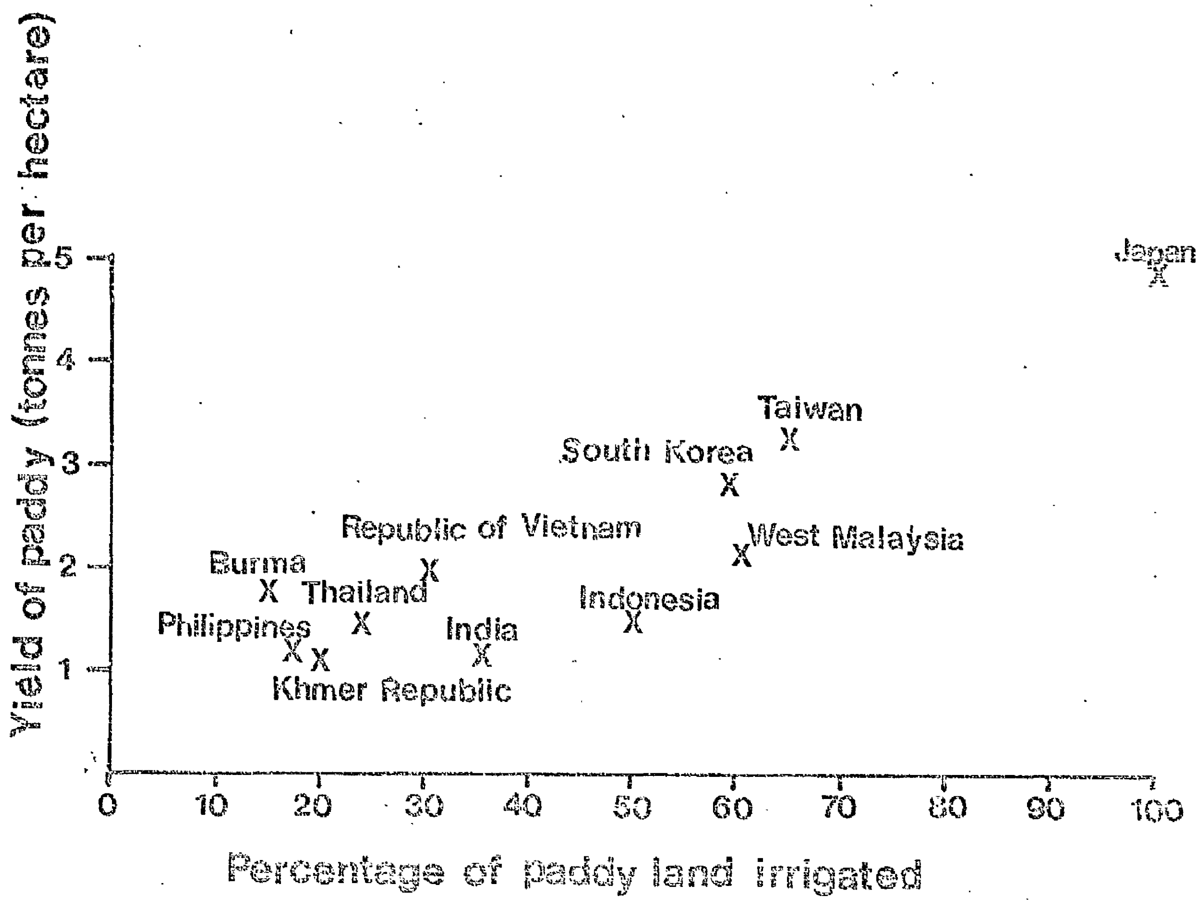
(1) Behrman, J.R., "The Significance of Intracountry Variations for Asian Agricultural Prospects", Asian Surv., Vol.8, 1968.

(2) Tanabe, S., Historical Development of the Canal System in the Chao Phraya Delta, Part I, Kyoto Univ., Japan, 1973, (in Japanese with English abstract).

Figure 2.1 Yield of paddy and percentage of paddy land irrigated in certain countries



Source: IRRI Annual Report 1966

recent and incomplete. In 1971 the north-east had only 1.4% of the total irrigated area in the Kingdom.(1)

The necessity of irrigation in the north-east is clear. Fig. 2.2 shows that from 1955 to 1968 the north-east was that region most consistently affected by drought, although it did not suffer the maximum drought damage recorded for a single year over that time period.

According to the Mekong Secretariat considerable increases in the anticipated land area (for double cropping) are required to meet the future anticipated demands for agricultural produce, as Fig. 2.3 shows. This demand can only be met by bringing new land into cultivation, for, according to Louis Berger Inc. (consultants), the cultivable land area in north-east Thailand will be exhausted by 1984, if present trends continue.(2) However, according to Chuchart, all irrigation projects to be developed will irrigate paddy land rather than upland.(3) Seldon and Walker have demonstrated by cost-benefit analysis that cash returns from an irrigated rai of paddy are considerably greater than from an unirrigated rai, whilst costs do not rise proportionately.(4)

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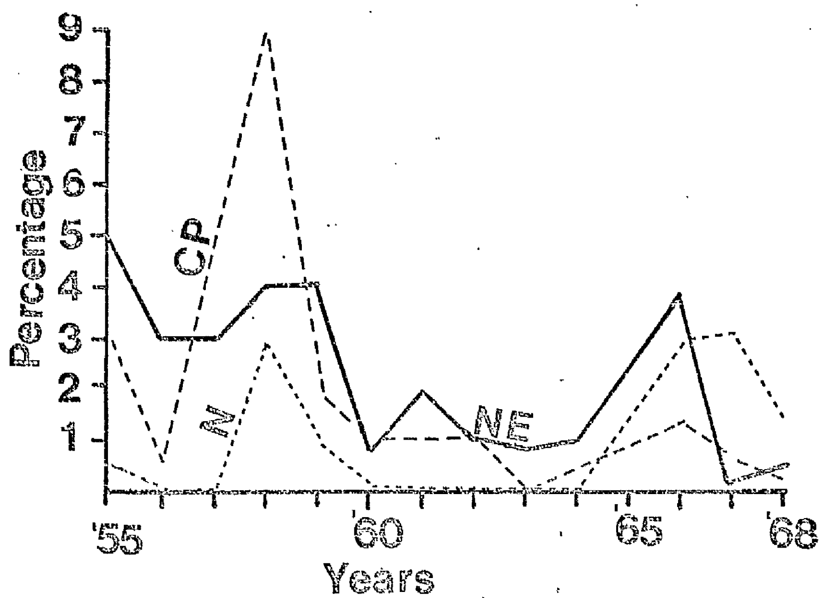
(1) RID Handbook.

(2) Louis Berger Inc. (Development Economics Group Division), Recommended Development Budget and Foreign Assistance Projects, North-east Thailand, Bangkok, 1971.

(3) Chuchart, C., Review of Agricultural Situations in north-east Thailand, Bangkok, undated.

(4) Their conclusions are as follow:
a) for paddy rice without irrigation project conditions:
total expenses = 231.73 Baht/rai
net return = 15.79 Baht/rai
b) for paddy rice with irrigation project conditions:
i. in the wet season:
total expenses = 393.68 Baht/rai
net return = 288.82 Baht/rai
ii. in the dry season:
total expenses = 413.56 Baht/rai
net return = 200.69 Baht/rai
Seldon, T.H. and Walker, L.D., Economic Evaluation and Selection of Lands for Irrigation, for presentation at the Soil Survey Seminar, Dept. of Land Development, Min. of National Development, Bangkhen, Thailand.

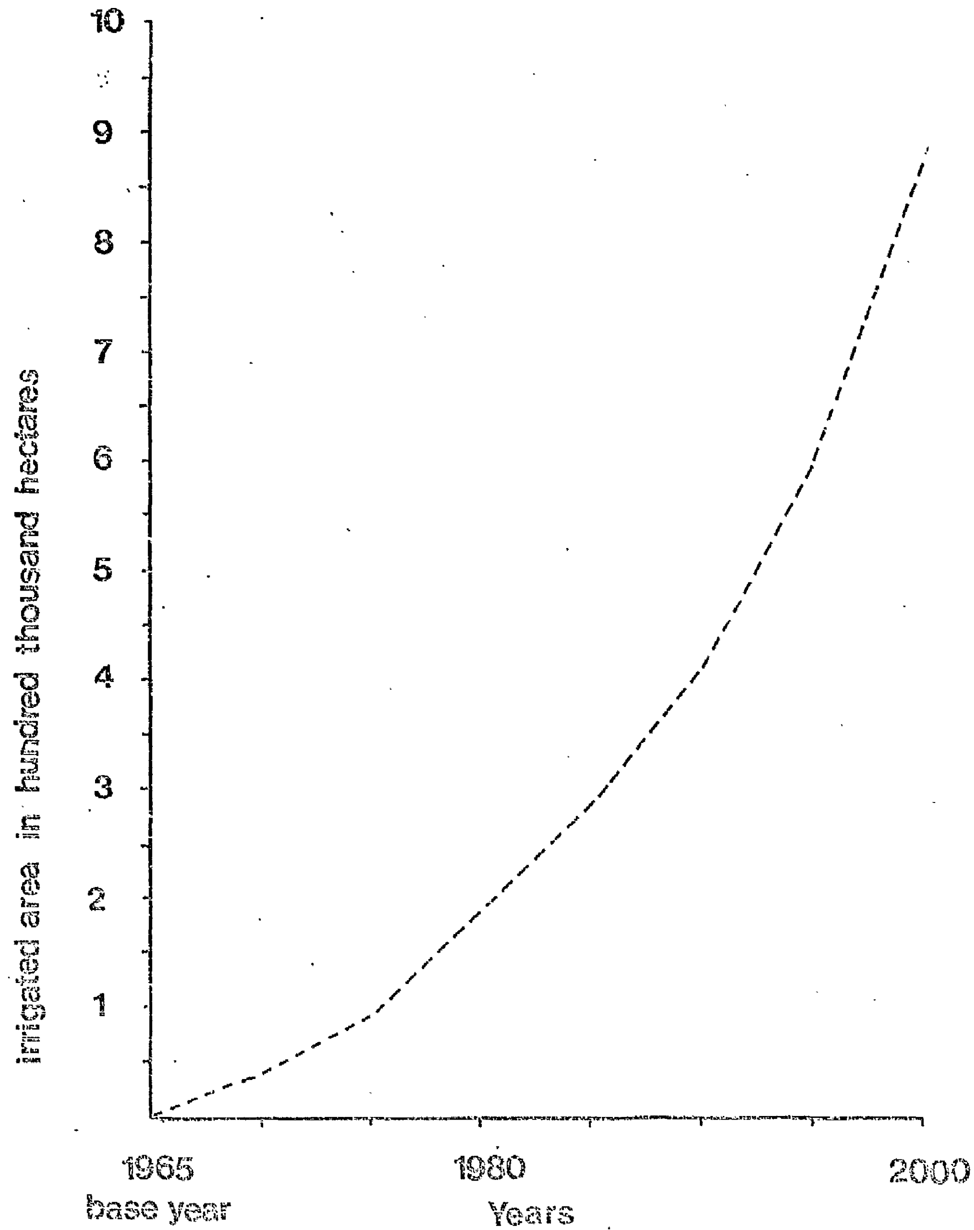
Figure 2.2 Percentage of total planted area damaged by drought for 3 regions of Thailand 1955-'68



Source : Annual Reports on Rice Production in Thailand

Figure 2.3 Increase in irrigated land area (double crop) for required demands for agricultural produce to 2000 - accumulative to end of each year

Source: Report on indicative plan for the Lower Mekong Basin, Mekong Secretariat



Therefore, despite rather slow progress, the Royal Thai Government regards irrigation as a major investment. Louis Berger Inc. estimated that 75% of the total government expenditure for agriculture during the period of the Second Plan (1967-'71) went to the Royal Irrigation Department.(1)

The north-east's propensity to drought is well known to the farmer. In Narkswasdi's study 89% of the farmers in his sample in changwat Kalasin and 70% in Maha Sarakham reported uneven rainfall as a major difficulty in cultivation.(2)(3)

Moreover, Ruttan _et al._ claim that "standardized" yield calculations indicate that under comparable irrigation conditions yields in the north-east and Central Plain would be almost identical.(4) However, whilst the increase in the irrigated area throughout Thailand has tended to taper off, as Fig.24 shows, the north-east still lags behind the Central Plain in both its actual and its projected irrigated area. (This histogram only includes land irrigated by State schemes,

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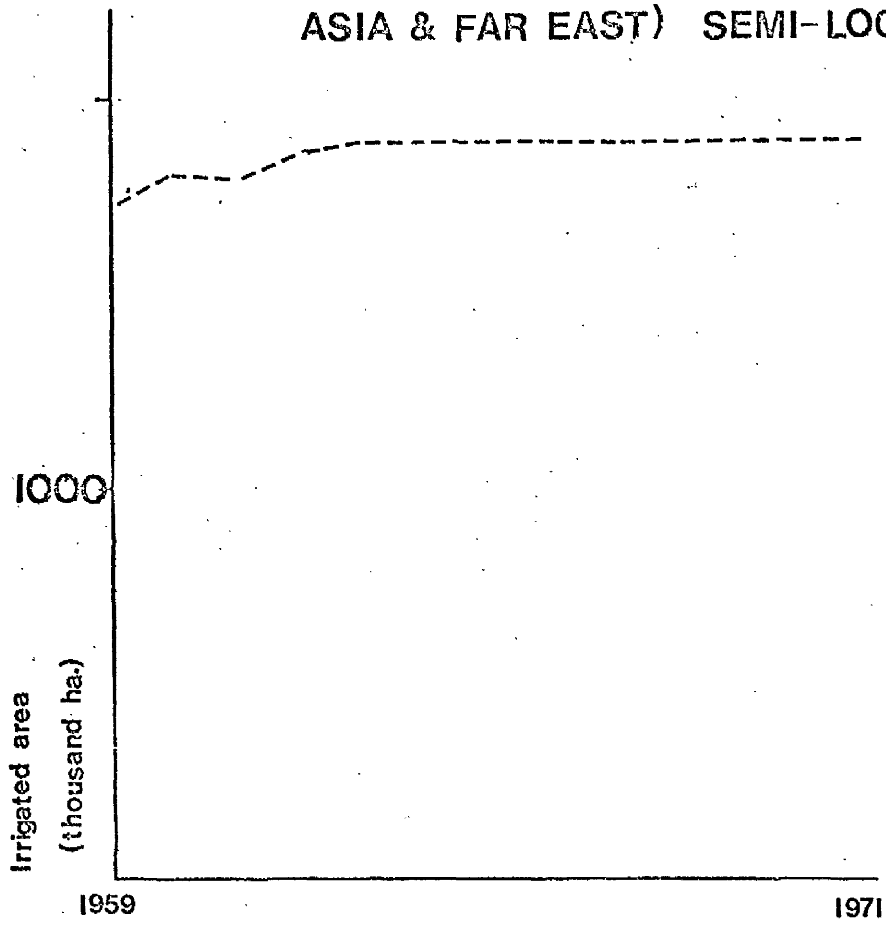
(1) Louis Berger Inc., _op.cit._

(2) Narkswasdi, U., _A Study of the Socio-economic Conditions of People Living in the Development Areas of the North-east,_ Kasetsart Univ., undated.

(3) Irrigation is the obvious answer to uneven rainfall. It is of interest to note, however, that on August 26th 1969 the successful production of artificial rain took place over amphoe Cha-am, changwat Phetchaburi, the site of the Thai-Israeli Rural Development Project. Fourteen millimetres fell. The dry-ice sprinkler was invented by M.R. Debaridhi Devakul, special agricultural officer, whilst the Australian Embassy provided the air truck plane. The cost was estimated at 4 Baht per acre.
Attayodhin, C., _Water Resources Development in Thailand_, Thailand Development Report, August 1969.
Rural people throughout the north-east annually attempt to induce rainfall through their so-called _bong fai_ ceremony, whereby home-made rockets are fired into the air. In Nong Khai the _bong fai_ ceremony has become a tourist attraction.

(4) Ruttan, V.W., Soonthipan, A. and Venegas, E.C., "Changes in Rice Growing in the Philippines and Thailand", _Wld Crops_, 1966.

FIG. 2.4 INCREASE IN AREA OF IRRIGATED LAND IN THAILAND (SOURCE: STATISTICAL YEARBOOK ASIA & FAR EAST) SEMI-LOG



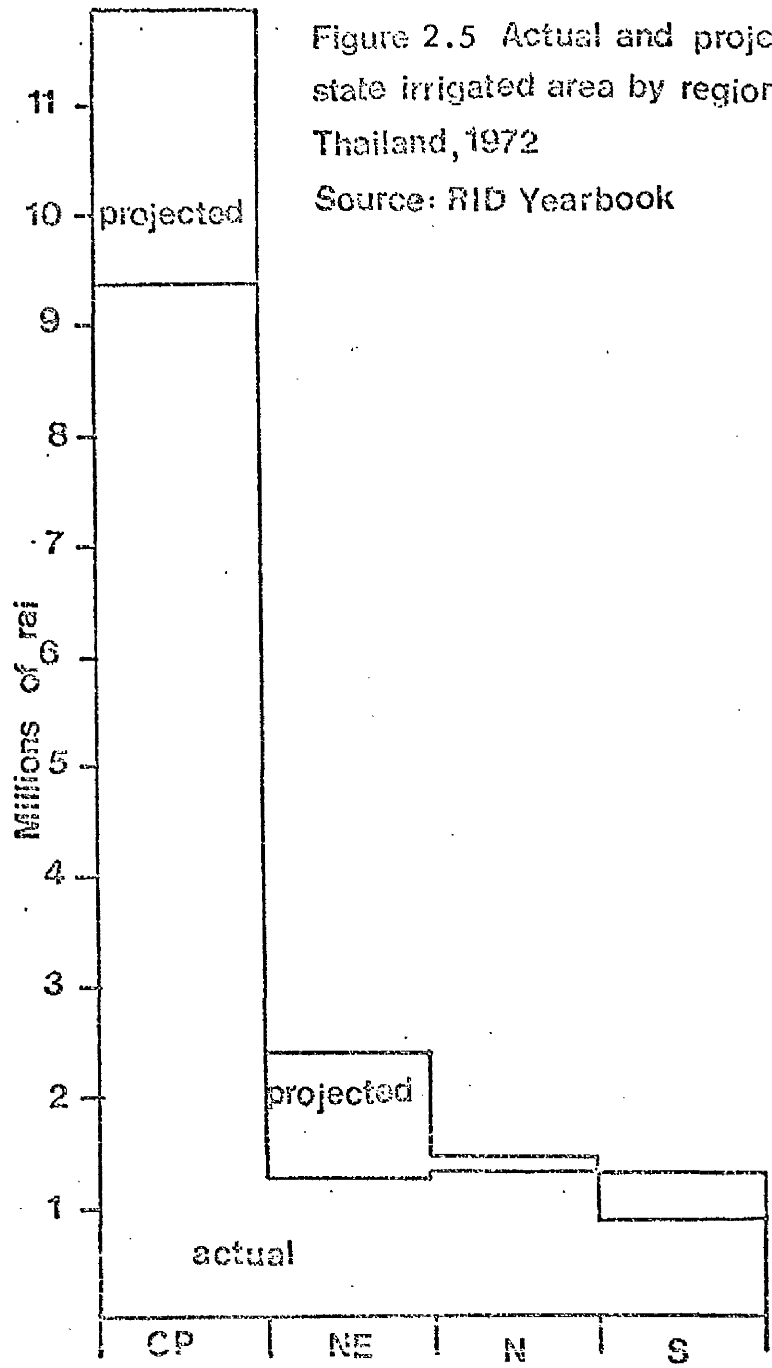


Figure 2.5 Actual and projected state irrigated area by region in Thailand, 1972
Source: RID Yearbook

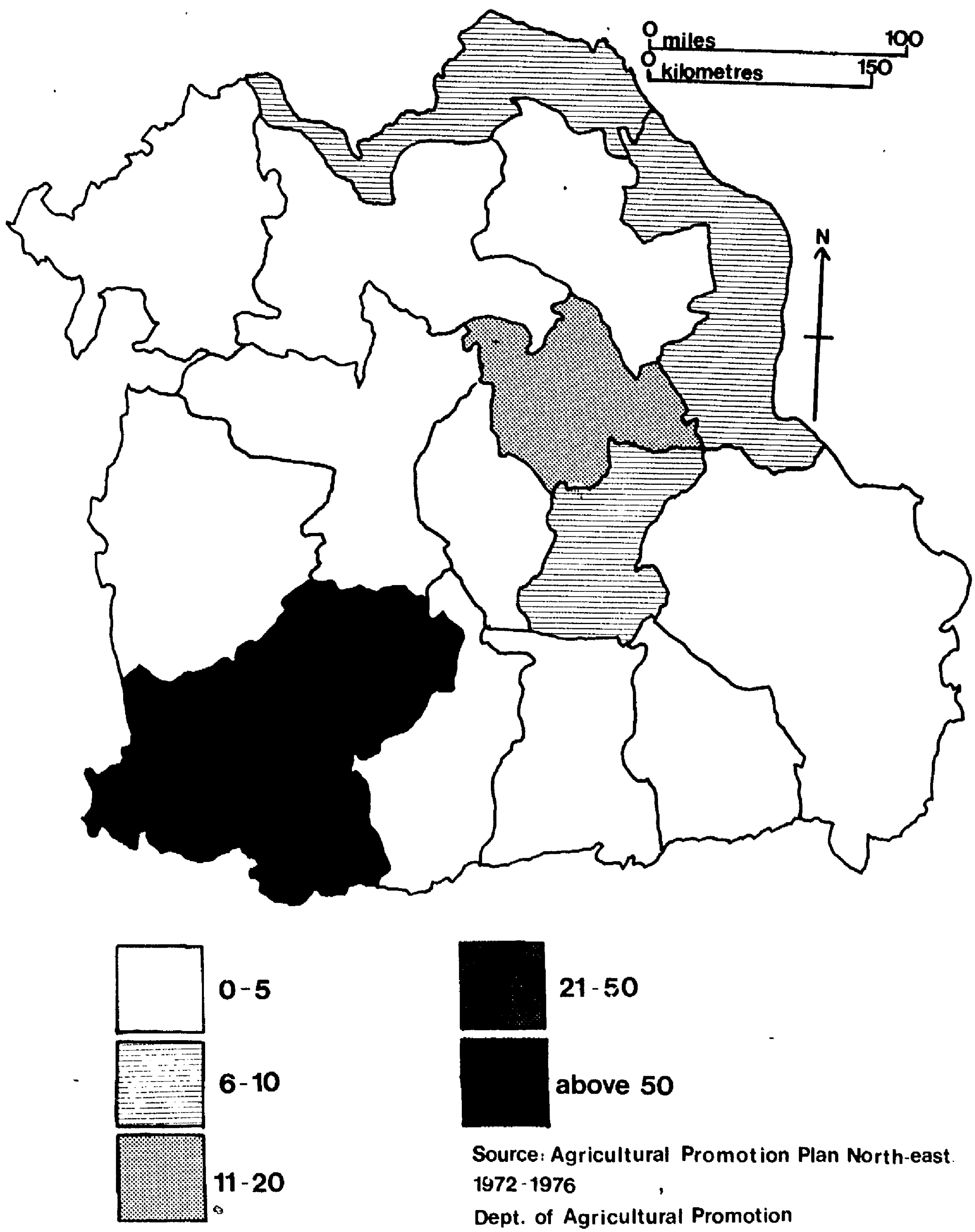
but it may be safely asserted that more traditional forms of irrigation, classified in Thailand as "people's irrigation", are generally absent from the north-east, whilst they are an important feature of the northern region; the more truly wet tropical régime of the southern region makes irrigation less necessary, whilst the peculiar configuration of its terrain makes large-scale irrigation projects more difficult).

Within the north-east there are at least thirteen agencies of the government involved in water resource development and use, whilst there are seven entities within USOM which have field activities associated with water resource development.[1]

Map 2.1 shows that by 1970 irrigated land was unevenly spread throughout the north-east. Changwat Nakhon Ratchasima had the highest proportion of irrigated land with changwat Kalasin in second place, albeit with a much lower proportion. The riparian changwat of Nong Khai and Nakhon Phanom had fairly high proportions of irrigated land arising from developments on the Mekong River, as did Roi Et. In all the other changwat the proportions of irrigated land were equally low.

(1) RID Handbook.

Map 2.1 Percentage irrigated area per changwat for NE Thailand 1970



Source: Agricultural Promotion Plan North-east 1972-1976, Dept. of Agricultural Promotion

II. The Study Area

i. Changwat Kalasin

Changwat Kalasin is a fairly new changwat, having been created in 1947; prior to that date it was part of changwat Maha Sarakham. It is difficult to make a case for Kalasin as either a typical or atypical north-eastern changwat, since as subsequent chapters show, the north-east is internally quite diverse. Changwat Kalasin is, for example, less prosperous and advanced than Maha Sarakham, Khon Kaen and Nakhon Ratchasima, which lie to its west; on the other hand, it is more advanced than changwat Sakon Nakhon and Nakhon Phanom (which have severe insurgency problems) to the east. It can, however, be said that Kalasin demonstrably suffers from all those problems, climatic, edaphic, economic and social, which are considered peculiarly north-eastern.

The principal rice crop is glutinous rice grown mainly for subsistence, but some non-glutinous rice and dry or upland rice are also grown as Table 2.1 shows. The principal field crop here as in most of the north-east is kenaf (<u>vide</u> Table 2.2), but maize and groundnuts, which have long been grown on a small scale, are making significant progress, as Tables 2.3 and 2.4 show.

Agricultural methods remain fairly traditional, as Table 2.5 shows. The use of chemical fertilizer is making some progress, but mechanization, in the form of tractors or water pumps, is insignificant, as is the use of fertilizer sprays. No information was available about the use of insecticide or other purchased inputs.

Map 2.2 Changwat Kalasin

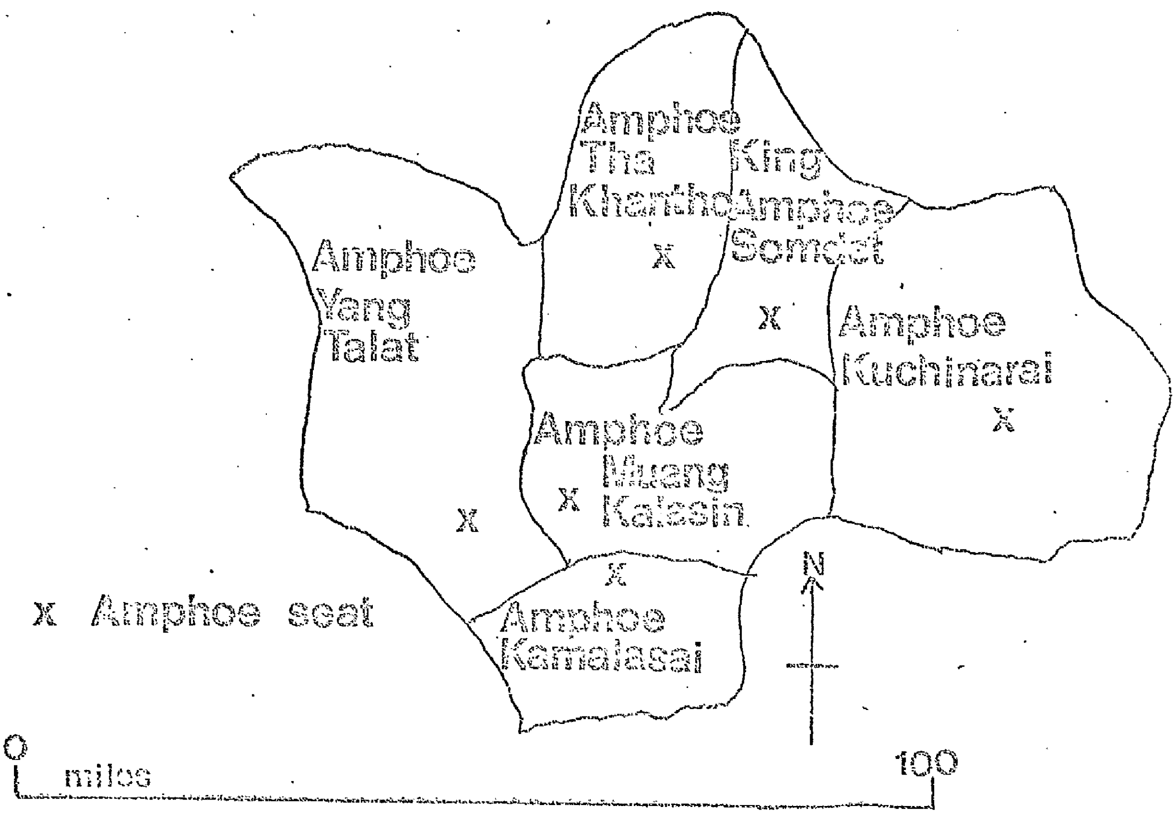


Table 2.1 Cultivation of Rice in changwat Kalasin 1971

Amphoe(+)	Glutinous Rice (kg.)	Non-glut.rice (kg.)	Upland rice (tang)	Upland rice (rai)
Muang	3,861,475	22,925	173,760	5,792
Yang Talat	559,095	31,800	5,820	194
Kamalasai	-	426,750	27,500	1,100
Sahatsakhan	3,516,875	47,150	487,000	15,900
Somdet	2,245,000	5,625	6,340	178
Kuchinarai	4,370,225	29,425	23,700	790
Tha Khantho	882,550	27,325	33,450	1,115

(+) Somdet is a king amphoe.

The figures for production of glutinous rice in Kamalasai were not available.

(Source: Changwat Office, Kalasin).

Table 2.2 Area and Production of Kenaf in changwat Kalasin 1971

Amphoe	Area (rai)	Production (kg.)
Muang	27,000	6,750,000
Yang Talat	33,982	7,476,040
Kamalasai	11,550	2,310,000
Sahatsakhan	3,920	750,000
Somdet	3,290	483,000
Kuchinarai	9,750	1,950,000
Tha Khantho	13,400	2,680,000

(Source: Changwat Office, Kalasin)

Table 2.3 Area and Production of Maize in changwat Kalasin 1971

Amphoe	Area (rai)	Production (kg.)
Muang	850	85,000
Yang Talat	920	92,000
Kamalasai	782	78,200
Sahatsakhan	1,300	130,000
Somdet	331	33,400
Kuchinarai	1,300	13,890
Tha Khantho	2,500	250,600

(Source: Changwat Office, Kalasin).

Table 2.4 Area and Production of Peanuts in changwat Kalasin, 1971.

Amphoe	Area (rai)	Production (kg.)
Muang	400	12,000
Yang Talat	420	12,600
Kamalasai	850	17,000
Sahatsakhan	1,400	42,000
Somdet	487	9,740
Kuchinarai	750	22,500
Tha Khantho	2,000	40,000

(Source: Changwat Office, Kalasin).

Table 2.5 Production Characteristics of changwat Kalasin 1971

Amphoe	Fertilizer (kg.)	Water pumps	Fertilizer sprays	Tractors
Muang	40,000	10	2	-
Yang Talat	8,000	-	-	-
Kamalasai	122,000	6	10	1
Sahatsakhan	10,000	-	-	-
Somdet	10,000	8	2	-
Kuchinarai	15,000	4	5	-
Tha Khantho	-	-	-	-

(Source: Changwat Office, Kalasin).

ii. The Lam Pao Irrigation Project Area

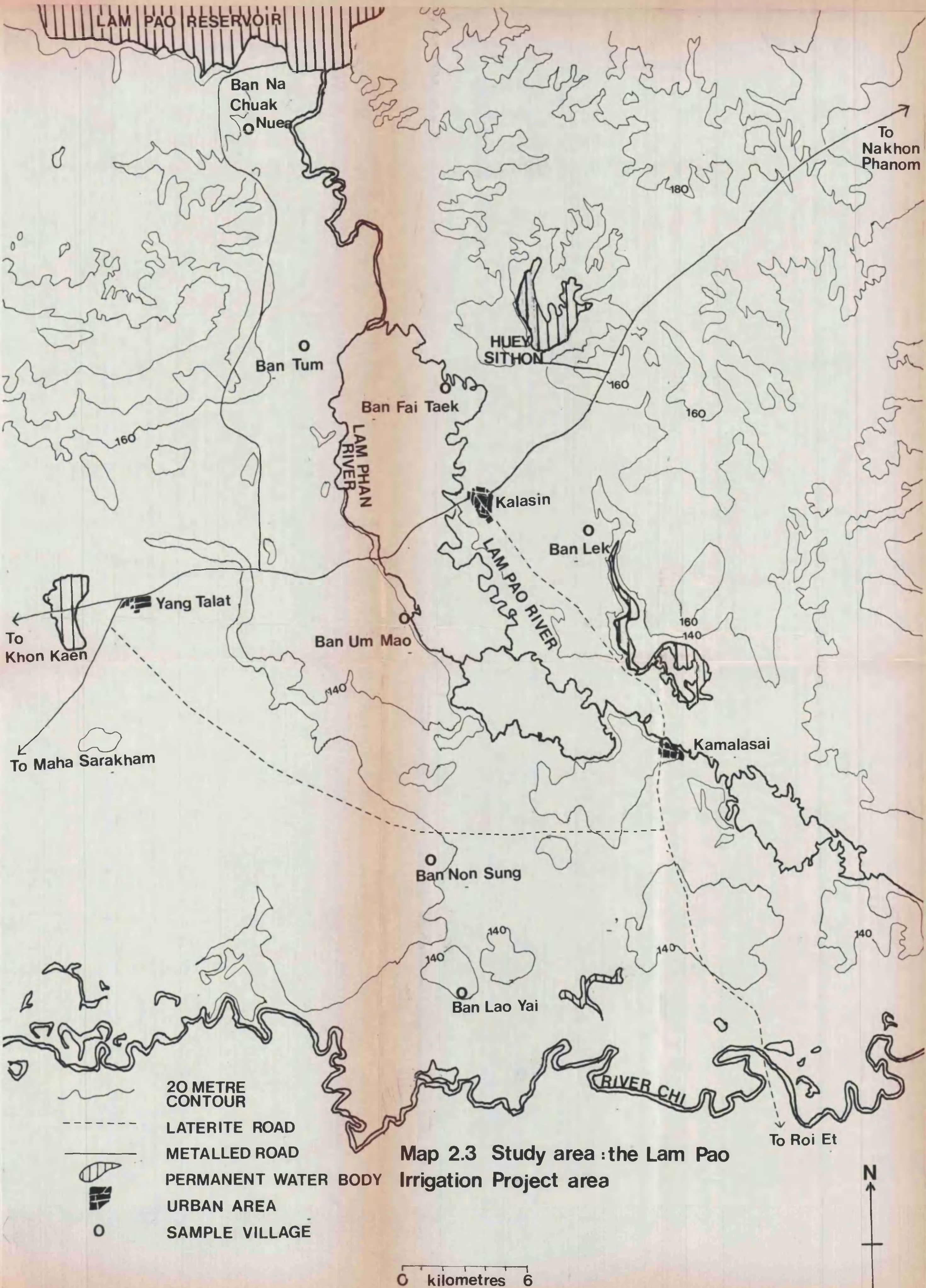
The Lam Pao Irrigation Project Area, falling entirely within changwat Kalasin, is based upon the Lam Pao River, which is one of the three tributaries of the Chi River, itself a major tributary of the Mun River, which flows into the Mekong River. (vide Map 2.3)

The Lam Pao area lies 130m. to 170m. above sea-level. The topography is varied: very flat parts dominate from a point south of Ban Chieng Ngam - in this southern area higher knolls and ridges occur, which are from a few metres to over 20 metres above the general level of the plain; whilst the valleys of the Lam Pao and the Lam Phan are situated 1 to 4 m. below the level of the plain. In spots the transition between plain land and lower river valley is formed by a distinct escarpment, but elsewhere the transition is gradual. The different levels, viz. river valleys, plain lands, higher knolls and ridges, concur largely with different terrace levels.

North of Ban Chieng Ngam the relief is more accentuated and the land rather undulating. This part of the area presents itself as a series of higher ridges, separated by U-shaped valleys of varying width and depth. The relief of this area makes it largely unsuitable for irrigation.

Around Yang Talat there is an area of flat land, which is separated from the main flat area by a higher ridge.

Geologically, the deeper substrata of the area are formed by sandstones and conglomerates of the Khorat series. However, these formations are nowhere at or even close to the surface and do not influence landforms and parent materials to any great extent. In some valleys, however, eroded in younger formations, local outcrops of base-rock may be found, such as is the case in the valley of Huai Si Thon



Map 2.3 Study area : the Lam Pao Irrigation Project area

near the dam site, where weathered sandstones and conglomerates are found in deeply excavated pits.

The surface formations are formed almost exclusively by alluvial sediments. Moormann recognizes three terrace levels, viz. low, middle and high, in addition to the recent alluvial plain.(1)

The alluvial plain is that part of the area which is subject to flooding by rivers and creeks. The Lam Pao and the Lam Phan usually have well-defined valleys, but this is not as yet a stabilized stream system and in some parts of the area the present-day rivers hardly have alluvial valleys at all, both sides being flanked by terrace formations. The sediments in the main alluvial valley are mostly clayey but river levees are partially or completely composed of lighter textured materials and sometimes of sand.

In the side valleys the sedimentation pattern is mostly different from the main alluvial plain: here the creeks are rarely associated with higher river levees but are situated in the lower parts of the valley. Mostly, these consist of recent alluvial sediments composed of clay but in the north of the area, where the valleys are flanked by sandy terrace formations, the valleys may be lighter-textured and usually loamy.

The low terrace is flat with the exception of certain spots where the presence of recent erosion valleys causes some relief. The majority of the low terrace formations of the region have a clayey texture; this clay has been strongly weathered and is kaolinitic.

The middle terrace is less important than elsewhere in the north-east, being absent altogether from the south of the area. The

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(1) Moormann, Poomvises and Montrakum, Detailed Reconnaissance Survey of Lam Pao Irrigation Project, RID, Min. of Agr. and Dept. of Rice, RID, 1963.

high terrace is found in several high ridges.

The low terraces and narrow alluvial plains form the paddy land, which often consists of poor soil developed on highly weathered sandy parent materials; the high terraces are utilized for field crop cultivation.

The soils of the area have been classified by Moormann et al. into several series.(1) The Phimai series (which includes the Ratburi series) occupies the larger part of the alluvial plain of the Lam Pao and occurs to a minor extent in the valleys of tributary creeks. Mostly, these soils are well-provided with organic matter in the surface layers. They are mottled throughout and natural drainage is sometimes poor. All are somewhat acid and subject to flooding. The Chiengmai series is found on the natural levees of the Lam Pao and Lam Phan. This series consists of soils which are sandy and well-drained or over-drained. The Si Thon series is composed of the alluvial sediments of the brooks and creeks. The Kalasin series occurs in the alluvial plain of the Lam Pao and the lower parts of the tributary valleys. Soils of this series occur mostly in marshy depressions. They are waterlogged or even inundated for most of the year and have a black humiforous topsoil. The Roi-et series is widespread on the lower terrace formations of the area and is the main series to benefit from irrigation. It is mottled throughout and has poor natural drainage. In the dry season it dries out over considerable depths so that hardly any plant growth is possible. In the wet season it is mainly water-saturated and temporarily inundated. The Ubol series is found mainly on the higher transitional areas between the low and higher terrace formations. The soils are poor and low in

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(1) Moormann et al., op.cit.

fertility. In the wet season the soils slowly fill up with water; in the dry season they dry out completely. They are mainly used as paddy soils. Other series include the Khorat series, poor, sandy soils, found in small spots and bands on the low terrace formations and mainly used for fruit and vegetable cultivation, the Udorn series, which is saline and unsuitable for agriculture, the rare Phon Phi Say series, a medium-textured soil with a clayey subsoil and the Yasothon series, a poor, sandy soil occurring on the high terrace formations. In addition to these soil series soil complexes are also found in the area, including the Roi-et / Phimai complex, the Yasothon / Khorat complex and the "alluvial complex", in which soils of the Chiengmai, Ratburi, Phimai and Kalasin series occur side by side in intricated pattern.

Surface water in the area is supplied by the Lam Pao system. The increasing floods of the Lam Pao have caused many rice fields in the alluvial plains to be abandoned, whilst the destruction of forest has led to increased run-off and soil erosion during the heavy rains. Also the gradual silting up of the Lam Pao branch is causing water to pass through the Lam Phan alone which is neither deep nor wide enough to carry all the water during high floods.

Ground-water occurs in all rock units. The Lam Pao Irrigation Area falls within the Phu Phan range physiographic unit and, according to Phiancharoen, productive aquifers for this region are only the Khok Kruat formation located along the synclinal troughs and the Phu Kradung formation located in the basin floors of structural domes.(1) More than

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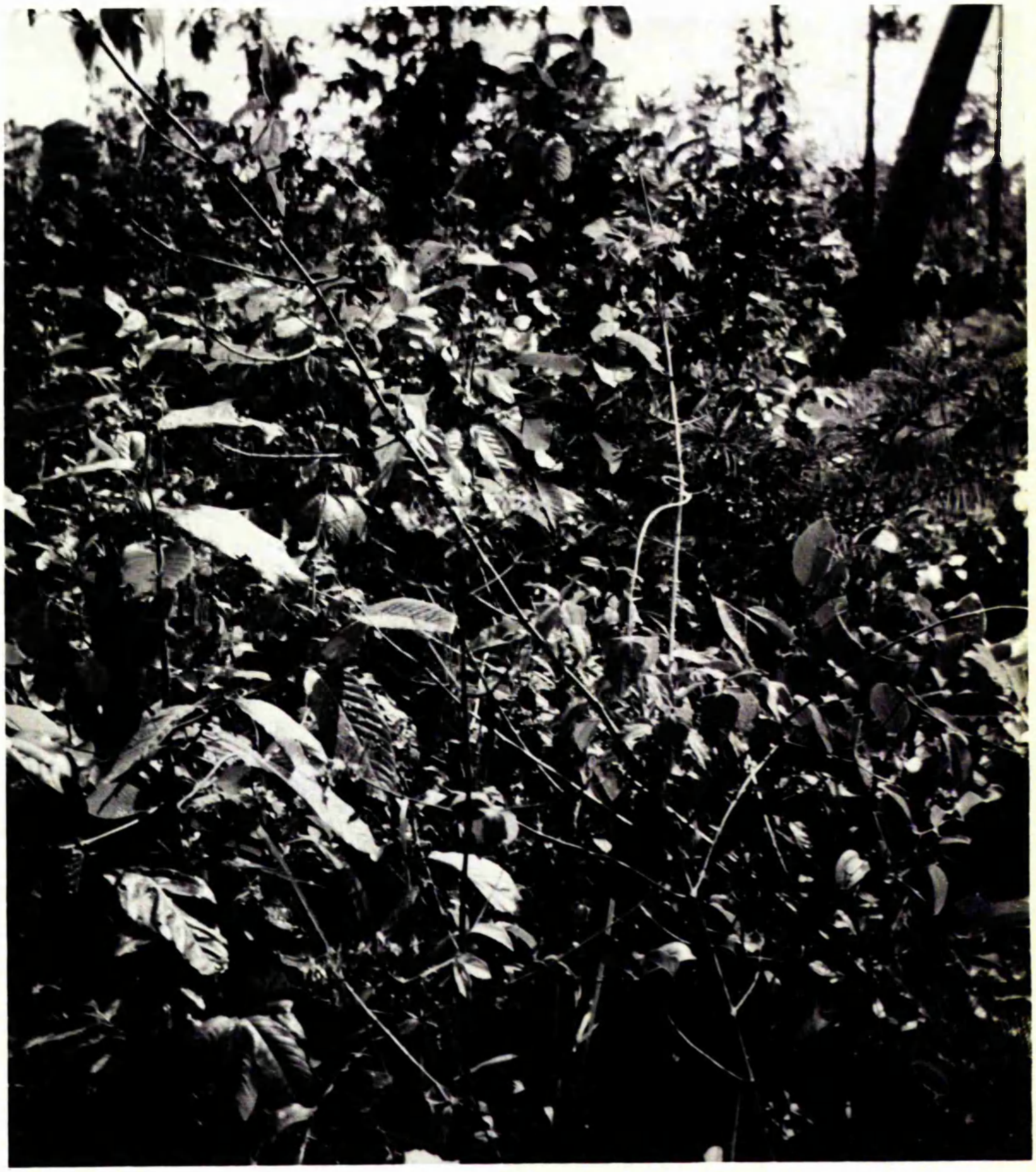
(1) Phiancharoen, C., "Geologic Controls on Ground-water Availability of North-eastern Thailand", in <u>Methods and Techniques of Ground-water Investigation and Development</u>, Transactions of the Second Ground-water Seminar on Methods and Techniques of Ground-water Investigation and Development, held at Tehran, Iran, 1966, Water Resources Series, No.33, UN, 1967.



Source: O'Reilly, dry
season, 1972.

Plate 2.1 Forest in Ban Tum

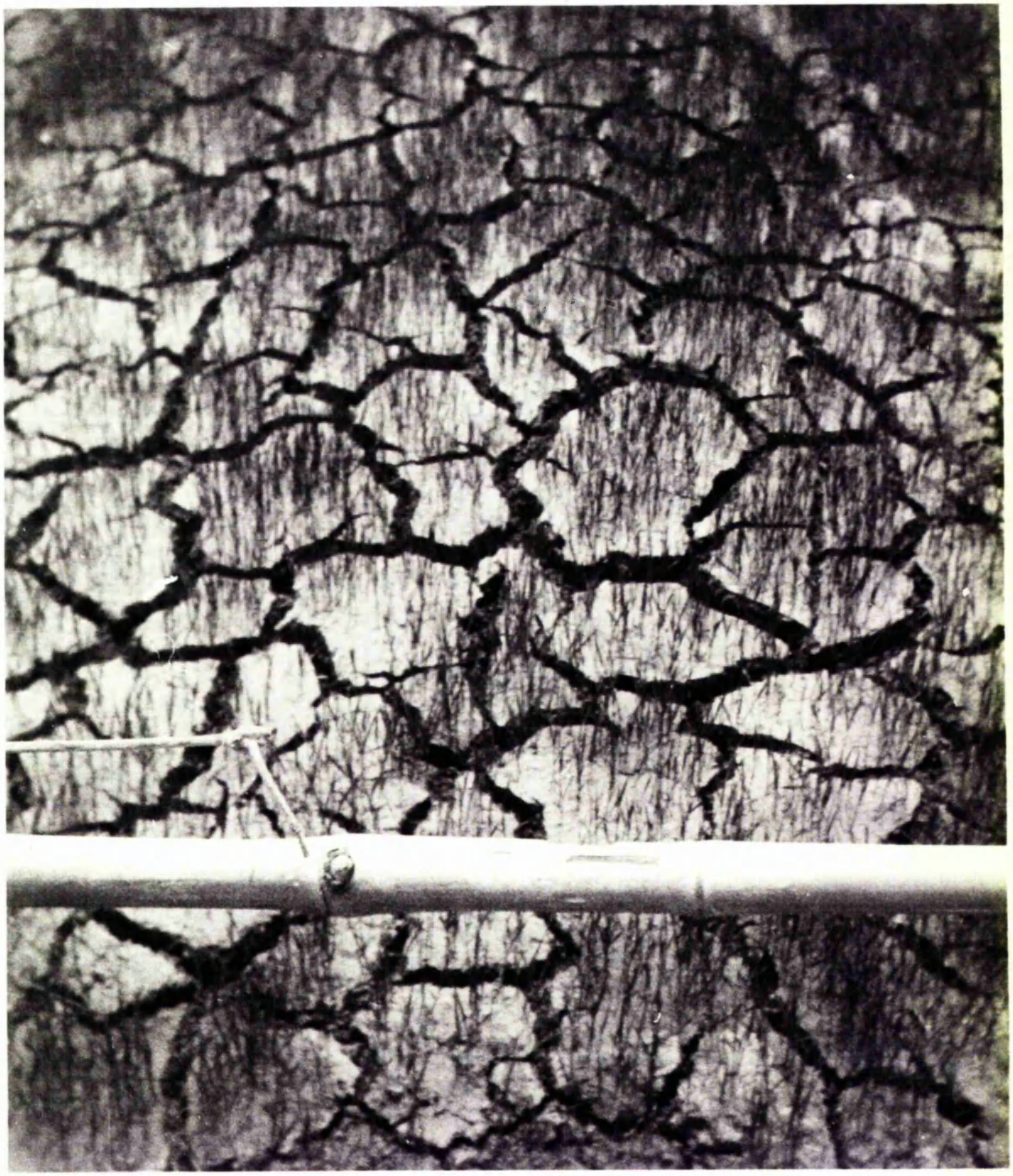
This dry deciduous dipterocarp forest forms the natural vegetation throughout the Lam Pao area. Penetration is difficult because of the dense undergrowth. Clearing the forest to produce fields is obviously an arduous and unpleasant task.

80% of wells drilled in these aquifers were successful, the failures being due to dry holes rather than poor water quality. Yields as high as 50-100 gpm can be expected. Artesian flowing conditions may be encountered in the synclines.

Although Moormann *et al.* also state that ground-water is present at a reasonable depth throughout the area, they consider this water to be of poor quality, brackish and even saline during the dry season.(1)

The rainfall régime remains crucial to both the farming and the natural vegetation growth. On the higher soils growth comes to a standstill during the dry season, the forest undergoes a rest period and natural undergrowth, especially grasses die back. Therefore, unirrigated agricultural lands and those in which the ground-water table is low lie fallow through the dry season and are only cultivated during the wet season.

(1) Moormann *et al.*, *op.cit.*



Source: O'Reilly, dry season, 1971.

Plate 2.2 Paddy soil, Ban Non Sung

This paddy soil, situated on the low terrace, has dried out completely to a brick-like consistency and is deeply cracked and fissured. This is at the height of the dry season.

iii. Prospects and Plans for Irrigation

The Royal Irrigation Department has classified the land in the Lam Pao area according to its suitability for irrigation. They recognize four major classes, viz. Class 1 is excellent irrigable land without or with only very minor limitations; Class 2 is good irrigable land with slight limitations; Class 3 is moderate irrigable land with moderate to rather severe limitations; Class 4 is land not suited to gravity irrigation.

There are many types of "limitations" encountered in the area. Principal among these are soil deficiency, in which case soils are inherently infertile or too sandy or for certain upland crops too heavy and topography deficiency, in which case the land has a distinct micro-relief with a more or less strong slope, or the land is of isolated high elevation, surrounded on most sides by lower land so that provision of gravity irrigation is problematic. Other soils have a drainage deficiency: as a result of their low situation and/or heavy texture they have excess water for an important part of the year and, consequently, need artificial drainage or ridging for certain crops. Other areas, mostly low areas of the alluvial valleys of the Lam Pao and its tributaries, are subject to periodic flooding, where flash floods recurrently damage crops or make agricultural use of the land impossible. Yet other lands suffer from actual or potential salinity.

The RID conclude that the area is of good to moderate irrigable land for both paddy and field crops. However, the northern part of the area is least favourable since it has relief and soils which make irrigation difficult or economically unfeasible. The best consolidated tract of good quality land suitable for irrigation is the flat area to the east of the Lam Phan branch, composed mainly of Class 2 land (Roi-et series). The interfluvial land between the Lam Phan and the Lam Pao, though of moderately good quality, poses some problems because of its slightly less favourable relief and drainage and flood potential. The tract around Yang Talat, though topographically and edaphically adequate, is less good because of salinity problems. However, flood control will result in immediate benefit in productivity in the southern part of the interfluvial area between the Lam Pao and the Lam Phan.

Work began on the Lam Pao dam in 1963 and was completed in 1968. The dam consists of a twin reservoir with a capacity of 1.260 million cubic metres. The provision of irrigation is divided into stages. The first stage was begun in 1963 and was expected to be completed by 1969. However, progress was behind schedule and the first stage was not completed by the time of the SOAS Lam Pao Project. The second stage was to have been commenced in 1968 and completed in 1971.(1) However, the second stage was later scheduled to be commenced in 1972.(2) The first stage was intended to irrigate 16,000 hectares, the second stage 38,210 hectares.(3)(4) The target is to attain 80% of the land suitable for second cropping, whereas in the study year only 30% was suitable. The major irrigation ditches are lined and the farmers themselves are expected to dig farm ditches from the major laterals, a farmer being appointed as "ditch rider" with control over a canal, whilst the Water Users' Association (at present weak on membership) must carry

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(1) Tables showing Water Resources Development in Thailand completed to the End of 1968 and under construction in 1969, RID, 1969.

(2) Chang Nookol Thongthawi, Project Maintencance and Operations Engineer, Lam Pao Project, RID, personal communication.

(3) as (1).

(4) A U.S. team was during the study year working on the survey and classification of land to be irrigated in the second stage.

Source: O'Reilly, dry season, 1971.

Plate 2.3 View of the Lam Pao Reservoir

out the maintenance of the canal.[1]

iv. The Lam Pao Sample

Within the Lam Pao area seven villages were selected for study by the Lam Pao Project of the School of Oriental and African Studies of the University of London. This sample is in this thesis henceforth to be referred to as the Lam Pao Sample. Thus statements made by the writer about the Lam Pao Sample refer only to the Lam Pao Sample. They are not general statements about the Lam Pao area as a whole. When reference is made to information pertaining to villages or areas outside the Lam Pao Sample, this will be pointed out. The term "Lam Pao area" embraces the whole project area.

The seven villages were selected by the SOAS Lam Pao Project according to their representativeness with respect to spatial distribution, location, environmental conditions and socio-economic characteristics. They were not randomly selected. Table 2.6 shows the nature of the Lam Pao Sample. Thus in the text when the writer refers to statistics from any one of the villages in the Lam Pao Sample, it should be understood that these statistics refer only to the households that fall within the sample in that individual village. Thus, for example, if reference is made to 50% of the farmers in Ban Na Chuak Nuea, this means 50% of the 35 farmers in that village who were selected for the Lam Pao Sample. If reference is made to farmers in Ban Na Chuak Nuea, for example, who are outside the Lam Pao Sample, then this will

(1) Information derived from a lecture delivered by Chang Nookol Thongthawi at the RID Headquarters, Lam Pao dam site, 1971.

Table 2.6 The Villages of the Lam Pao Sample

Village	Amphoe	No. of holdings	Sample size	Sampling fraction
Ban Na Chuak Nuea	Yang Talat	124	35	28.22
Ban Tum	Yang Talat	201	57	28.35
Ban Um Mao	Yang Talat	112	35	31.25
Ban Fai Taek	Muang	75	25	33.34
Ban Lek	Muang	140	42	30.00
Ban Non Sung	Kamalasai	124	33	26.61
Ban Lao Yai	Kamalasai	39	11	28.20

always be made clear in the text. Thus, the writer selected a small, independent sample for intensive study. This is to be referred to as the Small Sample.

Within the Lam Pao Sample a detailed questionnaire was administered to the household heads of 302 agricultural households. (vide Appendix I.)

a. Ban Na Chuak Nuea

Ban Na Chuak Nuea is a fairly new village of 124 families in total, situated close to the headworks of the Lam Pao Irrigation Project, and 36 km. away from Kalasin town. It has a plentiful supply of uncleared forest close to the village. To date it is the only village which has received irrigation, having been irrigated since 1969. The principal crops grown in the village are glutinous rice and kenaf. However, agricultural diversification has been stimulated by the Agricultural Credit Co-operative (ACC), established in the village in 1971. At present the ACC only provides supervised credit. It is intended to cover the whole of the Lam Pao Irrigation area, where it has at present 888 families as members. The ACC sets a fixed price for rice and is tied in with the quota system, so that a farmer must be a member of the ACC to have a quota for the sale of rice in Ban Na Chuak Nuea.(1)

The Land Co-operative is also active in the village. This was established in 1971 and has also 888 members in the whole of Lam Pao. The village headman sits on the committee. In 1971 the Land Co-operative's budget for credit was 1 million Baht.(2)

In general, the village has an air of comparative prosperity,

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(1) and (2) Information from conversations with the village headman.

helped to a great extent by the existence of considerable employment opportunities in work at the dam site. The village has a general shop, which at the time of survey had in stock 200 kg. of chemical fertilizer for sale at 2 Baht per kg. and also ample stocks of "slug-killer" for destroying the slugs which attack water melons. In the village there is a temple and a well-built school. In addition there are three cafés, which serve soft drinks, tea, coffee and Thai desserts (khonom).

In addition to being studied by SOAS, this village has also been studied by a team from the Social Science Research Institute of the Faculty of Political Science, Chulalongkorn University, Bangkok, under the supervision of Père Jacques Amyot, S.J., as part of their comparative social and economic studies of villages in Thailand.

b. Ban Tum

Ban Tum, a village of 201 families, is situated 14 km. from Ban Na Chuak Nuea and 22 km. from Kalasin town. It is an old-established village with many large extended families. It possesses ample upland near to the village, which has been made more accessible to the village by the construction of the RID access road. Accordingly, it concentrates on field crop cultivation to a greater extent than the other villages. It is as yet unirrigated and irrigation is here overdue, having been promised for 1971. The neighbouring village of Ban Lao (not to be confused with Ban Lao Yai) has a demonstration plot on which new field crops are tried out. Ban Tum lacks shops and cafés. However, it has a successful carpenter.

This village has been studied by a World Bank team and is also included in the sample of villages chosen for study in the Education Project of Maha Sarakham Teachers' Training College under the supervision of Mr. John Pilgrim, formerly of the Mekong Secretariat.

c. Ban Um Mao:

Ban Um Mao is a village of 112 families situated 7 km. away from Kalasin town. It has very little upland and therefore has the highest concentration on rice cultivation in the seven villages. Cultivation of both rice and field crops here suffer from the flooding of the Lam Phan. It is a village which contains some well-built houses, the work of a particularly enterprising local carpenter, whose reputation spans three changwat.

The Farmers' Association was established in the village by a government agent, but so far it has only twelve members. The village was scheduled to receive irrigation water in 1972. RID has constructed a tank for irrigation purposes in this village. This village has also been studied by the World Bank team.

d. Ban Fai Taek:

Ban Fai Taek is a village of 75 families, situated 5 km. away from Kalasin town, which serves as an important provider of employment for the village. The upland is quite distant from the village, being about 5 km. away, and hence has only recently been developed, whereas the paddy land is well cultivated and high-yielding. No tractors are used in the village and no co-operative officers have ever visited the village. There is already a canal here, but irrigation is overdue. There are plans to establish a demonstration farm here.

e. Ban Lek:

Ban Lek is a village of 140 families, situated 5 km. away from Kalasin town, where some villagers find employment opportunities. The village economy is augmented to a considerable degree by remittances from off-farm work. There is a long tradition of emigration from the village. The first stage of the Irrigation Project is, according to

RID officials at Lam Pao, due here in 1974. The proximity of the experimental farm of the Food and Agricultural Organization of the United Nations at Huai Si Thon places this village in an advantageous position to benefit from the fruits of research there.

f. Ban Non Sung:

Ban Non Sung is a village of 124 families, situated 24 km. away from Kalasin town. It is sited on a terrace of the Chi River. It is characterized by large, extended families. The paddy land is low-lying and consists of inherently fertile alluvial soil; however, danger from inundation is a problem. The second stage of the Irrigation Project is due here in 1974/'75. Like Ban Tum this village is being studied as part of the Education Project of the Maha Sarakham Teachers' Training College.

g. Ban Lao Yai:

Ban Lao Yai is a new village of immigrants from Laos. Although the north-easterners or Isan as a whole are akin to the Lao, the villagers of Ban Lao Yai regard themselves and are regarded by others as being culturally and dialectally distinct. Situated 30 km. away from Kalasin town, it has 39 families and is characterized by large families. It has little upland, but the paddy land on the Chi floodplain is very fertile, although severe flooding, possibly as frequently as two years out of every three constitutes a problem. The second stage of the Irrigation Project is due here in 1975.

Table 2.7 presents some basic comparative statistics about the seven villages.

Since the Lam Pao Sample is selected from an Irrigation Area, it is obvious that irrigation is here meant to be a stimulus to progress and innovativeness within the area. Irrigation should therefore be

Table 2.7 Basic Statistics of Land-Use in the Sample Villages

Name	Total area rai	Total pop.	Total planted area (rai)	Total paddy area rai	Total fallow area rai	Total forest area rai
Lam Pao Area	4694.56	1807	4386.36	3134.15	248.20	60
Ban Na Chuak Nuea	996.45	280	850.75	633	109.7	36
Ban Tum	1211.5	383	1157	731.75	43.5	11
Ban Um Mao	560.83	241	549.33	442	11.0	0
Ban Fai Taek	291.78	158	272.78	207.5	9.0	10
Ban Lek	665.5	272	615.5	469.75	50.0	0
Ban Non Sung	712.5	271	692.5	524.65	20.0	0
Ban Lao Yai	256.0	75	248.0	125.5	5.0	3

regarded as a catalyst for innovation rather than an innovation in its own right. However, as stated earlier, the spread of irrigation in the area is incomplete and overdue.(1) Fig. 2.6 shows that 10% of the Lam Pao Sample had never heard of irrigation. This 10% includes farmers in Ban Fai Taek, whose village is bounded by a canal.(2) Use of irrigation in the Lam Pao Sample is so far small. This reflects the unavailability of irrigation rather than its rejection, although 1% of the Lam Pao Sample have used and rejected irrigation.

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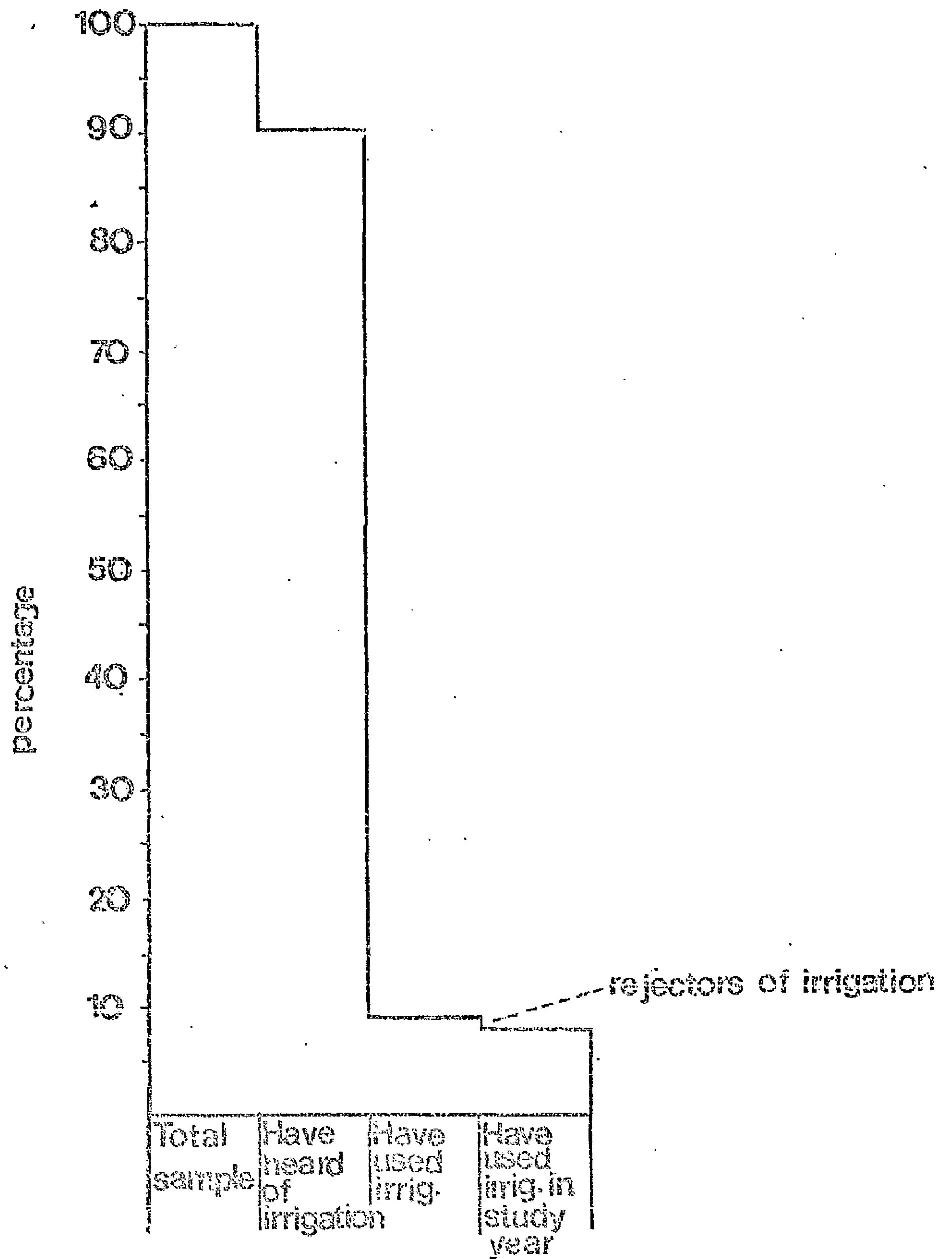
(1) It would be of great value to survey innovations within the seven villages of the Lam Pao Sample at a future date when irrigation becomes more widespread in order to assess whether irrigation is having the anticipated effect.

(2) This canal is regarded as something of an obstacle for the villagers, which has to be crossed by makeshift bridges. Water buffaloes provide a problem for the RID here, since they cause the sides of the canal to cave in.
Attayodhin comments on this being a general problem throughout Thailand.
Attayodhin, C., op.cit.

Figure 2.6 Knowledge and use of irrigation in the Lam Pao Sample



III. Sources and Techniques

Primary data used in this thesis came mainly from fieldwork in the dry season of 1971. This data consists of the information gathered by questionnaire from the Lam Pao Sample and the Small Sample, as well as less systematic but equally valuable information gathered in conversations with farmers and government officials. A second period of fieldwork in the dry season of 1972, when the writer was engaged on the Ban Tum Transect Soil Survey, provided the opportunity to check previous views and conclusions.

Secondary data was acquired from a wide variety of sources. These included the relevant ministries and departments of the Royal Thai Government in Bangkok and the changwat and amphoe offices in Kalasin. Data was also forthcoming from the Mekong Committee Office in Bangkok and fruitful use was made of the library of the Applied Scientific Research Council of Thailand (ASRCT). Comparative data and statistics were obtained from international organizations, such as FAO and ECAFE.

The analysis of the data was considerably facilitated by the use of the IBM computer at University College London.

Most research faces certain problems. One such problem which faces workers in developing countries is the unavailability or unreliability of national or provincial statistics. Moreover, it is often difficult to acquire statistics which are up to date.

A second problem arose from the questionnaire work. Many farmers are not used to precision; indeed, some do not know their own age. It is unreasonable therefore to expect anything other than an approximation, when they are asked, for example, about crop yields. When one is asking questions about previous years, the uncertainty seems to increase geometrically. Moreover, often one feels that the farmer gives the response which he thinks will please the questioner. The farmer often implicitly expects some return from his co-operation: he expects that the results of the researcher's work will provide immediate solutions to the farmer's ills. This cannot but trouble the conscience of the researcher, whose work usually has some quite different end.

In Thailand there is little problem of "distance" between the rural people and the researcher, encountered in some other societies. On the contrary, the researcher is treated with almost embarrassing hospitality and consideration. By inter-acting with his villagers in social settings he is able to extract much valuable information that would be denied him, if he confined himself to formal questionnaire. It is essential that a researcher should sympathize with those whom he studies (not to do so would be not to understand), but there is the danger of losing objectivity through complete identification. Moreover, the researcher knows that he is being studied by those whom he studies.

A further and common problem arose from insufficient time. In the field most of the time was devoted to the Lam Pao Questionnaire, which yielded invaluable research data. This meant, however, that little time was left for following up particular lines of enquiry that suggested themselves in the field and that could not have been envisaged before going out into the field. Indeed, this piece of research raised more questions than it answered.

CHAPTER THREE

AN EXAMINATION OF THE NATURE OF THE LAM PAO ECONOMY : SUBSISTENCE, POPULATION PRESSURE AND UNDEREMPLOYMENT

I. Criteria of Subsistence

Prior to assessing the development potential of the Lam Pao area, it is important to appreciate the nature of the present agricultural economy. In particular, it is necessary to establish the extent to which the farms of the area are commercial and viable undertakings at present and the degree to which the farmers are "economically-minded" men.

The terms "subsistence agriculture", "semi-subsistence agriculture" and "subsistence living" are often used without precision. Wharton defines the term "subsistence" as referring to a situation where 50% of the production is consumed, whilst "commercial" refers to a situation where 50% of the production is sold.(1)

Apart from the commercial/subsistence ratio and the ratio between production and consumption (he thinks that an increase in consumption would lag behind production), he suggests other criteria, both economic and social, of subsistence.

Thus he considers that the ratio of hired to total labour and the ratio of purchased factor inputs to all inputs used in production are indices of a farmer's involvement in the wider economy. Likewise,

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(1) Wharton, C.R., Jr., "Subsistence Agriculture: Concepts and Scope" in Subsistence Agriculture and Economic Development, ed. Wharton, C.R. Jr., Aldine Publ. Co., Chicago, 1969.

he considers a subsistence economy to be characterized by a low level of technology and,naturally, to involve little monetary income and a low level of living.

Less easily quantifiable, but perhaps equally valid, he considers a subsistence farmer has little decision-making freedom, since his prime motivation must be the maintenance of subsistence for a traditionally large family. Moreover, he considers that a subsistence farmer's decisions are not motivated by purely economic criteria, being rather influenced by ritual or supernatural considerations on the one hand, and considerations of status and social harmony on the other hand, whilst his social milieu may be governed by a peculiar matrix of interpersonal relations. Finally, he adds the vague truism that the subsistence farmer is psychologically distinct from the commercial farmer.

Wharton further defines "subsistence agriculture" as "that part of the agricultural sector made up of those farms and farm families characterized as subsistent on the basis of any or all of these criteria" and a "subsistent economy" as "the economic activities carried out by these subsistent individuals in the production, consumption, distribution and exchange of goods and services". It is thus to be distinguished from "subsistence living",which is "the absolute level of living".

The writer cannot accept that any of Wharton's criteria used individually apart from the production/commercial ratio and the commercial/subsistence ratio can be treated in isolation as an index of subsistence. Thus a fully commercial agriculture might just as easily be characterized by a low level of labour hire and a low level of purchased inputs, although a subsistence agricultural economy could hardly be characterized by a high level of purchased inputs. Similarly, although subsistence agriculture has generally a low level of technology there are types of commercial agriculture which may have an even lower level, e.g. small scale intensive vegetable cultivation, as, for example, practised by Chinese smallholders in south-east Thailand.

Similarly, a commercial farmer may be restricted in his decision-making, whilst, as Clayton has shown in East Africa, a subsistence farmer may have considerable latitude in his choice of subsistence crops.(1) Likewise, a commercial farmer need not necessarily have any greater contacts than a village middleman.

Accordingly, the writer would say that only the production/consumption and the commercial/subsistence ratios can be used to define subsistence agriculture, although the other factors may be important subsidiary characteristics of subsistence.

Likewise, Wharton identified different types of subsistence production, viz. the simple individual or familial subsistence production (a type almost unknown in the world, although the very primitive hunting-and-gathering Phi Thong Lu'ang, the so-called Spirits of the Yellow Leaves of northern Thailand may be such a type, albeit non-agricultural), the group or tribal subsistence production (e.g. the Hill Tribes of the north of Thailand), the pre-industrial subsistence production, e.g. the peasant type, which characterized most of south-east Asia, and the post-industrial subsistence type, where there exist in advanced industrial nations what Schultz calls "low income lacunae", where a subsistence agriculture prevails.(2)

The premises of Wharton's model are disputed. Thus Mathur and Ezekiel believe that the cash needs of semi-subsistence farmers are fixed

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(1) Clayton, E.S., Economic Planning in Peasant Agriculture, Wye College, Univ. of London, 1963.

(2) Schultz, T.W., Transforming Traditional Agriculture, Yale Univ. Press, 1964.

and that only the quantity of product required to secure this necessary cash is sold.[1]

Mellor, on the other hand, assumes that the subsistence farmer has limited aspirations, because the marginal utility of added goods and service income drops substantially once subsistence is met.[2]

Fisk produced a more simple model of a pure subsistence unit entirely isolated from the outside world, based upon his research among the Highland people of Papua-New Guinea.[3] His conclusion was that in such a pure subsistence economy with adequate land there is a distinct ceiling to the demand for food.

There may, of course, be a distinct ceiling to the demand for the staple food item, be it rice, yams, wheat, or, as in Fisk's example, sweet potato, but many traditionally subsistent societies may, in the first place, be deficient in calorie-intake[4] and even where the staple provided an adequate calorie-intake there may be felt deficiencies in protein or vitamins, which will be required to be made up either by

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(1) Mathur, P.N. and Ezekiel, H., "Marketable-Surplus of Food and Price Fluctuations in a Developing Economy". Kyklos, Vol.XIV, Fasc.3, pp.396-408, 1961.

(2) Mellor, J.W., "The Subsistence Farmer in Traditional Economies" in Subsistence Agriculture and Economic Development, op.cit.

(3) Fisk, E.K. and Shand, R.T., "The Early Stages of Development in a Primitive Economy : the Evolution from Subsistence to Trade and Specialization", ibid.

(4) Oshima reports that the Interdepartmental Committee on Nutrition for National Development (organized by the National Institute of Health of the U.S. Government) does not show any Asian calorie-deficiencies except for Thailand, taking existing levels of activity and body size as given. He further considers that insufficiency of calories may express itself in the form of inadequate work effort after the peak season. Thus a low calorie-intake is associated with low multiple cropping index. Oshima, H.T., "Food Consumption, Nutrition and Economic Development in Asian Countries", EDCC, Vol.15, No.4, July 1967.

diversifying cultivation or by purchasing from outside. This of course assumes that a subsistence economy is not totally isolated but has access to a wider external commercial economy. However, even if the subsistence economy does not have such access, there are few agricultural tribes so isolated or at such a low level of living that there is not some exchange with other groups or tribes, which provides a stimulus to production over and above subsistence needs. Finally, even when one has attained a balanced, healthy diet, there is still not a distinct ceiling for food, because then preferences and likings (always present, even at the lowest level) for non-essential or luxury food items and beverages will assume a greater prominence and a greater diversity in eating habits will be apparent.(1) The possible diversity is seemingly boundless in a free economy. Thus the new middle class urban Thai, for example, diversify their diet by the conspicuous consumption of exotic foods and drinks, e.g. European liquors, dairy products and confectionery.

Moreover, Fisk overlooks the fact that food has other functions besides personal consumption. If it is not readily perishable, as rice is not,(2) it may be stored and thus form both a security and an investment and even a standard of exchange (as was the case in Thailand before the spread of a money economy). Also it has a ceremonial and status value in most societies, exemplified in the ritual offering up of food either to supernatural powers or their earthly vicars. The Thai "merit-making" (<u>tham bun</u>), whereby one acquires spiritual "credit"

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(1) In this context the commonly heard Thai phrases, <u>kin len</u>, which refers to eating for pleasure or titillation, literally "playing at eating" and <u>bamrung khwam suk</u>, which can refer to eating or indeed the performance of any activity for the psychological satisfaction that it provides, literally "feeding one's happiness", illustrate a frame of mind which may be common in traditional societies.

(2) Rice in Thailand may be stored for over a year, if the storage facilities are adequate.

by, among other things, donating food to the monks, illustrates this, as does the sharing of food and feasting with kinsmen and strangers alike to achieve prestige through one's munificence.(1)

For all these reasons the writer believes that it is not proven that there is a distinct ceiling to the demand for food, but that, on the contrary, the demand for food may be both an important stimulus to the rationalization and increasing productivity of a subsistence economy and a primary stimulus of the desire to achieve money income by the cultivation of commercial crops.

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(1) The most extreme case of this widespread phenomenon is provided by the Pacific Coast Indians of British Columbia, such as the Nootka, Chinook, Kwakiutl and Haida, who used to accumulate food and belongings for ritual destruction to achieve prestige in the community.
Farb, P., Man's Rise to Civilization as Shown by the Indians of North America from Primeval Times to the Coming of the Industrial State, Paladin, 1971.

II. The Quantitative Criteria applied to the Lam Pao Sample

Since the seven villages of the Lam Pao Sample are basically rice-producing, Wharton's subsistence/commercial index could justifiably be applied to the percentage of glutinous rice sold. Table 3.1 shows the results. It can be seen that, using the index of less than 50% sold as a determinant of subsistence, then the Lam Pao Sample is overwhelmingly subsistent : indeed, in the majority of cases there is no sale of rice at all.

There are, however, interesting variations within the Sample. Thus Ban Lao Yai, the Lao village on the Chi River flood plain, is entirely subsistent with regard to rice. Also totally subsistent in this context is the old-established village of Ban Tum, where non-sellers are again in the majority. The other villages are all over 90% subsistent, and in only one of them, Ban Um Mao, does the number selling rice exceed (only slightly) the number not selling.

Thus on the basis of providing themselves with their staple food item for consumption, the sample villages are subsistent. However, the north-eastern farms are also characterized by "upland", which is land slightly too high or too steep for flooded paddy cultivation, and in the main this is given over to the cultivation of "field crops", i.e. crops other than rice and other than suan (fruit trees and garden crops). Except for the case of Ban Lao Yai, where such field crops as cotton and maize are primarily cultivated for domestic consumption, most field crops are per se commercial crops. At present kenaf is the most important field crop; this is by its very nature entirely cultivated for sale and indeed mainly for export. Thus the importance of field crops can be used as a supplementary means of assessing the subsistent nature of the Sample.

Table 3.1 — Index of Subsistence based upon percentage of rice sold

(No. of households)	Ban Na Chuak Nuea (35)	Ban Tum (57)	Ban Um Mao (35)	Ban Fai Taek (25)	Ban Lek (42)	Ban Non Sung (33)	Ban Lao Yai (11)	Lam Pao Sample (238)
a. non-sellers	26 cases	51 cases	16 cases	20 cases	32 cases	25 cases	11 cases	199 cases (76%
b. less than 50% sold	7 cases	6 cases	17 cases	4 cases	8 cases	8 cases	none	50 cases (20%
c. more than 50% sold	2 cases	none	2 cases	1 case	2 cases	none	none	7 cases (4%
d. total subsistence (a + b)	33 cases	57 cases	33 cases	24 cases	40 cases	33 cases	11 cases	249 cases (96%
e. total sale (b + c)	9 cases	none	19 cases	5 cases	10 cases	8 cases	none	57 cases (24%

Thus Table 3.2 shows that in the Sample as a whole upland cultivation is only important on 58% of the holdings. A similar importance of upland is reflected in the case of Ban Na Chuak Nuea and Ban Lao Yai. Ban Tum and Ban Non Sung, on the other hand, are villages in which field crops are of considerable importance, 89% and 76% respectively. In Ban Lek and Ban Fai Taek the cultivators of field crops are slightly in the minority, whilst in Ban Um Mao field crops are of little significance. It is interesting to note that Ban Tum and Ban Lao Yai, which are the most subsistent villages with respect to rice, are the very villages in which the cultivation of field crops is most important. Similarly, Ban Um Mao, in which field crops are quite insignificant, is that village which is most commercial with respect to rice.

Thus it is clear that the commercial cultivation of field crops is of some importance in the area, although a large majority of farms remain purely subsistent rice farms. The tables also tentatively suggest that there may be some relationship between the cultivation of field crops and the subsistent nature of rice cultivation, in that it may be the non-cultivation of field crops (owing to there being no available upland or insufficient labour) which induces a farmer to produce rice commercially. Similarly, expansion of field crops may be a bar to commercialization of rice cultivation. Of course, this is not necessarily undesirable, since conditions in the north-east are not optimum for rice cultivation and a more profitable situation might be one in which the farmers concentrated heavily upon field crops even to the extent of having to purchase most of their rice requirements. (Naturally, there would have to be other favoured areas within the north-east concentrating upon the production of commercial glutinous rice

Table 3.2 Index of Subsistence based upon production of upland crops

(no. of households)	Lam Pao Sample (238)	Ban Na Chuak Nuea (35)	Ban Tum (57)	Ban Um Mao (35)	Ban Fai Taek (25)	Ban Lek (42)	Ban Non Sung (33)	Ban Lao Yai (11)
	(cases)	(cases)	(cases)	(cases)	(cases)	(cases)	(cases)	(cases)
cultivation of upland crops	137 (58%)	18	51	9	10	17	25	7
no cultivation of upland crops	101 (42%)	17	6	26	15	25	8	4
upland crops with subsistence rice	132 (55%)	17	51	8	10	14	25	7
upland crops with less than 50% rice sale	26 (11%)	5	6	4	2	2	7	none
upland crops with more than 50% rice sale (most commercial)	4 (1%)	1	none	1	none	2	none	none
upland crops with rice sale	30 (13%)	6	6	5	2	4	7	none
upland crops with no rice sale	112 (47%)	11	45	3	8	10	18	7
no upland crops with subsistence rice (most subsistent)	96 (40%)	16	6	23	14	25	8	4
no upland crops with less than 50% rice sale	24 (10%)	2	none	13	2	6	1	none
no upland crops with more than 50% rice sale	3 (1%)	1	none	1	1	none	none	none
no upland crops with rice sale	27 (11%)	3	none	14	3	6	1	none
no upland crops with no rice sale	69 (30%)	13	none	9	11	19	7	4

for the peculiar regional market). However, such a possibility seems at present remote and the reason is the perfectly reasonable desire of the north-eastern farmer to have the wherewithal to support his family from his own farm, no matter how much he venture into commercial cultivation with its attendant risks, uncertainties and vacillating prices.

Table 3.3 shows the area under field crops as an index of subsistence. For the Lam Pao Sample as a whole this area is quite unimportant. Only 26.9% of holdings have over 5 rai of field crops, whilst the large cultivators (over 10 rai) constitute only 9% of holdings. The mean size of upland is highest in Ban Tum and also in Ban Lao Yai, in which latter village it is likely to be subsistent upland. Elsewhere the area under field crops approaches the mean for the Sample as a whole, but it is particularly low in Ban Um Mao, in which village the sale of rice is most important. Similarly, the percentage of the total population which does not cultivate field crops is highest in Ban Um Mao and lowest in Ban Tum and Ban Lao Yai.

In using Wharton's ratio of hired to total labour as an index of subsistence, the writer adopted the figure of over half the total labour used on the farm being hired as an index of commercialization. Table 3.4 illustrates the pattern.

This brings out the unimportance of hired labour in the agriculture of the sample. However, if labour is hired, it is twice as likely to be hired on a relatively large scale, i.e. comprising half or more of the total labour force.

The hiring of labour is least common in Ban Lao Yai (where there is none), Ban Non Sung and Ban Lek. It is slightly more important in Ban Tum, Ban Na Chuak Nuea and Ban Um Mao, whilst in Ban Fai Taek

Table 3.3 — The Area under Field Crops as an Index of Subsistence

	no field crops	0.1-4.9 rai	5-9.9 rai	10-19.9 rai	20 plus rai	Mean (rai)	Total (rai)
	(cases)	(cases)	(cases)	(cases)	(cases)		
Ban Na Chuak Nuea (35 households)	17	9	8	none	1	3	106.6
Ban Tum (57 households)	6	20	22	9	none	5.3	303.3
Ban Um Mao (35 households)	22	10	2	1	none	1.3	47
Ban Fai Taek (25 households)	11	10	4	none	none	2.1	52.6
Ban Lek (42 households)	22	14	1	5	none	2	84.6
Ban Non Sung (33 households)	8	18	6	1	none	2.75	96.5
Ban Lao Yai (11 households)	1	6	2	2	none	4.6	50.8
Lam Pao Sample (238 households)	87	87	45	18	1	3.1	737.8
	(36.5%)	(36.5%)	(19%)	(7.5%)	(0.4%)		

Table 3.4 Ratio of Hired to Total Labour as an Index of Subsistence

	no hired labour (cases)	less than 50% hired (cases)	50% and over hired (cases)
Ban Na Chuak Nuea (35 households)	177	22	39
Ban Tum (57 households)	37	5	13
Ban Um Mao (35 households)	25	2	8
Ban Fai Taek (25 households)	14	7	4
Ban Lek (42 households)	36	1	5
Ban Non Sung (33 households)	27	5	1
Ban Lao Yai (11 households)	11	none	none
Lam Pao Sample (238 households)	177 (74%)	22 (9%)	39 (17%)

the proportion of hirers and non-hirers is similar. There is no appreciable difference between Ban Tum, the village which is most important for field crops and mainly subsistent with respect to rice, and Ban Um Mao, which is most commercial in its rice cultivation and unimportant in field crop cultivation, with respect to the hiring of labour.

In all the villages except Ban Non Sung and Ban Fai Taek large scale hiring of labour is appreciably more important than small scale : the former lays relatively great emphasis upon field crops, the latter relatively little. The amount of hiring in Ban Fai Taek is clearly a result of a considerable amount of small scale hiring and slightly less large scale hiring.

More significant than the ratio of hired to total labour is the proportion of all mandays which are hired mandays, since in some cases a high proportion of hired mandays is associated with a low proportion of hired men and vice versa. Table 3.5 illustrates the pattern.

Thus for the Lam Pao Sample as a whole hired men are of greater proportional significance than hired mandays. 17% of the households have 50% and over hired men, whilst only 3% have 50% and over hired mandays. This pattern is reflected in all the villages with the exception of Ban Non Sung, where 9% of the households have over 50% hired mandays, but only 3% of the households have more than 50% of their manpower hired. The Ban Non Sung figure is also the highest figure for hired mandays in the Sample, indicating a greater commercialization of agriculture in this village. On the other hand, Ban Lek is remarkable, because, although 12% of the households have 50% and over hired men, there are no households with over 50% hired mandays.

Table 3.5 Percentage Hired Mandays of Total Mandays as Index of Subsistence

	no hired mandays (cases)	1-9% (cases)	10-49% (cases)	50-100% (cases)
Ban Na Chuak Nuea (35 households)	25	5	4	1
Ban Tum (57 households)	39	3	15	none
Ban Um Mao (35 households)	25	3	6	1
Ban Fai Taek (25 households)	36	3	3	
Ban Lek (42 households)	36	3	3	
Ban Non Sung (33 households)	27	1	2	3
Ban Lao Yai (11 households)	11			
Lam Pao Sample (238 households)	177 (74%)	16 (7%)	39 (16%)	6 (3%)

The extent of purchased inputs and their relationship to total inputs is an index of the farmer's involvement in the wider economy. Moreover, since the principal non-purchased factor input in this case is labour, this relationship will be an indicator of the extent to which farming in the Lam Pao area is capital- or labour-intensive.

First of all, the writer investigated the extent of purchased factor inputs, which embraces hired labour, chemical fertilizer and insecticide use, tractor hire, purchase of seeds and other similar expenditures. The results are indicated in Table 3.6.

It can thus be seen that in the Lam Pao Sample as a whole there is a large proportion of households which have no purchased inputs at all or only a very small proportion (0 - 99 Baht). However, this is exceeded by the group with a moderate amount of purchased inputs (100 - 499 Baht). Finally, the truly capital-intensive farms form a small minority.

As far as the villages are concerned, Ban Lao Yai is conspicuous for its almost total lack of purchased inputs, but the paucity of capital inputs in Ban Na Chuak Nuea is rather surprising in the light of other data about this village. Ban Tum, Ban Lek, Ban Fai Taek and Ban Um Mao reflect the Lam Pao mean by having a preponderance of cases within the 100 - 499 Baht range, whilst Ban Non Sung, surprisingly, emerges as the most capital-intensive village, although it lacks the really "big spenders", which, although of minor importance everywhere, are most marked in the case of Ban Tum and Ban Um Mao.

As a converse of these findings one would expect the area to be one of labour-intensive agriculture. Accordingly, the statistics for total mandays per annum were examined. However, these figures only refer to family labour, since hired labour is included as a purchased

Table 3.6 — The Range of Purchased Inputs as an Index of Subsistence

	no purchased inputs (cases)	1-99 Baht (cases)	100-499 Baht (cases)	500-999 Baht (cases)	1,000 Baht plus (cases)
Ban Na Chuak Nuea (35 households)	19	6	7	none	3
Ban Tum (57 households)	14	7	28	5	3
Ban Um Mao (35 households)	4	0	23	7	1
Ban Fai Taek (25 households)	8	4	11	0	2
Ban Lek (42 cases)	12	2	26	1	1
Ban Non Sung (33 cases)	5	1	24	3	0
Ban Lao Yai (11 cases)	10	1			
Lam Pao Sample (238 cases)	72 (30%)	21 (9%)	119 (50%)	16 (7%)	10 (4%)

At the time of the survey 50 Baht was equal to £1 sterling.

input. Thus, although this fact would give a misleading impression of the degree of labour-intensiveness, it provides a more reliable index to the degree of subsistence.

These figures also fail to take into account the institution known as long khaek, whereby relatives would provide labour on a reciprocal basis. This institution, the like of which is widespread throughout the traditional world and was very much in evidence in peasant agriculture in Europe, awaits detailed study in Thailand.

However, the writer suspects that the institution of long khaek comes to play most frequently at certain stages in the development of the family, when there is insufficient labour for subsistence needs. Such stages might be represented by the married couple with a number of young children who are not yet able to undertake their productive responsibility, the family which has a dearth of labour through illness or widowing, the ageing man or woman who is not able to farm his plots efficiently. Thus the writer speculates that the institution of long khaek is not one which promotes or provides for commercial agriculture : in such cases labour would have to be hired.

On this matter Georgescu-Roegen claims with regard to traditional agriculture as a whole that the farmer's estimate of desirable family size and hence labour force is predicated upon the maximum numbers required for the peak seasonal load when crops follow a seasonal pattern and the maximum numbers required for bumper crops.(1)

It is the writer's impression that in the Lam Pao Sample, although the farmer has a quite definite idea of what constitutes labour shortage and the minimum desirable family size, he has no idea regarding

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(1) Georgescu-Roegen, N., "The Institutional Aspects of Peasant Communities : an Analytical View", in Subsistence Agriculture and Economic Development, op.cit.

either maximum or optimum family size. Families are not at the moment planned and large families are considered a good in their own right as well as being an insurance for old age.(1)

Table 3.7 shows total mandays per year as an index of subsistence. In the Sample as a whole total labour inputs are not very great and this situation is reflected in all the study villages, although most markedly in the case of Ban Lek. Only Ban Tum and Ban Na Chuak Nuea have any large labour inputs (500 to 999 mandays per year).

The ratio of purchased to total inputs is a quite meaningful index of subsistence. Total inputs were arrived at by the summation of total purchased inputs with total labour. Labour was given a monetary value on the basis of the average agricultural wage per manday at the time of the survey, i.e. 9 Baht. Table 3.8 illustrates the results.

Thus, where purchased inputs occur, they are more likely to constitute a high proportion of purchased inputs, whilst the group within

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(1) In the dry season of 1971 an ECAFE team from Bangkok under the leadership of Dr. R. Gavin Jones conducted a survey into fertility, fecundity and contraceptive methods in the Lam Pao area. Some of their study villages overlapped the Lam Pao Sample. They encountered an understandable reticence among the villagers, especially since the interviewers were young girls from Bangkok. Generally, they concluded that birth control has made little progress in the area. Of course, there are here, as in many other traditional societies, traditional methods of birth control using local medicines. It is difficult to judge the efficacy of these medicines, but, like most traditional medicines, they are probably not totally ineffective. However, the situation is not the same throughout the whole Kingdom. Khun Preecha Kuwinpant, Faculty of Political Science, Chulalongkorn University, states that more progress has been made in the Chiang Mai rural area : there there is vigorous birth control propaganda and the paraphernalia of contraception are freely available (personal communication).
According to Dr. Mali Thaineua, family planning in Thailand is opposed on the grounds that the Chinese in Thailand will not accept it as readily as the Thai and thus will increase disproportionately. Thaineua, M., "Ratio of Particular Groups of Population", Thailand Development Report, Vol.IV, No.7, April 1969.

Table 3.7 — Total Mandays / Year as an Index of Subsistence

	0-99 mandays	100-199	200-499	500-999	1,000 plus
Ban Na Chuak Nuea (35 households)	13	13	8	1	0
Ban Tum (57 households)	19	26	10	2	0
Ban Um Mao (35 households)	9	17	9	0	0
Ban Fai Taek (25 households)	10	11	4	0	0
Ban Lek (42 households)	16	18	8	0	0
Ban Non Sung (33 households)	8	17	8	0	0
Ban Lao Yai (11 households)	3	4	4		
Lam Pao Sample (238 households)	78 (33%)	106(45%)	51 (21%)	3 (1%)	0

Table 3.8 Ratio of Purchased Inputs to Total Inputs

	no purchased inputs	1:1 to 1:4	1:5 to 1:9	1:10 to 1:19	1:20 to 1:99	1:100 plus
Ban Na Chuak Nuea (35 households)	19	4	2	5	4	1
Ban Tum (57 households)	14	23	7	8	4	0
Ban Um Mao (35 households)	4	13	15	3	0	0
Ban Fai Taek (25 households)	8	6	5	4	2	0
Ban Lek (42 households)	12	8	11	9	1	1
Ban Non Sung (33 households)	5	6	15	6	1	0
Ban Lao Yai (11 cases)	10	0	0	0	1	0
Lam Pao Sample (238 households)	72 (30%)	60 (25%)	55 (23%)	35(15%)	13(5%)	2 (0.8%)

the range of from 1:20 to 1:99 comprises only 5.8% of the total Sample. This group is similarly poorly represented in all the villages with the exception of Ban Na Chuak Nuea.

Table 3.9 uses the monetary income per household as an index of subsistence. This income includes both sale from commercial crops and the relatively small sale from handicrafts or fish, as well as off-farm income derived from part-time work in Kalasin town or at the Lam Pao dam site and remittances from members of the family working elsewhere. This index is more clearly an index of subsistence living than of commercialization of farming.

The figures for monetary income indicate that, although the proportion of families that lack any such income is small, the majority of families have an income of below 5,000 Baht and the proportion of "wealthy" families (over 20,000 Baht) is very small.(1) Most of the villages have similar mean monetary incomes to the Lam Pao Sample mean of 4,056 Baht, Ban Non Sung and Ban Tum having lower means and the others with the exception of Ban Lao Yai having higher means, with Ban Fai Taek having the highest mean. Ban Lao Yai, as expected, has the extreme low mean of 1,724 Baht.

The "wealthy" group are absent in Ban Lao Yai, Ban Non Sung and Ban Fai Taek and of equal importance in all the other villages. The

(1) Usher considers that conversion by foreign exchange rates into U.S. dollars per capita exaggerates the differences in living standards between rich and poor countries. Thus, he thinks that in comparison of the income between two areas the income of each area is buoyed up by transport costs embodied in the final product which constitute income and, moreover, comparisons do not reflect the comparative advantage of poor countries in untraded products. Therefore, although conventional comparisons show the per capita national income of the U.K. to be fourteen times that of Thailand, his recomputation to allow for the "bias" in comparison suggests the ratio should be 3 to 1.
Usher, D, "The Transport Bias in Comparisons of National Income", Ec., Vol.XXX, No.118, May 1963.

Table 3.9 Monetary Income as an Index of Subsistence

	no income or heavily indebted	1-999 Baht	1,000-1,999 Baht	2,000-4,999 Baht	5,000-20,000 Baht	20,000 Baht plus	Total income (Baht)	Mean income (Baht)
Ban Na Chuak Nuea (35 households)	3	6	4	9	12	1	163,604	4,923
Ban Tum (57 households)	4	6	14	17	15	1	223,406	4,923
Ban Um Mao (35 households)	2	3	8	11	10	1	162,234	4,635
Ban Fai Taek (25 households)	0	1	1	14	9	0	133,350	5,334
Ban Lek (42 households)	5	10	8	9	9	1	174,097	4,145
Ban Non Sung (33 households)	0	8	9	10	6	0	106,923	4,145
Ban Lao Yai (11 households)	0	4	5	1	1	0	18,960	1,724
Lam Pao Sample (238 households)	14	38	49	71	62	4	982,474	4,056
	(6%)	(16%)	(21%)	(30%)	(27%)	(2%)		

income-less group occupies a similar position in the villages in which it is present, but is, interestingly, lacking in precisely those villages which lack the "wealthy" group. The group with a mean income of from 2,000 to 4,999 Baht, is, as expected, most common, but the irrigated village of Ban Na Chuak Nuea has the majority in this category, whilst Ban Lao Yai has the majority in the category below this group.

If a low level of living is an indicator of subsistence, then the possession of non-essential 'luxury' items is an indicator of the level of living. Accordingly, the writer investigated the value of 'luxury' items in the Lam Pao Sample, purchases at any time from 1950 to the study year. Table 3.10 shows the results.

There is a significant proportion of the population in the total Sample, which has no expenditure on 'luxury' items. This proportion is less marked in the case of Ban Tum and Ban Fai Taek, whilst in the other villages this proportion is similar to the proportion in the total Sample. In Ban Lao Yai, Ban Na Chuak Nuea, Ban Um Mao and Ban Lek this is the most important group. In Ban Tum and Ban Non Sung, however, most numerous are those farmers who have spent up to 499 Baht on 'luxury' items. The 'big spenders' (2,000 Baht and over) are absent from Ban Lek, below average importance in Ban Na Chuak Nuea and Ban Tum and quite marked in the case of Ban Fai Taek, being twice the mean for the Lam Pao Sample. 'Big spenders' are quite important in Ban Um Mao, of average importance in Ban Na Chuak Nuea and, surprisingly, Ban Lao Yai and of very little importance in Ban Lek.

The actual luxury items involved are watches, radios, bicycles and sewing machines. They may be taken as fairly reliable indicators, since they are quite expensive and durable, and, also, whilst all are 'luxuries', all may also have a profound influence upon the way of life

Table 3.10 Luxury Expenditure as an Index of Subsistence

	no expend-iture	1-499 Baht	500-999 Baht	1,000-1,999 Baht	2,000 Baht plus	Mean (Baht)
Ban Na Chuak Nuea (35 households)	15	7	9	3	1	529
Ban Tum (57 households)	10	32	10	2	3	578
Ban Um Mao (35 households)	13	6	5	6	5	929
Ban Fai Taek (25 households)	2	5	7	4	7	1,441
Ban Lek (42 households)	18	11	7	6	0	368
Ban Non Sung (33 households)	13	15	1	1	3	471
Ban Lao Yai (11 households)	4	2	3	1	1	600
Lam Pao Sample (238 households)	75	78	42	23	20	690
	(31%)	(33%)	(17%)	(10%)	(8%)	

of the possessor. All can rapidly make the transition from 'luxury' to 'necessity'. The sewing machine, is, of course, a piece of capital equipment, which may be of use to provide clothing for the family or for sale. Other possible 'luxury items', e.g. the purchase of manufactured male and female clothing are indeed probably the major items of 'luxury' expenditure, but as individual items are not very expensive and in total not easily remembered or quantifiable. From the writer's observations, however, it would appear that there is no ceiling to the demand for clothing in the study area; this applies to the population as a whole, but is most marked among youths and young unmarried men and women. Of the other major 'luxury' items, the small motor cycle or scooter will probably become increasingly popular in the future, as it is in Kalasin town at present: at the moment there is to the writer's knowledge only one motorcycle in the Sample, the property of the carpenter in Ban Tum.

As Table 3.11 shows, the most common possession in the Sample as a whole is the radio. This is important in all the villages, especially Ban Fai Taek. However, the radio and 'luxury' articles in general are least important in Ban Lek and, surprisingly, Ban Na Chuak Nuea.

In the Lam Pao Sample as a whole after the radio, the bicycle, the watch and the sewing-machine form a sequence of importance, which is repeated in Ban Na Chuak Nuea, Ban Fai Taek and Ban Lek. In Ban Lao Yai bicycles and watches are of equal importance. In Ban Tum the order of importance is watch, sewing-machine, bicycle; in Ban Lek, bicycle, watch, sewing-machine; in Ban Non Sung sewing-machines are more important than bicycles and watches. In Ban Um Mao the radio is most important, followed in sequence by the bicycle, sewing-machine and watch.

Table 3.11 The Possession of Luxury Items as an Index of Subsistence

(no. of households)	Ban Na Chuak Nuea (35)	Ban Tum (57)	Ban Um Mao (35)	Ban Fai Taek (25)	Ban Lek (42)	Ban Non Sung (33)	Ban Lao Yai (11)	Lam Pao Sample (238)
possess no luxury items	15	10	13	2	18	13	4	75 (32%)
watch	7	11	5	8	5	1	3	40 (17%)
radio	16	44	19	22	20	16	6	143 (60%)
bicycle	10	2	14	16	11	2	3	58 (24%)
sewing-machine	1	6	6	6	3	4	1	27 (11%)
watch and radio	6	9	4	8	5	0	2	34 (14%)
watch and bicycle	6	2	4	6	4	0	1	23 (10%)
watch and sewing-machine	1	2	2	5	0	0	0	10 (4%)
bicycle and sewing-machine	0	0	3	5	10	0	1	19 (8%)
radio and bicycle	7	2	10	15	8	0	0	44 (18%)
radio and sewing-machine	1	4	6	6	2	1	1	21 (9%)
watch and radio and bicycle	5	2	3	6	4	1	1	22 (9%)
watch and radio and bicycle and sewing-machine	1	0	2	3	0	0	1	6 (3%)
radio, bicycle and sewing-machine	1	0	2	3	0	0	0	6 (3%)

III. Summary of the Subsistence Nature of the Seven Study Villages

Ban Na Chuak Nuea emerges as a village with high total labour inputs, a large ratio of purchased to total inputs and a scarcity of luxury items. With respect to all other indices it is moderate.

Ban Tum is a village of subsistence glutinous rice cultivation, where field crops are important and the area under field crops large. It is a village characterized by large labour inputs.

Ban Um Mao is a village where the sale of glutinous rice is important and field crops unimportant both with respect to number of cultivators and area cultivated.

Ban Fai Taek is a village where hired labour and hired mandays are important, there is a high monetary income and neither 'wealthy' nor poor group. It is a village of 'big spenders' with a high mean expenditure and the greatest number of 'luxuries' of any village.

Ban Lek is a village where hired mandays are not important and total labour small. There is a low mean expenditure, no 'big spenders' and 'luxuries' are not important.

Ban Non Sung is a village where field crops are important and hired mandays not important. Purchased inputs are important and there is neither 'wealthy' nor poor group.

Ban Lao Yai is a village of subsistence glutinous rice cultivation with a large area under field crops, which, however, are cultivated for subsistence consumption rather than for sale. It has both a low proportion of hired labour and of hired mandays. It has a low monetary income and neither 'wealthy' nor poor group.

Thus Ban Um Mao and Ban Na Chuak Nuea emerge as the villages most typical of the Lam Pao Sample as a whole with respect to subsistence characteristics, and Ban Lao Yai and Ban Fai Taek deviate most from the average subsistence conditions fround in the Sample as a whole.

Thus the Lam Pao Sample is representative of the wide variety of subsistence conditions which may be found throughout the Lam Pao Irrigation Area. By the same token, however, it is not homogeneous, and the salient differences between villages must constantly be borne in mind in description of and conclusions from the statistics of the Lam Pao Sample as a whole, as equally in predictions of future trends within the Sample.

IV. A Composite Index of Subsistence

From the various indices of subsistence seven were selected as the surest distinctive signs of subsistence, viz. the percentage of glutinous rice produced which is sold, the area under field crops, the percentage of hired men in the total labour force, the percentage hired mandays in the total mandays expended, purchased inputs as a percentage of total inputs, monetary income and expenditure on luxury items.

The taxonomic technique was used to arrive at a Composite Index of Subsistence.(1) The standard score (Z) of each variable was first derived by the following formula:

$$Z = \frac{xj - \bar{x}j}{Sj}$$

Where there is a set Y of N points representing households 1, 2 ......N for a group of variables 1, 2 ... m;

then $j = 1, 2 \ldots m$

$\bar{x}$ = mean

s = standard deviation.

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(1) This taxonomic method was developed by a group of Polish mathematicians in the early 1950's and proposed in 1968 to UNESCO as a means of making comparisons of international development by Prof. Zygmunt Hellwig of the Wrocław Higher School of Economics. Floret, K. et al., Taksonomia Wrocławska (Wrocław Taxonomy), Poznań, 1952. Hellwig, Z., Procedure of Evaluating High-Level Manpower Data and Typology of Countries by Means of the Taxonomic Method, unpublished UNESCO working paper 1967.
The method converts indicator values into quantities which can be added together. This is achieved by a process of standardization based on the mean and standard deviation of each indicator. These standardized values then replace raw values and result in a new matrix. The method is used and elaborated to compare degrees of development among the nations of the world in Harbison, F.H., Marunhic, J. and Resnick, J.R., Quantitative Analyses of Modernization and Development, Princeton, 1970.

From the standard scores the Index (I) is then derived by the following formula:

$$I = \frac{\sum_{i=1}^{m} Zi}{m}$$

These Composite Indices of Subsistence were then expressed graphically, as Fig. 3.1 shows. The plotted points were divided into four groups. Thus the first group indicates the subsistent farms, whilst the fourth group indicates the commercial farms. The second group is thus partly commercial, and the third group partly subsistent.

Thus the overwhelming visual impression from the figure is of the subsistent nature of the Sample. In the Lam Pao Sample there are four fully commercial farms, as defined above, (1.7%), and twelve partly commercial farms (5%). This leaves 222 (93%) which tend towards subsistence. Of these 62 (26%) are semi-subsistent and 160 (67%) fully subsistent.

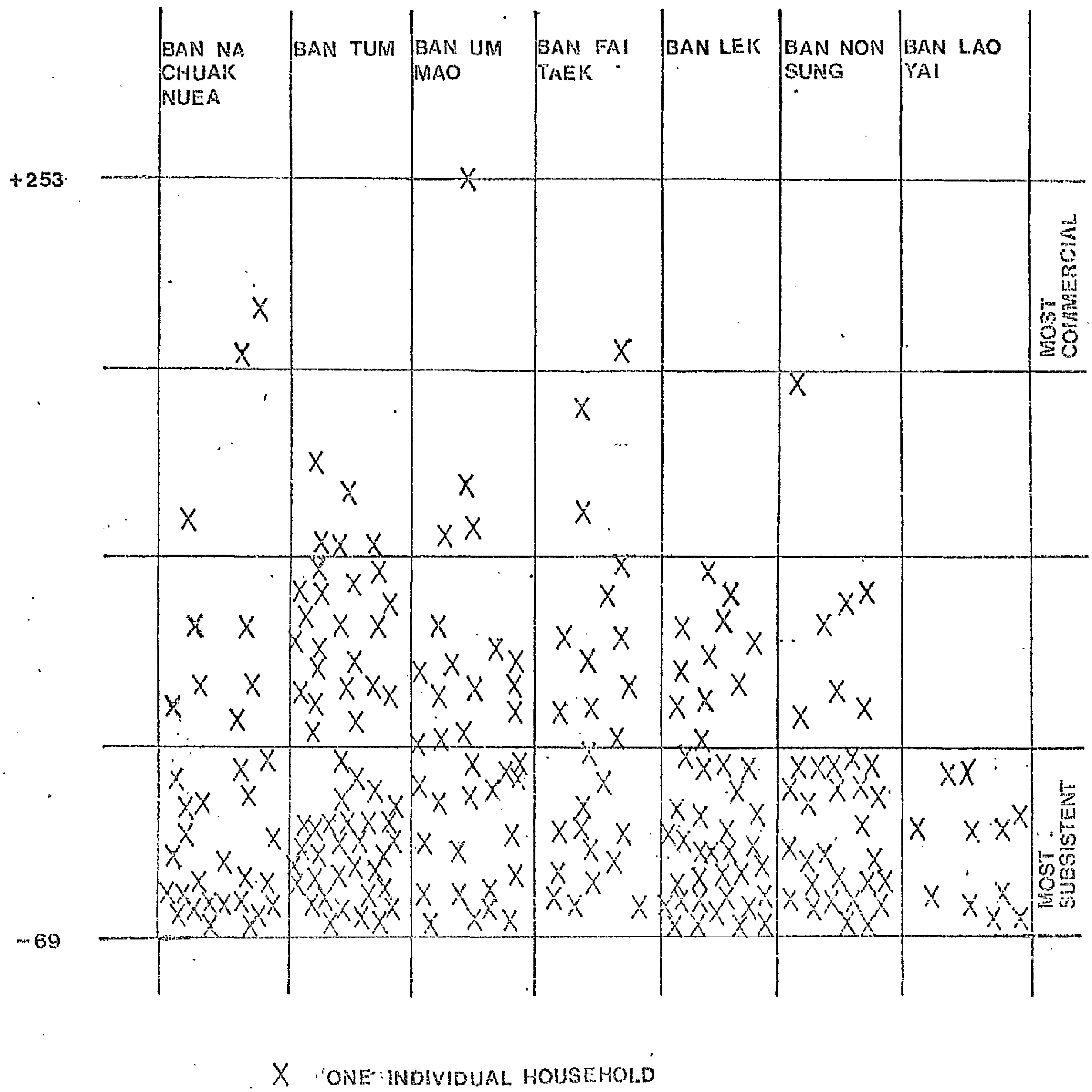
In Ban Na Chuak Nuea there are two fully commercial farms, one partly commercial. Thus 32 tend towards subsistence with 6 semi-subsistent and 24 fully subsistent.

Ban Tum has no fully commercial farms, but 5 partly commercial. Thus 52 tend towards subsistence with 20 semi-subsistent and 32 fully subsistent.

Ban Um Mao has one fully commercial farm (which has the highest Index of the whole Sample), 3 partly commercial farms. Thus 31 tend towards subsistence with 11 semi-subsistent and 20 fully subsistent.

Ban Fai Taek has one fully commercial farm and two partly commercial farms, leaving 22 farms tending towards subsistence with 8 semi-subsistent

Figure 3.1 Degree of subsistence in the Lam Pao Sample based on seven selected indices



and 14 fully subsistent.

Ban Lek has no fully commercial or partly commercial farms. Of its farms 10 are semi-subsistent and 32 fully subsistent.

Ban Non Sung has no fully commercial farms either and only one partly commercial farm. Of the remainder 6 are semi-subsistent and 26 fully subsistent.

Ban Lao Yai emerges as the most subsistent village in the Sample. All of its farms are fully subsistent.

Thus it is clear that the Lam Pao Sample as a whole is subsistent in character according to the Composite Index of Subsistence. Moreover, all the villages partake of this subsistent character: each village is over 80% subsistent. Also, everywhere fully subsistent holdings outnumber semi-subsistent holdings. Fully commercial holdings are everywhere insignificant but most noticeable in Ban Na Chuak Nuea which benefits from irrigation and considerable opportunities for off-farm income.

Partly commercial farms would be expected to be more important than fully commercial farms in this area. Ban Tum, Ban Um Mao and Ban Fai Taek are the villages with most partly commercial farms. However, in Ban Na Chuak Nuea partly commercial farms are less important than fully commercial farms, which may indicate that the improved opportunities in this village have enabled a few farmers to grow disproportionately wealthy but have not necessarily produced a commercial 'outlook' in the village as a whole. In fact the partly commercial farms are even more important in the more subsistent village of Ban Non Sung than they are in Ban Na Chuak Nuea, which may indicate that marked inequalities, not usually characteristic of north-eastern villages but commonplace in the villages of the Central Plain (where the process of commercialization created wealthy farmers, large landlords and tenants and a landless class of agricultural labourers), may be arising in Ban Na Chuak Nuea. Whether this will be a necessary concomitant of commercialization in the north-east is not at present ascertainable.

Thus taking all the fully commercial and partly commercial farms together, Ban Fai Taek and Ban Um Mao emerge as the most commercial villages, whilst Ban Tum and Ban Na Chuak Nuea are both equally commercial.

The size of the group of semi-subsistent farms may be a guide to future progress, since movement from this group to the partly commercial group is the easiest and most likely inter-group movement. The proportion of semi-subsistent farms of all subsistent farms is fairly similar in Ban Tum, Ban Um Mao and Ban Fai Taek, being 38%, 35% and 36% respectively, whilst Ban Na Chuak Nuea and Ban Non Sung have lower proportions, 18% and 19% respectively. Ban Lek (24%) is transitional.

V. Relationships between the various Quantitative Indices of Subsistence

Use of the Chi-square test suggests certain relationships between the various indices of subsistence. The values of Chi-square obtained are more significant for the Lam Pao Sample as a whole than for the individual village samples, since Chi-square varies directly with N, the size of the sample.

Within the Lam Pao Sample there seems to be a relationship between the proportion of hired labour per farm and the monetary income per farm. This is as would be expected. Similarly, monetary income appears to be related to the extent of 'luxury' expenditure and to the existence of a group of 'big spenders'. More perplexing, however, is the fact that the existence of a poor group seems to be related to the area under field crops. All these values of Chi-square are significant at the 0.1% level.

Significant at the 1% level, a relationship appears between hired labour and 'luxury' expenditure. The hire of labour is also related, at the 5% level of significance, to large spending on 'luxury items' and the proportion of purchased inputs used is similarly related to the existence of 'big spenders'. Perhaps, this indicates that investment on the farm and expenditure for conspicuous consumption are not mutually exclusive, but might go hand-in-hand.

At the 10% level of significance, there is a relationship between the proportion of purchased inputs of total inputs and both commercial glutinous rice cultivation and field crop cultivation.

At the 25% level of significance, a relationship is found between the percentage of glutinous rice sold and the area of field crops. The area under field crops seems to be similarly related to the hire of labour.

Within the individual villages the only meaningful relationship at the 0.1% level of significance is that between the proportion of purchased inputs and the existence of a 'wealthy' group in Ban Na Chuak Nuea.

At the 1% level of significance, the only meaningful relationship is that between the area under field crops and purchased inputs in Ban Tum.

At the 5% level of significance, the meaningful relationships are between hired labour and the existence of a group of 'big spenders' in Ban Na Chuak Nuea, the percentage of glutinous rice sold and the area under field crops in Ban Tum, the area under field crops and the proportion of purchased inputs in Ban Lek and the area under field crops and the extent of 'luxury' expenditure in Ban Lao Yai.

At the 10% level of significance, the meaningful relationships are between the proportion of hired labour and the extent of 'luxury' expenditure in Ban Na Chuak Nuea, the range of purchased inputs and the extent of 'luxury' expenditure in Ban Um Mao, the proportion of hired mandays and purchased inputs and 'luxury' expenditure in Ban Lek and the area under field crops with the existence of a group of 'big spenders' in Ban Lao Yai.

At the 25% level of significance, the percentage of glutinous rice sold appears to be related to the extent of purchased inputs in Ban Na Chuak Nuea, Ban Tum, Ban Um Mao and Ban Non Sung; in Ban Tum this variable is also related to the area under field crops. In Ban Na Chuak Nuea the area under field crops is related to the existence of a poor group; in Ban Tum to hired labour and purchased inputs. Hired labour is related to the existence of a 'wealthy' group in Ban Na Chuak Nuea and to 'luxury' expenditure in Ban Tum. The range of purchased inputs is related to the existence of a group of 'big spenders' in Ban Na Chuak Nuea.

From an assessment of these values of Chi-square, a number of interesting relationships are suggested, which merit further investigation. The most basic one is that there seems to be a relationship between the percentage of glutinous rice sold and the area under field crops. Such a relationship is crucial both to an understanding of the way agriculture in the area has recently changed and of any future changes and developments. Secondly, purchased inputs, which are an unmistakable sign of a developing agriculture, are associated equally with the percentage of glutinous rice sold and the area under field crops, which are usually innovations and mainly commercial. Thus, possibly, either rice, the traditional subsistence crop, or field crops, which are usually innovations and mainly commercial, can provide the impetus which transforms the farm from a subsistent to a commercial one. However, the area under field crops is apparently associated with other concomitants of development, viz. the use of hired labour, 'luxury' expenditure and the existence of a group of 'big spenders'. Interestingly, the area under field crops seems to be associated with the existence of a poor group. This association is of considerable importance, since it might indicate that advancement and relative prosperity in the area cannot but be at the expense of others. A final interesting relationship is that which seems to exist between purchased inputs as a whole (of which hired labour is a component) and both luxury expenditure and the existence of a group of 'big spenders' on 'luxury' expenditure. At first glance, one would think that a farmer's wealth could either be re-invested in the farm or expended in conspicuous consumption (or saved) and one would think that the two groups, the investors and the expenders, would differ markedly in social and economic respects and not least psychologically. However, the evidence would seem to indicate that in the Lam Pao Sample the investors and expenders are one and the same group: their investment in agricultural production is generally small-scale and not far-reaching; their expenditure on conspicuous consumption is moderate.

VI. Non-quantifiable Criteria of Subsistence Applied to the Lam Pao Sample

As far as Wharton's non-quantifiable criteria are concerned, the situation is far from clear-cut. The decision-making ability of the farmer, subsistent or commercial, is a vast field to which the theory of games has been applied with limited success and to which Clayton in the East African context has effectively applied linear-programming.(1)

Suffice it here to say that the writer found from conversations with farmers in the Sample that the Lam Pao farmer has considerable knowledge both about his immediate environment and the wider scene outside. In the former respect, it is to be expected that he recognizes the inherent infertility of much of the soil in the area and also recognizes edaphic differences within the individual villages and the area as a whole.(2) Moreover, he appreciates the dangers of monoculture and in particular the exhaustive effect upon the soil of the cultivation of cassava. With regard to the wider world outside, some farmers compared their lot unfavourably with that of the farmers in the Central Plain or even the north, having gained this knowledge either through travel or hearsay. However, they consider these discrepancies to arise more from economic, historical and administrative factors than physical factors.

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(1) Clayton, E.S., op.cit.

(2) In the dry season of 1971 a group of farmers from Ban Lao Yai, led by the headman and his assistant, were invited on the recommendation of Chang Nookol Thongthawi, Project Maintenance and Operations Engineer, Lam Pao Project, RID, to visit the Lam Pao dam site, where he explained to them the benefits of irrigation and outlined the planned extension of irrigation facilities. Later they visited Ban Na Chuak Nuea to observe the benefits of irrigation at first hand. Impressed as they were by what they saw, they were even more impressed, since they recognized the soil in Ban Na Chuak Nuea as being inherently inferior to their own soil on the Chi floodplain.

Most farmers were aware of the close dependence of the market for kenaf upon the vagaries of the jute crop in Bangladesh. More generally, they expressed keen interest in the outside world, asking perspicacious questions about British agriculture, for example. More importantly, most farmers were aware of many potential crops other than the ones they then grew. Fewer were aware of other possible techniques of cultivation or new inputs. (These factors will be examined in detail in Chapter 7). Where the farmer's knowledge is deficient, however, is basically with regard to economic matters. Often he was unaware of the then current prices of potentially new crops and understandably reluctant to embark upon cultivation of a crop, for which he cannot see a ready market or a sure profit, especially since many farmers have suffered in the past from the fluctuations in demand for that well-established field crop, kenaf. Likewise, he remained convinced, probably correctly (_vide_ Chapter 7), that the use of such new inputs as fertilizer, insecticide and tractor hire were at that time uneconomic.

As for the subsistence farmer being motivated not purely by economic considerations, this is true, but, in the writer's opinion, hardly of great import. In the first place, there is no society, large or small, nor indeed any individual, that is motivated purely by economic considerations. In the second place the subsistence farmer's prime motivation must _ipso facto_ be economic - the sustaining of himself and his family. Beyond the point where subsistence requirements have been met, other considerations may come to the fore. Some farmers, when interviewed, expressed satisfaction with their present lot, but this need not necessarily be a sign of lack of initiative. It may on the contrary indicate an ignorance of other possible ways of life beyond their own or a feeling that they do not have the wherewithal to improve their lot. More simply, it might be that this is considered to be the most diplomatic answer required both by Western researchers and Thai administration from a farmer in a politically sensitive region.

However, other farmers quite clearly wished to improve their lot, build new and embellished houses, buy 'luxury items' or invest in their children's education and advancement. Moreover, it is to be expected that a part at least of the surplus above and beyond subsistence will be used for religious purposes - 'making merit' by providing food and gifts for the monks or contributing towards the upkeep and repair of the village wat (temple).

Apart from these general considerations, there are a number of specific non-economic considerations, which the writer encountered in the field. In the Sample there was one individual who would not cultivate a particular piece of land, because his deceased grandfather had laid a curse upon it. Similarly, agriculturally unusable land is evident everywhere in the form of pa cha, the forest where corpses are kept prior to cremation.

Also farmers will not cut down a tree which carries the epiphyte, ton sai (strangling fig, Ficus bengalensis), since this is considered to be a haven for spirits. In similar vein, they will not remove the termite hills, which are such a familiar feature of the north-eastern landscape, since to do so is considered to bring bad luck.(1)

(1) There would seem to be little advantage in removing termite hills anyway, apart from facilitating ploughing. It is questionable whether termite mounds are richer in organic matter and plant nutrients than the surrounding soil. Agricultural scientists have not been in agreement on this matter. Hesse concludes from work in East Africa that the main advantage of a termite mound over the adjacent land is its better drainage and depth of soil rather than its organic and mineral content. Scope thus exists for growing vegetables on uninhabited termite mounds. However, he thinks, if a normal non-calcareous mound is removed and spread over the surrounding soil, the effect will be deleterious rather than beneficial, since, if, as he believes, a termite mound is built up entirely from subsoil collected from a depth of 50 to 60 cm., one is merely spreading subsoil on top of the topsoil.
Hesse, P.R., "A Chemical and Physical Study of the Soils of Termite Mounds in East Africa", J. Ecol., 43, 1955.
This not unimportant issue merits detailed investigation in Thailand.

Doubtless, there are many similar beliefs that detailed anthropological research would reveal. Their total effect upon the land-use in the Lam Pao Sample, is, however, small, and they do not invalidate the fact that most farmers are governed by economic considerations for most of the time.

As far as the social milieu of the Lam Pao farmer is concerned, it is probable that he, like most Thai farmers, inhabits a society which is less restrictive and more 'loosely-structured' than that of most rural people in south and south-east Asia.(1) His actions and interactions are not governed by considerations of caste, clan or kinship group, beyond the loose institution for co-operation, known as long khaek, to which reference has already been made. The basic unit of operation and decision-making in the Thai rural scene is the single nuclear family, although in many cases sons-in-law from another village may farm their mothers-in-law's land and fathers may exercise a considerable control over the

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(1) The term 'loosely-structured' was coined by the American anthropologist, J.F. Embree, who observed a lack of binding ties in Thai society, an emphasis upon individualism, social mobility and an unwillingness to co-operate.
Embree, J.F., "Thailand - A Loosely Structured Social System", AA, 52, 1950.
Wijeyewarden also stresses that "Thai society is pragmatic with organizations directed towards specific and limited ends".
Wijeyewarden, G., "Some Aspects of Rural Life in Thailand", in Thailand: Social and Economic Studies in Development, ed. Silcock, T.H., ANU, 1967.
Bunnag, however, refutes this view. Moreover, she makes the interesting comment that, "There is in fact very little value attached to innovation or originality.... Indeed, the Thai recognize and approve of their own ability to lian baep (imitate), a talent which enables them to adapt very easily ..."
Bunnag, J., "Loose Structure: Fact or Fancy? Thai Society Re-examined", JSS, Vol.59, Part 1, Jan. 1971
Thus Bunnag has claimed that, although innovators are unlikely to arise among the Thai, the Thai are very receptive to innovations from outside.

decisions made on their newly-wed son's farm.[1]

For purposes of marketing crops in the Lam Pao area, there is generally a choice both between merchants and the location of the market. Similarly, the farmer may seek or be given advice from many sources, viz. the village headman, friends, relatives, the Extension Officer, the co-operative or farmers' association. Alternatively, he may go further afield to an Agricultural Experimental Station in the area.

Thus, because the Lam Pao area is at present the scene of much concerted efforts to promote development, the farmer has no lack of real or potential external contacts. His social milieu is, in fact, anything but restricting.

Similarly, as a whole the Lam Pao farmers travel quite extensively, as the questionnaire revealed. All of them have been to Kalasin, the changwat capital, from time to time. However, in the Sample as a whole, 134 farmers (56%) have been to Khon Kaen, which is a sizable city and proposed regional capital of the north-east.

21% of the total Sample have been to Nakhon Ratchasima, an important city on the south-western edge of the north-eastern plateau. Historically, this city is the main link between the north-east and the Central Plain, a position enhanced by the construction of the Friendship Highway from Saraburi through Nakhon Ratchasima, Khon Kaen and Udon Thani to Nong Khai. Nakhon Ratchasima serves both as an outlet for north-eastern produce and a gateway for new ideas and practices. The

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(1) Mizuno draws attention to the temporary kinship groups which form when for a few years a married couple live uxorilocally in north-east Thailand.
Mizuno, K., "Multi-household Compounds in north-east Thailand", Asian Surv., 8 (10), Oct. 1968.
Assen points out that whilst nuclear families are common throughout the north-east, the extended family structure is quite common in changwat Kalasin.
Assen, J.H., Field Observation on Agriculture in north-east Thailand and Laos, Mekong Secretariat, May 1968.

agriculture of the surrounding rural area is particularly diversified and prosperous by north-eastern standards. Thus, farmers who have travelled to this city cannot but have taken notice of new crops and agricultural practices. (For self-evident reasons, the most prosperous and diversified farms in changwat Nakhon Ratchasima are precisely those which border the Friendship Highway and hence are easily seen from the Highway).

30% of farmers have been to the national capital, Bangkok, whilst 13% have been to the Central Plain outside Bangkok. 5% of Lam Pao farmers have been to the northern region and 4% to the southern region. 34% of farmers have not been to any of the places specified in the questionnaire.

Ban Lao Yai farmers are, surprisingly, most far-travelled. 91% of them have been to Khon Kaen, which compares with 69% for Ban Na Chuak Nuea, 64% for Ban Non Sung, 51% for Ban Um Mao, 49% for Ban Tum, 43% for Ban Lek and only 36% for Ban Fai Taek.

Similarly, 55% of Ban Lao Yai farmers have been to Nakhon Ratchasima. The figures for the other villages are low, viz. Ban Non Sung 24%, Ban Lek 21%, Ban Fai Taek 14%, Ban Um Mao 18%, Ban Tum 23% and Ban Na Chuak Nuea 17%. 64% of Ban Lao Yai farmers have been to the Central Plain, compared with 21% for Ban Non Sung and Ban Lek, 7% for Ban Fai Taek, whilst Ban Tum and Ban Na Chuak Nuea have the low proportion of 2% and 3% respectively. 9% of Ban Lao Yai and Ban Na Chuak Muea farmers have been to the northern region, compared with 7% for Ban Lek, 5% for Ban Tum, 3% for Ban Non Sung and 2% for Ban Fai Taek. None of Ban Um Mao farmers have been to the northern region. However, very few farmers have been to the southern region. Only in Ban Na Chuak Nuea, Ban Tum and Ban Non Sung are there farmers who have been to the southern region, constituting 5%, 2% and 3% of their respective totals.

Ban Lek farmers are the least travelled. 45% of them have been nowhere, compared with 37% of Ban Lek farmers, 33% of Ban Tum and Ban Non Sung farmers, 25% of Ban Um Mao farmers, 23% of Ban Na Chuak Nuea farmers and 17% of Ban Fai Taek farmers. However, only 9% of Ban Lao Yai farmers have not travelled to any of the specified places.

As for Wharton's statement that the subsistence farmer is psychologically distinct from the commercial farmer, it is obvious that economic well-being and mental outlook are both related in a two-way causality. However, this does not necessarily mean that the psychological attributes of the subsistence farmer need necessarily be an obstacle to commercialization. In any society there is a wide range of psychological types (whether there is the same range is left to cross-cultural psychology to ascertain), varying from those who accept the status quo and regard the commonplace as the inevitable, resisting change, and those who, from various sources, are provided with the stimulus and ambition to advance themselves or their society to the limits of known possibility. To expand these limits can only benefit the latter group; the effect upon the former group is less certain.

VII. Population Pressure in the Lam Pao Sample

Secondary in importance to the problem of subsistence, if the physical base can be taken as given, is the demographic aspect. In this context, a number of variables are important, viz. present population per cultivated land, present population per paddy land, and the availability of land for future development either in the form of forest or fallow, with the proviso that it is not at present considered desirable to remove large areas of forest cover. Table 3.12 shows the relevant statistics.

Thus for the area as a whole population densities are only moderate. Both population per rai of paddy land (which is the most crucial measurement for subsistence) and population per rai of cultivated land are moderate. The percentage of forest and fallow within the area is small and, surprisingly, the area of fallow considerably exceeds that of forest. The fallow is in most cases upland and has probably been left fallow through temporary lack of labour to cultivate it rather than with the purpose of restoring soil fertility. The forest and fallow combined represent the potential available land for future expansion, but actually this composite figure gives an exaggerated idea of room for expanding the cultivated area, since under present methods of cultivation with little fertilizer application or rotation of crops it would be prudent to let land lie fallow to restore fertility. Similarly, under present conditions of cultivation removal of more forest can only aggravate the present problem of soil erosion. On the other hand, however, these statistics refer only to the land within the village boundaries which is actually in the possession of farmers. There is available uncleared forest land within the area outside village boundaries and much uncleared forest land for pioneer settlement elsewhere in the

Table 3.12

Population Densities within the Lam Pao Sample

	Lam Pao Sample	Ban Na Chuak Ñuea	Ban Tum	Ban Um Mao	Ban Fai Taek	Ban Lek	Ban Non Sung	Ban Lao Yai
Population/rai	0.38	0.28	0.32	0.429	0.54	0.41	0.38	0.29
Popn./rai paddy	0.58	0.44	0.52	0.54	0.76	0.57	0.52	0.6
Popn./rai cultivated land	0.41	0.32	0.33	0.483	0.58	5.3	0.39	0.3
% forest of total	1.27	3.6	0.9	0	3.42	0	0	1.2
% fallow of total	5.28	11	3.59	1.96	3.08	7.5	2.8	2
% forest and fallow	6.55	14.6	1.49	1.96	6.5	7.5	2.8	3.2
Popn./rai forest	30	7.8	34.8	-	15.9	-	-	25
Popn./rai fallow	7.3	2.56	8.8	21.9	17.56	5.3	13.6	15
Popn./rai available land (forest and fallow)	5.86	1.92	54.5	21.9	8.3	5.3	13.6	9.4

north-east.

Population per rai of cultivated land and per rai of paddy is equally moderate throughout the seven study villages. The proportion of forest land, however, varies. In the sample for Ban Um Mao, Ban Lek and Ban Non Sung the figure is zero, although there is actually some forest in these villages which did not happen to fall within the samples. Only in Ban Na Chuak Nuea and Ban Fai Taek is there a reasonable amount of uncleared forest land available. Likewise, Ban Na Chuak Nuea together with Ban Lek has a fairly high proportion of fallow land. However, in all the villages fallow land is more important than forest land.

Accordingly, Ban Na Chuak Nuea emerges as the village with the most available cultivable land, whilst Ban Lek and Ban Fai Taek also have reasonable amounts. Least land is available for expansion in Ban Um Mao and Ban Tum. Similarly, on the basis of population per rai of available land Ban Na Chuak Nuea is most favoured, whilst Ban Tum has the highest pressure on its uncultivated cultivable land and pressures are also comparatively high in Ban Um Mao and Ban Non Sung.

VIII. Assessment of Underemployment in the Lam Pao Sample

Of great importance to the study of the development of traditional agriculture is the amount of available labour and the extent to which there is rural unemployment, disguised or real, or underemployment, perennial or seasonal. This matter is not only crucial to any industrial development plans for the area but is in fact possibly the most important factor in the rationalization and optimization of agriculture.

The controversy surrounding the issue is long-standing. Earlier studies in the 1940's such as Rosenstein-Rodan's in south and south-east Europe were optimistic about the estimate of agricultural labour surplus for industry.(1) This has long been the accepted view and has been supported by the work of, among others, Liebenstein, Mathur, Wonnacott, Ranis and Fei, Eckaus, Coale, Hoover, Nurske and Dovring.(2) Their basic premise is that traditional agriculture suffers from a redundant labour force with zero marginal product: this means that the marginal output of added labour days does not exceed the value of added food consumption and other costs associated with added labour days.

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(1) Rosenstein-Rodan, P.N., "Problems of Industrialization of Eastern and Southern Europe", EJ, LIII, June-September 1943.

(2) Liebenstein, H., Economic Backwardness and Economic Growth, New York, 1957.
Mathur, A., "The Anatomy of Disguised Unemployment", OEP, Vol.16, July, 1964.
Wonnacott, P., "Disguised and Overt Unemployment in Underdeveloped Economies", QJE, 76, May 1962.
Ranis, G. and Fei, J.C.H., "A Theory of Economic Development", AER, 51, September 1961.
Eckaus, R.S., "Factor Proportions in Underdeveloped Countries", AER, 45, September 1955.
Coale, A.J. and Hoover, E., Population Growth and Edonomic Development in Low Income Countries: A Case Study of India's Prospects, Princeton, 1958.
Nurske, R., Problems of Capital Formation in Underdeveloped Countries, Oxford, 1958.
Dovring, F., "Unemployment in Traditional Agriculture", EDCC, Vol. 15, No.2, Jan. 1967.

This view has been attacked by such as Schultz, Viner, Oshima and Paglin, who consider, on the contrary, that rationalization and improvement of agricultural techniques will exert a strong upward pull on the demand for agricultural labour.(1) Myrdal states "that the marginal productivity of labour is zero has been disproved beyond doubt ... the yield can almost everywhere be raised by an increased labour input".(2) Myrdal's views, derived from India, are to some extent supported by Paglin's work in analyzing a survey of Farm Management Studies covering "the six major agricultural regions of India".(3) He found that on the whole output per acre declined with farm size which was related, he considered, to the greater labour-intensiveness of the smaller farms. Thus he considers labour to be the most crucial determinant of agricultural production in large areas of India, which, after all, has long been regarded as the classic case of rural unemployment.

However, an earlier study by N.K. Sarkar, based on a number of villages in Sri Lanka, came up with strikingly different conclusions. He considered that under given techniques of cultivation 28% of labour days employed in agriculture were superfluous.(4)

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(1) Schultz, T., Transforming Traditional Agriculture, New Haven, 1964.
Viner, J., "Some Reflections on the Concept of Disguised Unemployment", IJE, 38, July 1957.
Oshima, H.T., "The Ranis-Fei Model of Economic Development", AER, 53, June 1963.
Paglin, M., "Surplus Agricultural Labour and Development: Facts and Theories", AER, Vol.LV, No.4, September 1965.

(2) Myrdal, G., Asian Drama: An Enquiry into the Poverty of Nations, Vol. II, Chaps. 21 and 22, Pantheon, New York, 1968.

(3) Paglin, M., op.cit.

(4) Sarkar, N.K., "A Method of Estimating Surplus-Labour in Peasant Agriculture in Over-populated Countries", JRSS, Vol.120, Part 2, 1957.

An opposite and extreme view is taken by Cho, who, on the basis of his work in South Korea, considers that in underdeveloped countries visible underemployment rather than disguised unemployment is the basic characteristic.(1)

From all these conflicting opinions, many, but not all, of which are based upon first-hand fieldwork data, it is obvious that there is no satisfactory model of the labour situation in the agriculture of developing countries. Moreover, conditions are bound to differ between and within countries and different points in time and also to be dependent upon the peculiar cropping pattern of the particular area.

Since the school of thought which favours the notion of surplus agricultural labour considers that there is no relationship between labour inputs and yields, it follows that proof of such a relationship in a particular area suggests that there is not disguised unemployment. Accordingly, it was decided to test this for the Lam Pao Sample.

It is necessary, however, to make a number of qualifications. In considering the nature of employment in the Lam Pao Sample one is relying upon estimates of labour use and yields supplied by the farmers themselves, which may not be accurate. Similarly, one does not know to what extent differences in yield are a result of the inherent differences in the quality of the soils. Nor does one know with regard to field crops the effect of the slope of the land, depth of the soil, drainage characteristics, the length of time that the land has been cleared from the forest and cultivated and differential application of non-labour

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(1) Cho, Y.S., "Disguised Unemployment" in Underdeveloped Areas with special Reference to South Korean Agriculture, Univ. of Calif. Press, 1963.

purchased inputs upon the yields.(1) However, since non-labour purchased inputs have, as stated earlier, made little progress so far in the area, the two most important determinants of yield would seem to be soil characteristics and labour inputs. With these provisos, one may postulate that the yield/labour relationship may serve as an index of the extent of underemployment in the Lam Pao Sample.

It has been demonstrated earlier that hired men and hired mandays are, as yet, unimportant in the Sample. Therefore, for this exercise hired mandays were not separated from ordinary mandays, although it goes without saying that a household that hires labour is not suffering from disguised unemployment. Similarly, no distinction is made between male and female labour. It is not known what proportion of this labour is made up of men, women and children respectively. The use of women and children will vary according to the task. In this context both elderly men and young boys are available labour. Fifteen years is the most commonly accepted dividing line between child and adult labour, but there is evidence from Lam Pao that younger boys have been used for ploughing where necessary. Similarly, sixty years may be regarded as the upper limit of available labour, although this would depend very much

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(1) In the dry season of 1972 the writer carried out a sample soil survey in Ban Tum together with R.W. Bradnock and P.A. Stott of the Dept. of Geography, SOAS. The purpose of this study was to illustrate the effect of clearing from the forest and subsequent monoculture upon the upland soils. To this end, three transect lines were selected from the forest to the irrigation canal and over 200 samples drilled. The farmers were questioned as to how many years the plot had been cleared from the forest and what had been cultivated over this period. Even cursory observations indicated that soils deteriorate very rapidly after the forest cover has been removed and cultivation commenced, if no fertilizer is applied or rotation practised. This is especially marked with cassava cultivation. Plate 3.1 shows the evidence.

Source: O'Reilly, dry season 1972.

Plate 3.1 Gulley erosion in Ban Tum

As a result of exhaustive monoculture without fertilizer application severe gulley erosion has set in in this upland field. This gulley is over six feet across at its widest point. The soil is almost white in colour. Probably this whole field will be unusable for any type of agriculture in a couple of years time: no remedial action can save it.

upon health.(1)

Accordingly, it was decided to investigate the relationship between the input of labour per rai and yield per rai for the cultivation of glutinous rice and for the principal commercial field crop, kenaf.

Glutinous rice exhibits a considerable range of yields in the Sample from zero to 1,000 kg./rai. Most cases, however, fall between 150 kg./rai and 300 kg./rai. Labour inputs likewise vary considerably from a minimum of 1.3 mandays per rai to a maximum of 40 mandays per rai, although most fall between 2.5 and 15 mandays per rai. Yields were thus regressed against labour inputs, as Fig. 3.2 indicates. The Coefficient of Correlation is 0.34, significant at the 0.1% level. However, labour inputs beyond 25 mandays per rai are not associated with increasing yields but with quite moderate yields. However, these extreme cases are too few to allow of any valid generalization. Thus it appears that for glutinous rice cultivation in the Lam Pao Sample as a whole, there is not a surplus of labour and additional labour will in most cases bring

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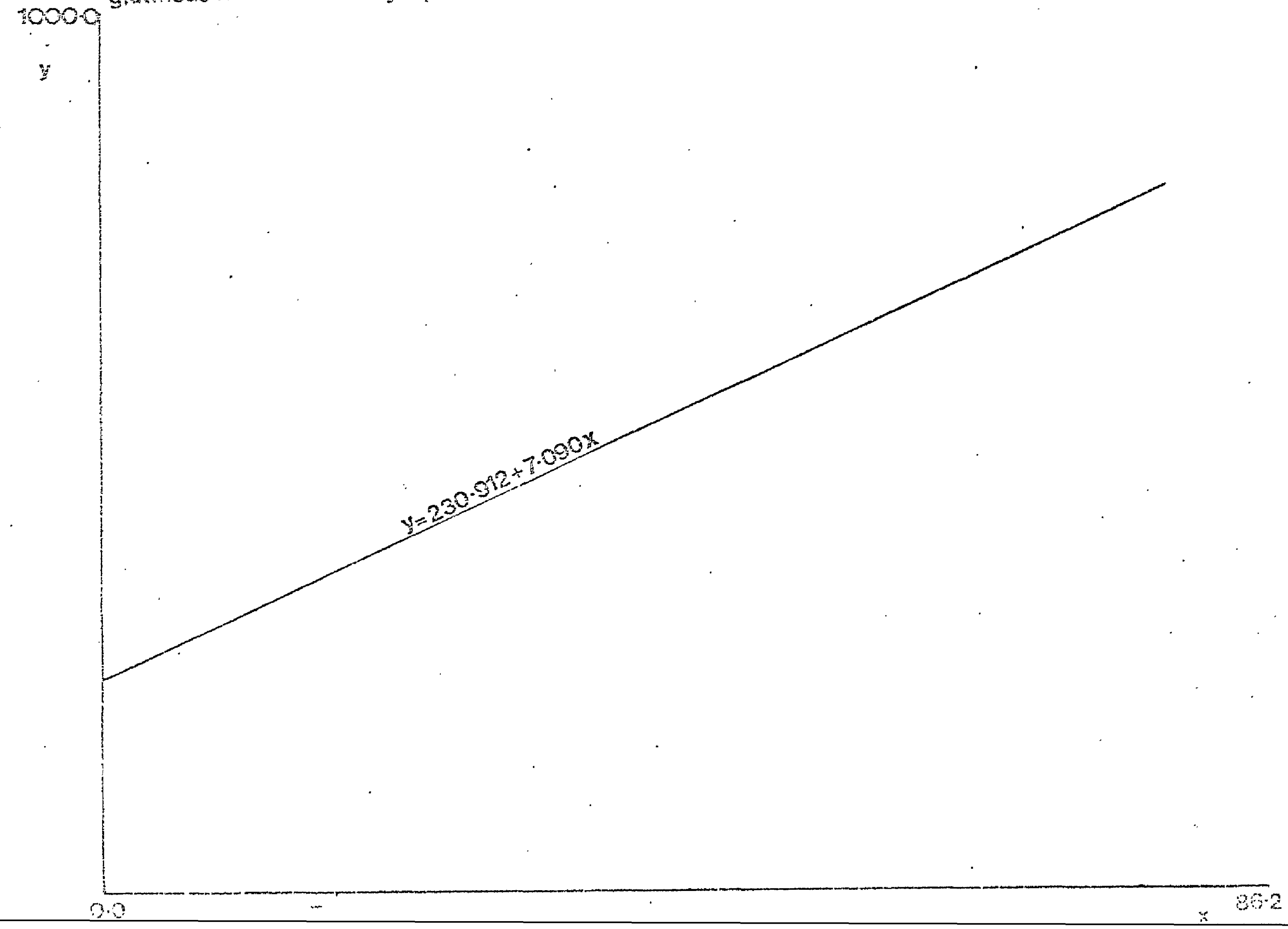
(1) The writer here follows the example of Khun Chamlong Tothong of the Mekong Secretariat who used the age range of 15 to 60 years as the range of adult labour in his survey of farms in the Nong Wai Irrigation Area, changwat Khon Kaen, which he conducted in 1969.
However, earlier studies have used different ranges:
Buck used the range of from 15 to 59 years for his study of Chinese agriculture.
Buck, J.L., Chinese Farm Economy : A Study of 2,866 Farms in 17 Localities in 7 Provinces in China, Shanghai, 1930.
Rosenstein-Rodan used the age range of from 15 to 65 years for his study of Italian agriculture.
Rosenstein-Rodan, P.N., op.cit.
In deciding upon such ranges, more than the physical strength of the youth and the old man should be taken into consideration. Equally important is the cultural perception of what it is proper and seemly work for people of certain ages to do.
In Thailand there are no cultural or religious reasons which exclude women from agricultural labour, as is the case in certain Moslem countries. Moreover, at certain tasks, e.g. transplanting rice, women are considered to be more deft than men.

Figure 3.2 Regression of yield of glutinous rice in kg. per rai (y) on labour inputs on glutinous rice in man-days per rai (x)



adequate recompense.

The sample with regard to kenaf is much smaller. The range of yields is from 10.8 to 900 kg. per rai. The maximum yield is associated with a moderate labour input, viz. 0.4 mandays per rai; in that instance clearly some other factor is involved. The mean of the yields is 96.0 kg./rai. The range of mandays is from 1.4 to 160 mandays per rai. The maximum labour inputs is associated with a correspondingly high yield, viz. 400 kg./rai. The mean labour input is 9.06 mandays/rai. Fig. 3.3 shows that when yields for kenaf are regressed against labour input a more significant relationship emerges than that between yields and labour inputs for glutinous rice. For kenaf the Coefficient of Correlation is 0.48, significant at the 0.1% level. Thus in the case of kenaf too increasing labour inputs are associated with increasing yields.

Therefore, as far as the two principal crops of the Lam Pao Sample are concerned, there seems to be no surplus of labour involved in their cultivation at present. This does not obviate the fact that there may be seasonal unemployment in the area. To determine this a Labour Concentration Index was produced. This is a summary index calculated from the percentage distribution in the annual labour consumption pattern with a value ranging from 0.0 to 100.00. The minimum value is achieved when the work schedule shows a completely even distribution for each month of the year, whilst the maximum indicates that all the farm labour expenditure is concentrated in a single month.

Table 3.13 shows a marked concentration of labour in all of the villages of the Sample. As would be expected, this concentration is highest in Ban Um Mao and Ban Lek, the villages in which glutinous rice cultivation is most important; the concentration is lowest in Ban Tum,

Figure 3.3 Regression of yield of kenaf in kg. per rai (y) on labour inputs on kenaf in man-days per rai (x)

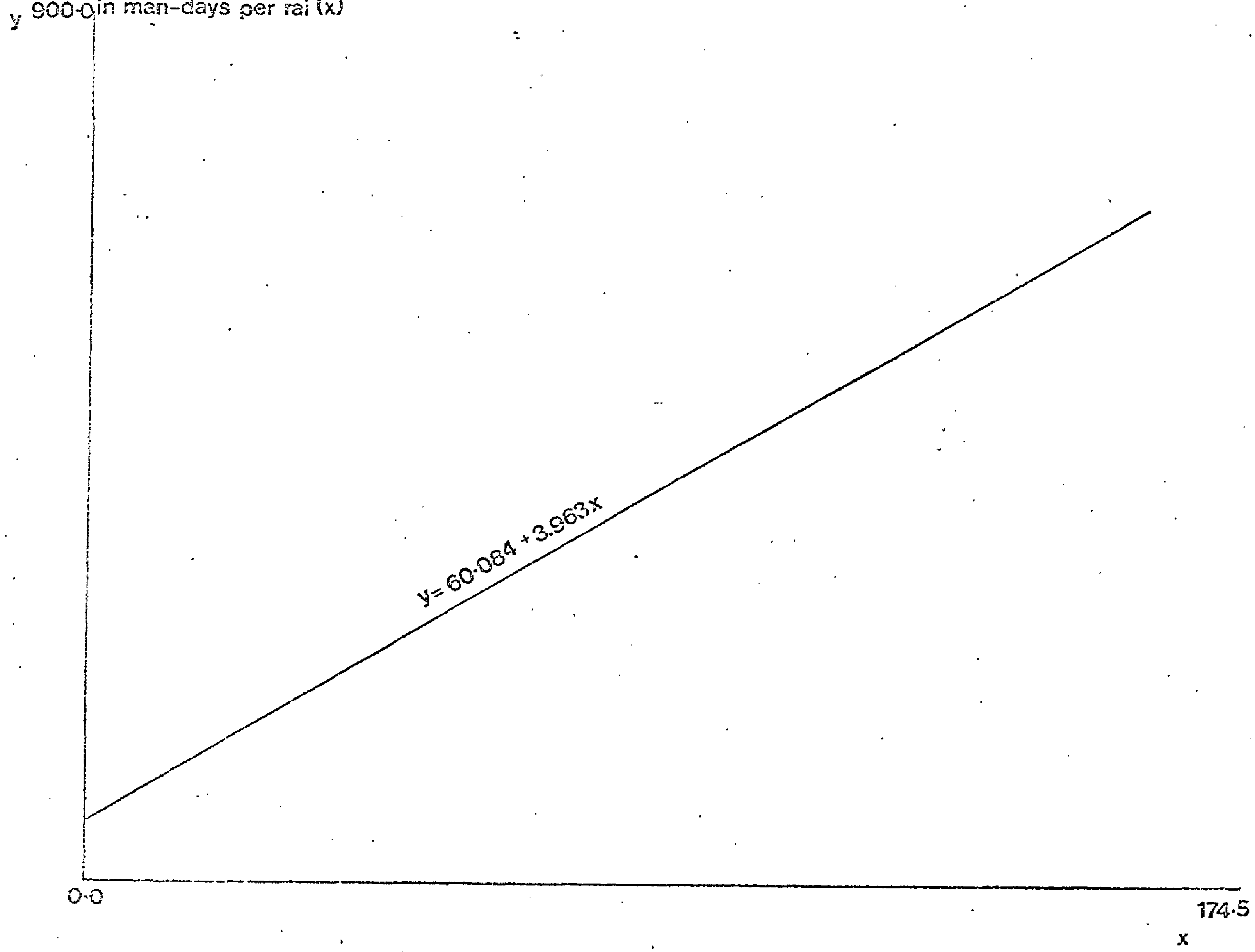


Table 3.13 The Degree of Labour Concentration within the Lam Pao Sample for one year

Ban Na Chuak Nuea	72
Ban Tum	64.6
Ban Um Mao	78
Ban Fai Taek	73.56
Ban Lek	78.1
Ban Non Sung	72.24
Ban Lao Yai	71.25
Lam Pao Sample	62

Table 3.14 Mean Labour Concentration per month for Lam Pao Sample

	Ban Na Chuak Nuea	Ban Tum	Ban Um Mao	Ban Fai Taek	Ban Lek	Ban Non Sung	Ban Lao Yai	Lam Pao Sample
Jan.	3.3	2.0	1.7	1.9	0.5	0	0	1.5
Feb.	4.6	2.0	0.1	0	0	0	0	1.2
Mar.	6.8	10.1	0.5	2.4	1.3	2.1	1.6	4.3
Apr.	7.0	7.6	1.7	6.5	3.4	6.5	9.5	5.7
May	28.3	16.2	26.7	19.0	20.6	26.3	40.2	19.5
June	37.5	32.1	44.5	17.6	31.9	37.2	50.9	35.5
July	19.3	25.5	26.4	23.4	30.9	26.5	5.0	24.6
Aug.	1.42	7.7	7.4	7.9	1.6	0.2	15.1	5.0
Sep.	5.0	11.7	2.5	1.2	2.9	8.6	0	5.7
Oct.	8.8	16.0	8.9	15.1	23.6	16.8	17.8	15.3
Nov.	29.9	21.8	37.0	19.2	23.6	32.4	38.6	27.5
Dec.	4.1	9.6	5.3	7.0	4.6	4.8	0.9	5.9

where widespread kenaf cultivation results in a more even spread of labour through the year.

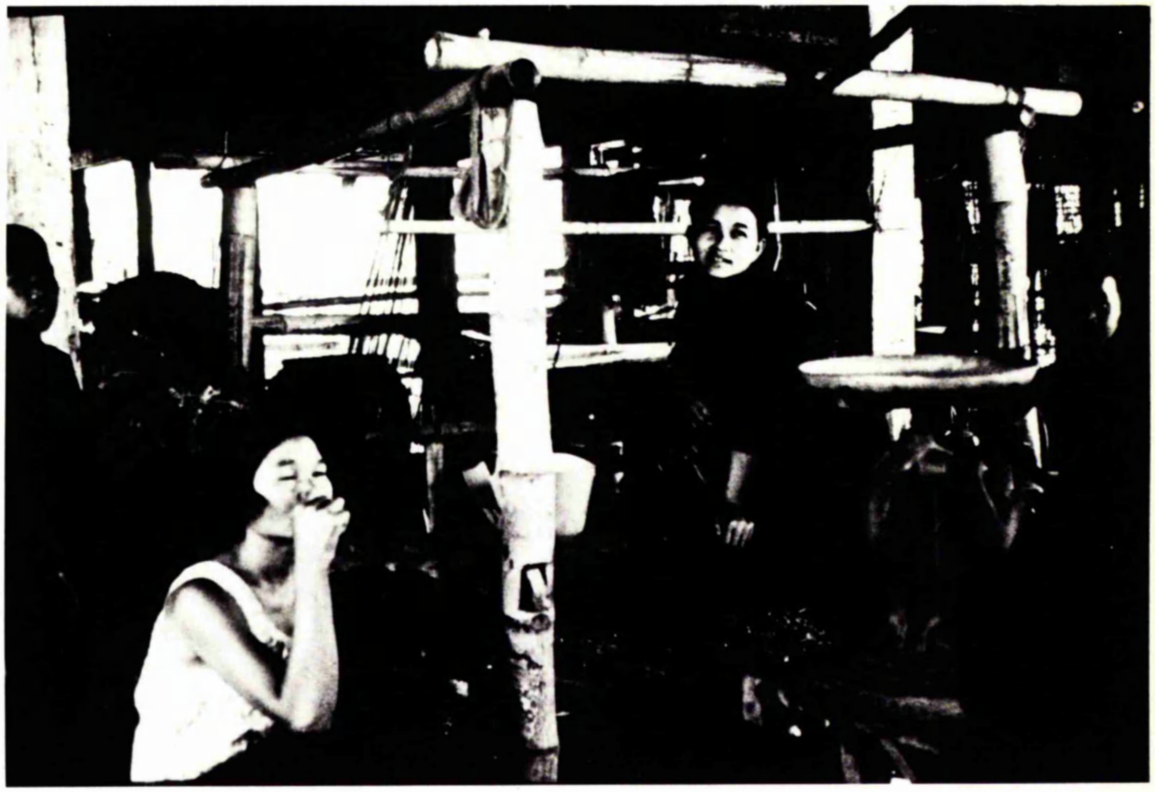
Table 3.14 shows the mean labour concentration per month for the Lam Pao Sample and the constituent villages. This table shows that there are months in which no agricultural work is performed, viz. February in Ban Fai Taek and Ban Lek, January and February in Ban Non Sung, January, February and September in Ban Lao Yai. Likewise it is obvious that to a greater or lesser degree labour in all the villages is concentrated in the months from April to July on the one hand and from October to November on the other hand. Thus even in the case of maximum labour input the Lam Pao farmers are only working for half the year. Therefore, *ceteris paribus*, (taking into consideration the working ability of the population, dependent partly upon health and the quality of nutrition and assuming that the powerful lure of off-farm work in the town or elsewhere can be offset), there is in the Lam Pao Sample a degree of seasonal farm unemployment (which might be both voluntary and prudent), which can be potentially utilized by investment in new farm enterprises in the form of double-cropping of rice, cultivation of non-rice crops on the paddies after the rice harvest, diversification of field crop cultivation or animal-rearing enterprises. (Animal-rearing enterprises are actually masked in labour-concentration figures, but at present are only slightly demanding in labour.)

However, the individual farms of the Sample exhibit considerable differences with regard to labour-intensiveness, labour concentration and seasonal unemployment and will be able to take advantage of new opportunities to differing degrees.

IX. Conclusion

Thus, despite the great variety in the area both within and between villages, one can say that most farmers in the Sample are practising to a greater or lesser extent subsistence agriculture and are liable to suffer considerably as a result of the vagaries of weather and the damage to their crops from insects, drought and flood. Being essentially subsistence rice cultivation it lacks at present the possibility of improvement which new strains of rice, fertilizer and insecticide bring about, since farmers are unable to afford these investments, the advantages of which seem dubious to them anyway. At least in the case of fertilizer in Thailand, its excessive price (in comparison with other south-east Asian countries) makes it uneconomic to use. Irrigation, however, will in the future it is hoped be an externally provided method of increasing yields, although where it has been provided, as in Ban Na Chuak Nuea, its full benefits have not been realized. Moreover, irrigation must go hand-in-hand with new inputs such as fertilizer if substantial increases in productivity are to ensue, as the Japanese and Taiwanese experiences testify.

Both those farmers who are producing commercial rice and those who are producing commercial field crops are still basically subsistence farmers, because, for both, their commercial enterprises constitute only a minor part of their total farm enterprises and because they still desire the wherewithal to provide their families with most of their sustenance, although non-food items such as clothing are more likely to be purchased from the town now than made at home as was the case when Zimmerman conducted his survey in the north-east in 1930/31. (vide Plate 3.2). However, these commercial farmers are subject to the vagaries of price as well as natural hazards, which in the case of rice remains



Source: O'Reilly, dry season 1971.

Plate 3.2 Weaving Cotton Cloth in Ban Non Sung

This activity, which is performed underneath the house, is one of the most common handicrafts of the area. Women produce cotton cloth from cotton grown locally either for their family's consumption or for sale. This woman is weaving the article most commonly produced in this manner, viz. the phakhaoma, a long strip of patterned cloth used by men for various purposes, such as as a loincloth, towel, sash or turban. Note that the frame of the loom is constructed of bamboo.

comparatively stable but unlucrative and the case of the principal field crop, kenaf, is subject to wide fluctuations owing to causes over which neither the farmer nor the government have any control. Accordingly, kenaf cultivation has not brought real, lasting prosperity to the area, but has merely tended to reinforce in the farmer's mind the wisdom of providing his own sustenance.

However, in certain of the villages, where favourable conditions have allowed, prosperous individuals have emerged (who, nevertheless, still provide their own subsistence) : they may owe their prosperity either to commercial rice cultivation or field crop cultivation. Doubtless personal qualities are responsible for much of their achievement, but equally important would seem to be their possession of either a large area of paddy or upland, a large able family labour force (which is a transient and purely fortuitous characteristic) or some outside source of income, or a combination of all these factors. Once these farmers have reached a certain level of prosperity their productivity can increase as they invest in purchased factor inputs, including hired labour (which of course also provides income for other less prosperous farmers in the area). These prosperous farmers may extend their holdings, innovate with impunity or even buy up land outside the village (in one case a Ban Tum farmer also farmed land he had bought in the neighbouring province of Maha Sarakham). Theoretically, the prosperous farmer can both enrich his fellow villagers by providing temporary work, perhaps loaning money or being a leader in the dissemination of new ideas and innovations, as well as providing leadership in the establishment and functioning of co-operatives and farmers' associations. On the other hand he can lead to their impoverishment by buying up their land and producing a class of landless peasants. All this is of course theory, since such a situation is very remote from the present reality in the north-east of Thailand. It is also a moot point to what extent government officials and Extension agents should concentrate their efforts on the more prosperous and more progressive farmers to the relative neglect of their fellow villagers.

However, the area as a whole has a substantial amount of off-farm income. That which comes from the sale of fish and handicrafts is of minor importance, whilst the government salary that the village headman receives is but adequate recompense for the many duties his position entails. Within the village the schoolteacher and in some cases the carpenter both provide their own subsistence through farming or are attached by marriage to families that do so, since both these types of individual, from observation, usually originate from outside the village. The carpenter can achieve a degree of prosperity that exceeds that of his fellow villagers who are merely farmers, and, indeed, the carpenter constitutes the principal specialized non-agricultural function in most villages, although not all villages have one. Fairly common throughout the north-east but not present in all villages are the small shop and refreshment café. These again are usually run by farming families. Just as their presence reflects the general wealth of the village, so their prosperity is dependent upon the level of prosperity in the village as a whole. Such establishments are thus unlikely to endow their owners with disproportionate wealth. In certain other villages not included in the Sample which are favourably located at cross-roads or important routes a greater variety of functions has emerged with several cafés, general shops and tailor's shops, the owners of which because of their increased trade no longer need to farm; indeed some of them may be townspeople anyway. These places display embryonic urban characteristics and even embryonic factory conditions, since the tailors and dressmakers gather together under one roof the young girls (and indeed boys) who would normally engage in their craft under the family house. Such places are and must be exceptional.

For others within the Lam Pao Sample, additional income may come from either helping in the harvest of the Central Plain or off-farm work in Kalasin town or at the Lam Pao dam site. Alternatively, income may come from remittances from sons and daughters engaged in work in the towns of the region or in Bangkok. Higher education and compulsory conscription both remove young men from economic life temporarily; the former may entail considerable financial sacrifice for the farm family to yield future great returns. Both soldier and student, in common with all who have worked outside the village, would return with widened outlook and new ideas.

Alternatively, at any stage in their life the village men are able to remove themselves from everyday economic life and enter the monkhood for any period of time; similarly, they may send their small sons to become dek wat (temple boys), thus simultaneously gaining spiritual merit and reducing the number of mouths to feed in the family. Less often and usually only in situations of great personal and economic stress will women enter the nunhood; they will usually remain for life. On the other hand, in addition to providing their own subsistence the villagers must maintain the monastery and provide the monks with food and gifts. However, the service the monastery renders the village is beyond economic valuation.

The standard of living in the Lam Pao area is low, although not by Asian standards. The diet is unvaried and monotonous, usually deficient in meat. It is significant that the north-easterners will supplement their diet by eating foods not usually acceptable elsewhere, such as red ants, rice-sparrow fledgelings and mice (and indeed through usage accepting such items as delicacies), so that the Central Plain Thai accuse the north-easterner of "eating anything". Doubtless there are nutritional deficiencies in the north-east and often these are at once apparent from personal observation. Similarly, a Thai doctor who carried out health tests in one of the villages claimed that a high proportion of the villagers suffered from intestinal parasites, in particular liver-fluke. Nevertheless, there is no sense in which life in the area is wretched; moreover, its potential is great.

The level of education is fairly low, although most people have received some education and thus are theoretically literate. Houses are simple but clean and comfortable, whilst some more prosperous farmers have built quite imposing houses. The expenditure on 'luxury' items is not high but is widespread, and the extent of the farmers' travel in and knowledge of areas outside the immediate region is impressive, whilst his possible range of outside contacts and sources of information is considerable.

The area's potential however owes much to a favourable population/land ratio. There is still considerable uncleared land within the area and furthermore areas within the north-east suitable for pioneer settlement. The area is not at present over-populated. Increasing inputs of labour in most cases lead to increasing productivity. There is however seasonal unemployment, which could provide a stimulus for increased prosperity in the area.

CHAPTER FOUR

DIVERSITY AND INNOVATION WITHIN THE TRADITIONAL GLUTINOUS RICE ECONOMY OF THE LAM PAO AREA

I. The North-east as a Rice-producing Region

Rice is the principal crop of the north-east of Thailand, as of the Kingdom as a whole. Within the Kingdom there are substantial differences between the yields of rice in different regions, whilst the optimum yields achieved experimentally are far in excess of those ordinarily achieved. Likewise, the annual rice competition gives yields which are deceptively high.(1)

Taking yields of rice as a whole in Thailand, it may be said that they are low: not only by world standards, but by Asian standards; not only in comparison with the modernized and capital-intensive rice cultivation of Australia, Peru, Japan and Taiwan, but even in comparison with the traditional methods of Sri Lanka, Indonesia and Malaysia. (One possible explanation of this is the greater dependability of rainfall throughout much of the last mentioned three countries and the more extensive and complete irrigation systems in areas of seasonal rain-deficit, such as the Dry Zone of Sri Lanka or East Java and Bali/Lombok). Table 4.1 indicates comparative yields in certain countries. Thailand's low place in the table may also be partly attributable to regional disparities within the country, the cultivation of rice on

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(1) Since 1963 the Farmers' Association has been sponsoring a contest of highest yield among all farmers on a national scale. Recently, a farmer in changwat Chai Nat in the Central Plain achieved a yield of 1,500 kg./rai for non-glutinous rice. (Source: Khun Pittaya Hiranburana, RID, personal communication).

Table 4.1 Rice Yields in Certain Countries 1963-'67

Country	Yield (quintals per hectare)
Australia	65.1
Japan	51.8
Peru	40.8
Taiwan	36.8
Malaysia	25.8
Sri Lanka	19.3
Indonesia	18.5
Hong Kong	18.3
Thailand	16.3
India	15.3
Burma	15.3
Philippines	13.2
Brunei	12.4
Khmer Republic	11.4
Laos	7.9

(Source: On peut produire davantage sur des superficies plus petites. Amélioration de la productivité grâce aux innovations techniques. FAO, Rome, 1969).

Table 4.2 Comparison of Rice Yields in Regions of Thailand 1969/'70

Area	Yield (kg. per rai)
North-east	246
Central Plain	301
North	382
South	307
Whole Kingdom	295

(Source: 1969/'70 Annual Reports on Rice Production in Thailand, Ministry of Agriculture, Bangkok).

unsuitable soils and the general lack of fertilizer use owing to its relatively high cost compared with other Asian countries.

Within Thailand the north-east is popularly regarded as the area of most backward rice cultivation. Certainly, yields of rice are much lower than in the other regions, as Table 4.2 shows. In explaining this regional difference, the common hypothesis accepted at the International Rice Research Institute at Los Baños (Philippines) is that yield increases in the past decade and yield differences within the major rice-producing areas within south-east Asia reflect primarily variations in the environmental factors under which rice is grown rather than differences in variety or cultural practice. However, this view has been challenged by Ruttan _et al._ (_vide_ Chapter 2).

Within the north-east the adverse environmental conditions are obvious. However, it would seem that varietal and cultural factors are also of some importance. Of the environmental factors the unreliability of rainfall and the uncertainty of date of onset is most important, even though rainfall totals may exceed those in the Central Plain.

Apart from unreliable rainfall and inadequate irrigation (_vide_ Chapter 2), the north-east is also characterized by generally poor soils (_vide_ Chapter 1). It is correspondingly generally assumed that the north-eastern rice crop suffers greater loss through damage than that of the other regions. Recent statistics, however, do not support this contention. In 1969 4% of the total planted area was damaged, which compares with 7.8% in the Central Plain, 4.5% in the northern region and 2.7% in the southern region. The figure for the whole Kingdom is 5.1%[1]

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(1) _Annual Reports on Rice Production in Thailand_, Min. of Agr.

Table 4.3 shows the type of damage in each region expressed as a percentage of total damage for each region for 1968. Thus it is apparent that the north-eastern area's proportion of drought damage was less than that of the northern region and the Central Plain, although the north-east has a greater propensity to flood, disease and insects. Since this finding is very surprising, it was necessary to examine statistics for a longer time span. Fig. 2.2 (Chapter 2) indicated that with the exception of the southern region each of the regions of Thailand has suffered both the highest and the lowest proportion of drought damage; all regions are likewise subjected to considerable fluctuations which affect all simultaneously. The north-east is not, however, noticeably subjected to greater fluctuations in damage than the other regions; indeed, prior to 1960 it was subjected to far less fluctuation.

Despite its adverse conditions the north-east has traditionally been the major rice-producing region in Thailand after the Central Plain, as Table 4.4 indicates. Indeed, in 1969/'70 it had a greater production than that of the Central Plain. It is impossible to say at present whether this is a temporary aberration or represents the beginning of a new trend.

In the past production in the north-east has fluctuated in accordance with fluctuations in the Kingdom as a whole except for 1965, when the north-east's production fell slightly, whilst that of other regions rose slightly. However, Table 4.5 indicates that production in the north-east has fluctuated far more extremely than in the Kingdom as a whole.

This increase in rice production in the north-east has largely come about through an increase in area under cultivation rather than

Table 4.3 Types of Damage to Rice expressed as a Percentage of Total Damage in Regions of Thailand for 1968

	Whole Kingdom	North-east	North	Central Plain	South
Total damage in rai	5,571,745	1,821,343	2,376,570	1,201,000	172,933
% damage from flood	4.8	6.1	5.64	0.73	8.1
% damage from drought	83.7	80.46	88.79	81.7	59.0
% damage from disease and insects	8.17	10.6	0.05	0.9	10.1
% damage from animals	1.18	1.99	0.05	0.9	10.1
% damage from other sources	2.13	0.83	1.69	5.0	1.73

(Source: Annual Reports on Rice Production in Thailand, Ministry of Agric.)

Table 4.4 Paddy Production for Regions of Thailand 1961-1969/'70

	North-east	Central Plain	South	North	Whole Kingdom
1961 production (metric tons)	2,322,952	4,273,283	706,935	873,656	8,179,876
Percentage of total	28.4	52.6	8.6	10.74	100
1965 production	2,291,289	5,091,371	747,808	1,068,425	9,198,893
Percentage	24	55	8	13	100
1966 production	3,975,527	4,011,179	805,840	3,334,608	11,947,154
Percentage	33.27	33.57	6.7	24.46	100
1967 production	2,350,244	3,818,234	718,730	2,737,907	9,625,164
Percentage	24.4	39.6	7.46	28.6	100
1968 production	3,191,824	3,569,723	1,026,931	2,558,859	10,347,337
Percentage	30.84	34.49	9.9	24.8	100
1969/'70 prodn.	4,787,775	3,893,024	1,084,161	3,577,191	13,346,151
Percentage	35.87	29.16	8.12	26.85	100

(Source: Annual Reports on Rice Production in Thailand, Ministry of Agriculture, Bangkok).

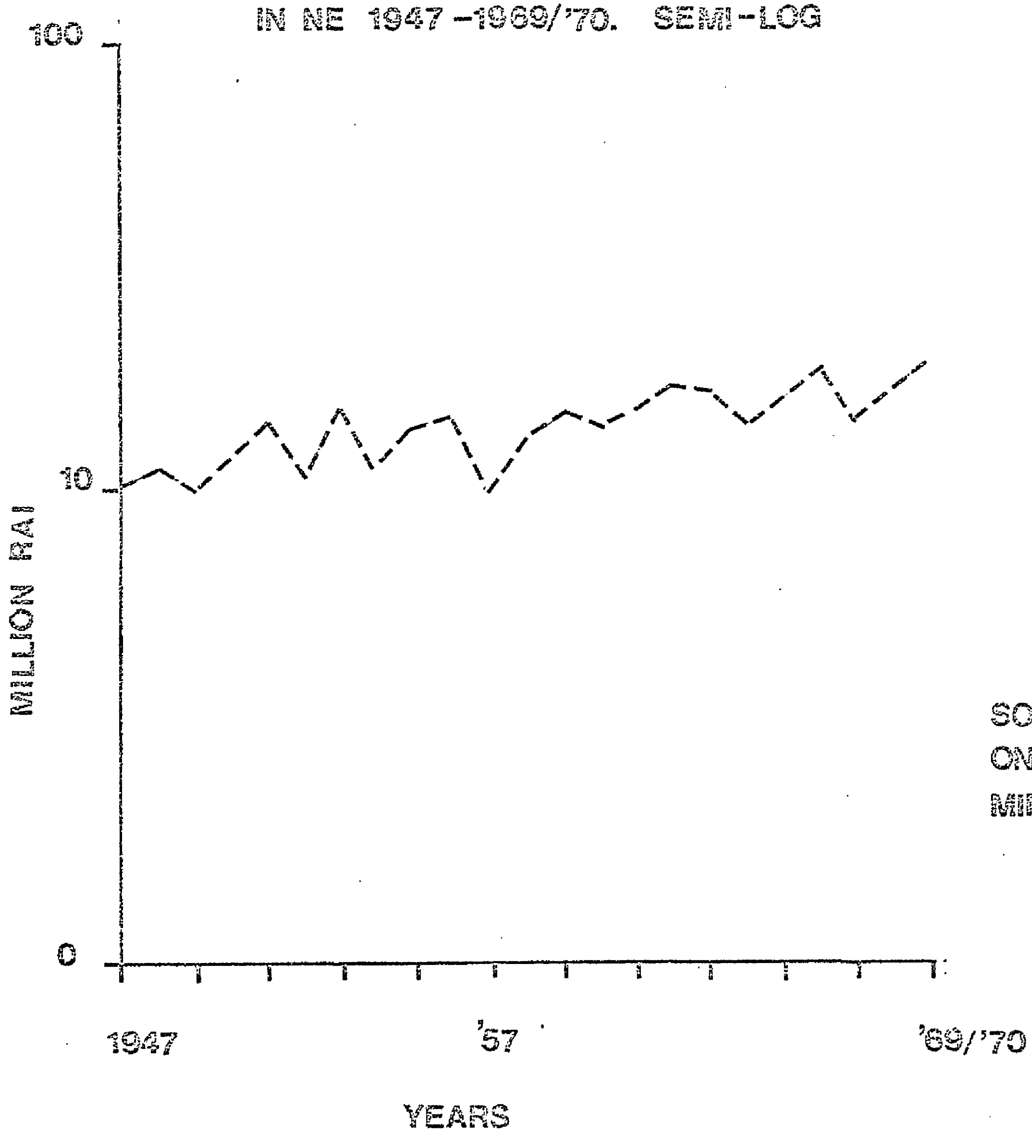
Table 4.5 Comparison of Percentage Increase in Rice Production of North-east with Whole Kingdom 1959 to 1969/70

	north-east	Whole Kingdom
1959-'61	53.66	46
1961-'65	-1.36	12
1965-'66	73.5	29.87
1966-'67	-40.88	-19.4
1967-'68	35.8	7.5
1968-'69/'70	144.49	28.9
1959-'69/'70	138.36	216.7

(Source: from data in the Annual Reports on Rice Production in Thailand, Ministry of Agriculture, Bangkok).

dramatic improvements in methods of cultivation, as Fig. 4.1 indicates. However, yields have also increased steadily, as Fig. 4.2 shows, although fluctuations have been marked. Nevertheless, as previously stated, yields are still low, and can be considerably improved.

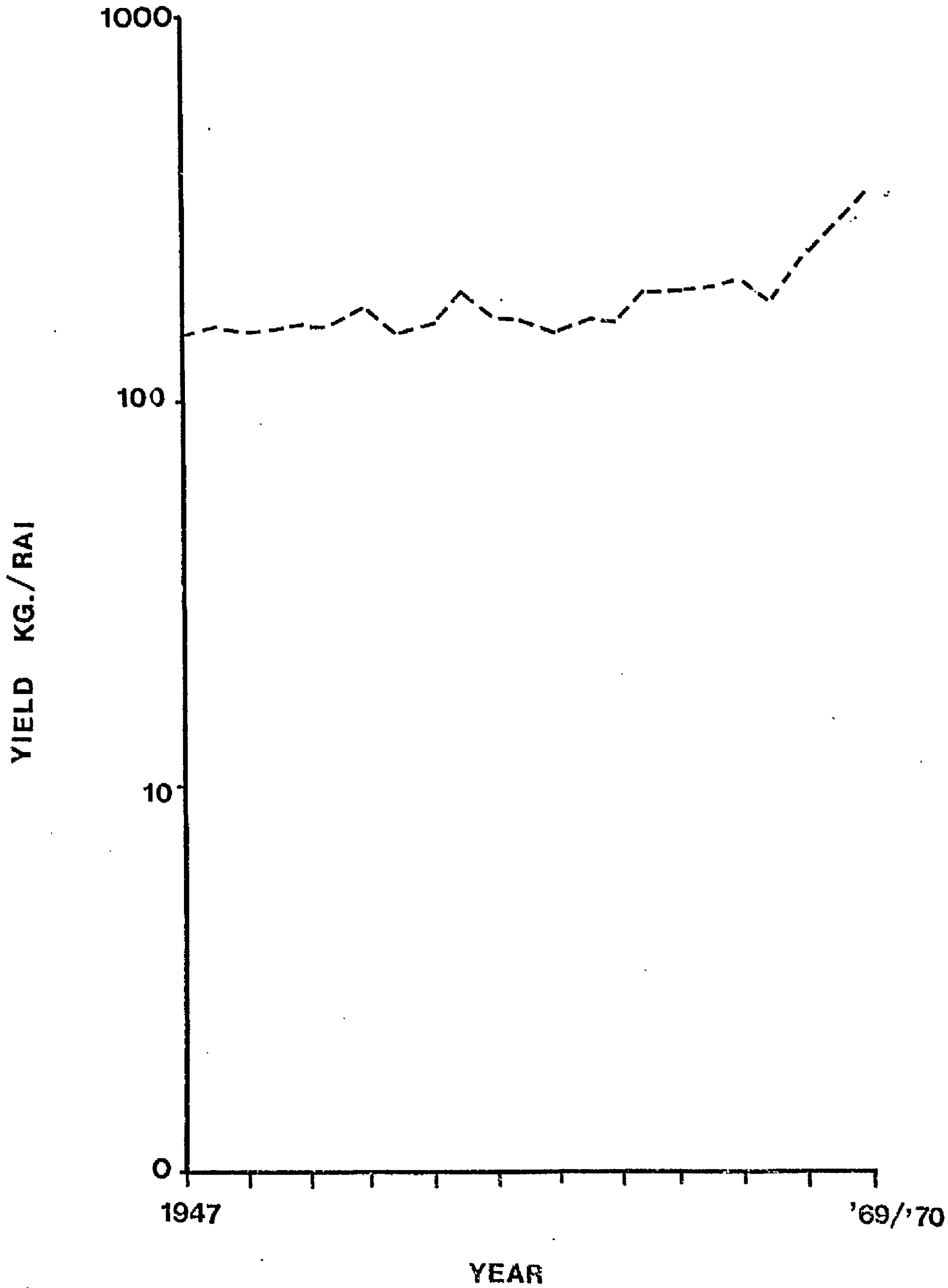
FIG.4.1 INCREASE IN PADDY AREA CULTIVATED IN NE 1947 –1969/'70. SEMI-LOG



SOURCE: ANNUAL REPORTS ON RICE PRODUCTION, MIN. OF AGR.

FIG.4.2 YIELDS OF RICE IN NE THAILAND 1947-'69/'70. SEMI-LOG

SOURCE: as FIG.4.1



II. Glutinous Rice Cultivation in north-east Thailand

Rice cultivation in the north-east of Thailand differs from that in the Central Plain (though not the north) and indeed most rice-producing areas of the world in that the principal rice crop cultivated is glutinous rather than non-glutinous rice.(1) The two types, glutinous and non-glutinous, are distinguished in Thailand as khao nieo (sticky rice) and khao čhao (lordly rice) respectively. Just as much as the north-easterner prefers his glutinous rice and will even seek it out in 'north-eastern' restaurants in Bangkok, so equally the Central Thai would claim inability to eat sticky rice. Doubtless, sticky rice is of greater nutritional value than non-glutinous rice and this may to some extent compensate the north-easterner for a general diet which is less rich and varied and more generally deficient than that of the Central Thai.

The glutinous rice grown in the north-east consists of several varieties.(2) However, the farmer has little comprehension of varietal distinction, instead taking the crop's superficial criteria and time taken to mature as designatory criteria. In fact, he may, deliberately or unwittingly, cultivate several different varieties

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(1) The rice plant like many other cereals has both a glutinous and non-glutinous variety. The glutinous differs from the non-glutinous in that the endosperm and pollen grain of the former have glutinous starch, whilst in the case of the latter they contain common starch. The difference between these two types of starch lies in the ratio between the amylose and the amylopectin, both of which are the main constituents of starch. Whereas non-glutinous rice is 20% amylose and 80% amylopectin, glutinous rice is almost 100% amylopectin. In the laboratory glutinous can be distinguished from common starch by using the iodine colour reaction test. In the field it is difficult to distinguish the two varieties. However, after harvest the two can be readily distinguished because glutinous rice turns opaque. Glutinous rice is not low-yielding vis-à-vis non-glutinous rice. Both have high and low-yielding varieties.

(2) It was long considered that most of the rice grown in Thailand was of the indica variety, but upland varieties contain japonica or japonica-like varieties.
Oka, H. and Chang, W.H., "A Note on Rice Varieties of japonica type found in Thailand", Bot. Bull. Acad. sin., 4, No.2, 1963.

simultaneously throughout his paddies, thus insuring himself against total crop failure, since the different varieties have different degrees of resistance and rates of maturing. In fact, there may even be non-glutinous varieties mixed in with the glutinous.(1) Such a system of cultivation is hardly compatible with improved methods of cultivation.

Moreover, it is obvious that the commercial potential of glutinous rice must remain strictly limited: it sustains the rural population of the north-east and north, it provides a surplus for the non-agricultural and urban populations of these regions (many of whom are increasing their consumption of non-glutinous rice at the expense of glutinous rice, as befits their enhanced and less taxing life style) and it provides a surplus for a relatively small export market, which mainly consists of Laos, but also includes Japan, Malaysia, Hong Kong, Singapore and to a lesser extent India, the Philippines, Indonesia and several countries in Europe. It can be safely said that only in Laos will the imported rice be used as a staple item of diet. In addition to its lack of commercial potential, it suffers from the fact that most research on rice concentrates and will continue to concentrate on the non-glutinous varieties. Research is being carried out on glutinous rice and improved varieties have been developed. This is, however, insignificant in comparison with the massive research on non-glutinous rice. In this way also the north-east is disadvantaged.

The production of both glutinous and non-glutinous rice has

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(1) Watabe checked glutinous rice sold in various market places throughout northern Thailand, using the iodine test, and found non-glutinous rice averaged 9.6% of the total.
Watabe, T., Glutinous Rice in northern Thailand, Report on Research in south-east Asia Natural Science Series N-2, Centre for SE Asian Studies, Kyoto, Japan, 1967.

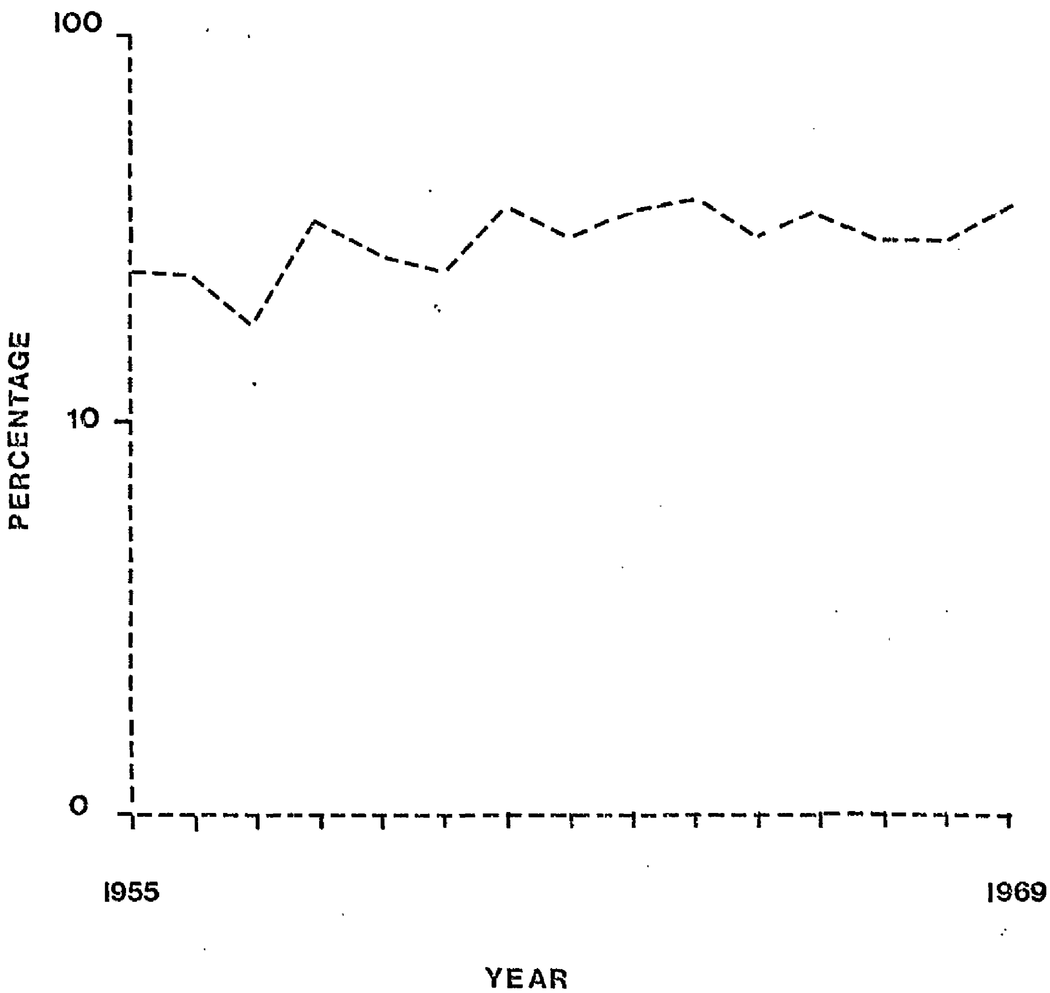
increased rapidly in recent years in north-east Thailand. Nevertheless, Fig. 4.3 suggests that the proportion of non-glutinous rice cultivated in the north-east is on the increase, but, in view of the wide fluctuations in this proportion over the last two decades this is not clear. Probably, non-glutinous rice cultivation should be viewed together with other cash crops in the north-east of Thailand as an enterprise which the farmer will invest in when he has ensured sufficient production of glutinous rice for home consumption. Thus, poorer farmers will concentrate all their efforts on their subsistence glutinous rice cultivation, whilst the non-glutinous rice cultivation of the better-off farmers will fluctuate with market factors in the same way that their cultivation of commercial field crops does. Thus non-glutinous rice in the north-east should be viewed as a commercial innovation (this is not to deny that its cultivation in the area has a long history). In no sense, however, is it at present replacing glutinous rice as a staple of cultivation and consumption. This objective, however, might not be an unreasonable one to encourage. Alternatively, it may happen that the replacement will take place naturally over time as the general standards of living in the area rise.

A comparison of Maps 4.1 and 4.2 indicates the differential distribution of glutinous and non-glutinous cultivation within north-east Thailand. There is considerable non-glutinous rice production in changwat Nakhon Ratchasima (the 'gateway' to the north-east), and cultivation is also noticeable in changwat Khon Kaen, Udon Thani and Nong Khai, through which the Friendship Highway passes (<u>vide</u> Chapter 6). All of these provinces have fairly large urban components, as, for different reasons, does changwat Ubon Ratchathani. The cultivation in Buri Ram, Surin and Si Sa Ket cannot thus be explained. They are

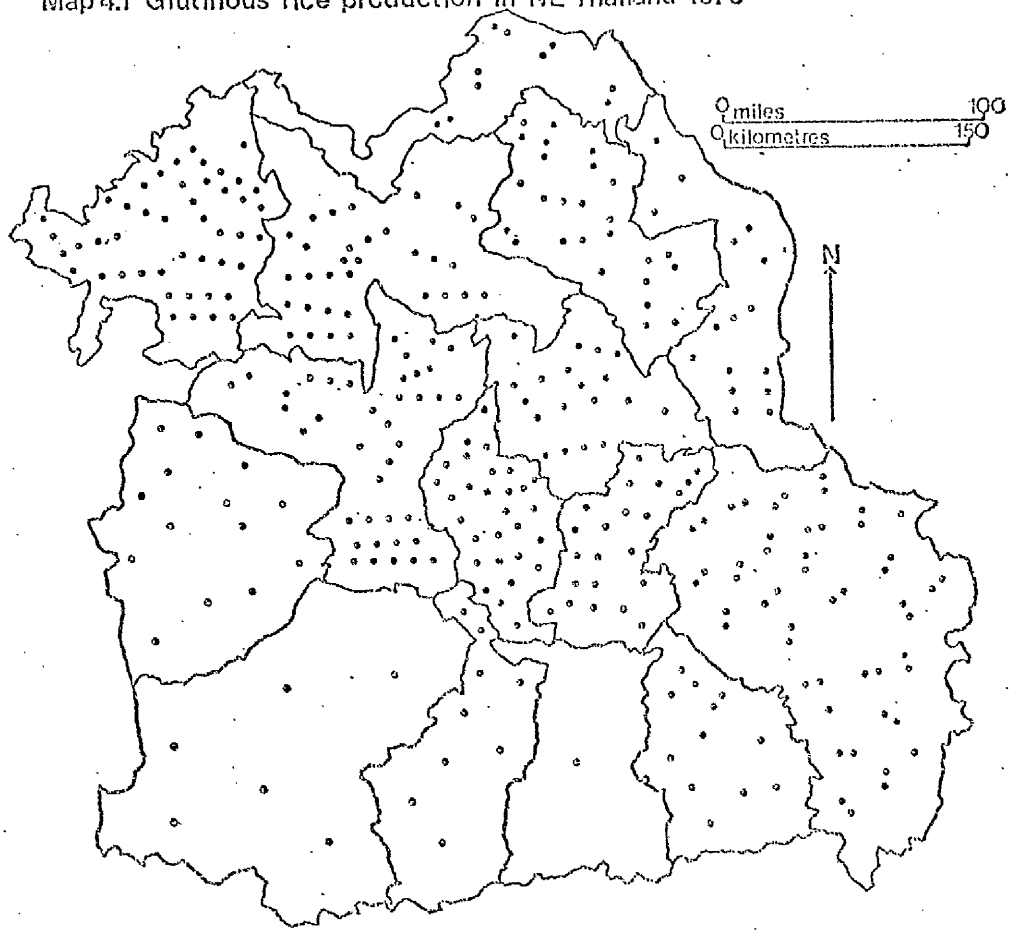
FIG.4.3. NON-GLUTINOUS RICE PRODUCTION EXPRESSED AS PERCENTAGE OF TOTAL RICE PRODUCTION IN NE THAILAND 1955-'69

SEMI-LOG

SOURCE: as FIG.4.1



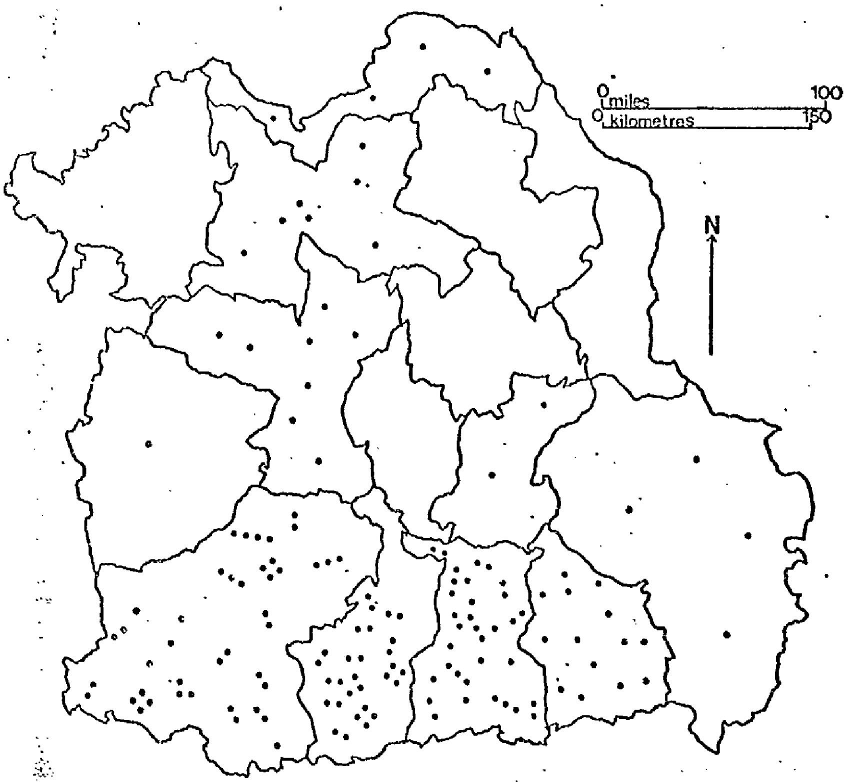
Map 4.1 Glutinous rice production in NE Thailand 1970



• 10,000 metric tons

Source: Reports on rice production in Thailand

Map 4.2 Non-glutinous rice production in NE Thailand 1970



• 10,000 metric tons
Source: Reports on rice production in Thailand

predominantly rural and poorly served by communications: in general they are considered the most backward areas of the north-east. They are also marked by a comparative lack of government projects and foreign research and investment. Thus non-glutinous rice cultivation is probably here a traditional rather than an 'innovative' feature, perhaps due to Khmer influence in these provinces. (Ethnically, the population of these provinces has resulted from admixture of Thai and Khmer).

Map 4.1 indicates a general relationship between the production of glutinous rice and the size of the rural population, although production in changwat Loei and Chaiyaphum owes a lot to yields which are above the north-eastern average. The comparative unimportance of non-glutinous rice production in changwat Nakhon Ratchasima is remarkable and possibly indicates either that the farmers here have largely become true commercial farmers and no longer subsist off their own produce or that non-glutinous rice has to a great extent replaced glutinous rice as a staple of consumption. The insignificance of glutinous rice cultivation in the remote changwat of Buri Ram, Si Sa Ket and Surin would underline the contention that glutinous rice is not traditionally of great importance in these provinces.(1)

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(1) Platenius, writing in 1963, divided the north-east into the rice-deficit changwat of Buri Ram, Loei, Si Sa Ket and Surin, the occasional rice-deficit changwat of Roi Et, Nakhon Ratchasima and Maha Sarakham and the rice-surplus changwat of Sakon Nakhon and Udon Thani. Platenius, H., The North-east of Thailand: its Problems and Potentialities, NEDB, Bangkok, 1963.

III. Rice Cultivation in the Lam Pao Sample

Kalasin is a changwat of predominantly glutinous rather than non-glutinous rice production. Yields in general, averaging 182 kg./rai for the main rice crop and 184 kg./rai for the off-season crop, are below the mean for the north-east.

In the Lam Pao Sample glutinous rice production likewise remains the principal activity. In the Sample 79.7% of the total cultivated area is sown to glutinous rice. The Sample mean percentage is exceeded by the mean percentages in Ban Um Mao (88.6%), Ban Lek (84%), Ban Na Chuak Nuea (83%) and Ban Fai Taek (81%). The proportion of land devoted to glutinous rice in Ban Tum and Ban Lao Yai, is, however, below the Lam Pao Sample mean, being 68% and 70% respectively. The reason for this differs in the case of the two villages: in Ban Tum it indicates the importance of cash-crop cultivation; in the case of Ban Lao Yai it denotes an economy which is more subsistent and thus must diversify its subsistent production.

The mean area of glutinous rice cultivated per household in the Lam Pao Sample is 13 rai (standard deviation 9 rai). Ban Um Mao with a mean of 13.8 rai is similar to the mean of the total Sample, Ban Non Sung and Ban Na Chuak Nuea with means of 15 and 17.4 rai respectively exceed the Lam Pao Sample mean. The means of the other villages are lower, viz. 11.7 rai for Ban Lek, 11 rai for Ban Lao Yai, 10.7 rai for Ban Tum and 10.4 rai for Ban Fai Taek.

These figures reveal a considerable range in the area of glutinous rice cultivated per household, ranging from a minimum of 2 rai to a maximum of 67 rai. Several factors could explain this range: the distribution could be purely fortuitous; it could be related to differences in the quality of the soil throughout the area and within each village; it could be related to the availability of irrigation water; it could be related most directly to the system of inheritance and/or buying and selling of land within the community; it could be related to the size of the family or, more specifically, either to the size of the active work force or the number of dependents. These relationships would be fairly clear-cut, but more complex relationships might exist with any or all of these factors and the amount of rice sold, negatively with the area devoted to commercial field crops or the amount of income available through off-farm work or remittances. Alternatively, all these aforementioned factors might combine to produce a pattern which admits of no ready explanation or is explicable only in terms of some external factor that study has not revealed.

Paddy soils do vary throughout the area and throughout each village. In the main the soils are poor, however, and it would appear that they are not the major factor responsible for significant differences in paddy yield. Within the Lam Pao Sample inherent fertility is greatest in Ban Lao Yai on the Chi floodplain and, possibly, lowest in Ban Tum, where continuous cultivation has proceeded for a relatively longer period of time. Yet Ban Lao Yai is, conversely, the village of fewest inputs in rice cultivation, whilst Ban Tum is relatively more prosperous. Such complications as these make it difficult to assess the importance of soil characteristics. If it is hypothesised that soil fertility does not have an important bearing on yields of glutinous rice in the Sample (until soil studies prove the contrary), then it follows that the area planted to glutinous rice per household does not bear a significant relationship to differential fertility of paddy soils between households.

With regard to irrigation, it is true that Ban Na Chuak Nuea, where irrigation is available, has a larger mean area of paddy holding than the other villages, but within each village the range is considerable. Moreover, within Ban Na Chuak Nuea not all farmers have taken advantage of irrigation and the advent of irrigation is so recent that, if it were assumed to be responsible for the present range of paddy holdings in Ban Na Chuak Nuea, it would have necessitated considerable change and re-allocation of land in recent years within the village. Who exactly were the agents of this change would have been influenced by socio-economic factors anyway. Moreover, there is no evidence for such a change having taken place. It is not improbable, however, that the availability of irrigation water will be a major factor in determining the future re-distribution of land within the Lam Pao Sample.

It is indubitable that the system of inheritance is the principal initial mechanism whereby land is distributed and allocated within a community; it does not, however, explain why some families had more land at their disposal in the first place. Ownership of land is confirmed by possession of a title deed (chonot thidin). Within the field, however, it is often difficult to ascertain ownership of land, since land might be registered as either belonging to a husband or a wife. Alternatively, a son-in-law might claim ownership of land, which, though in theory his, he is farming together with his parents-in-law as one unit. Similarly, a father might claim titular ownership of land which in practice is being farmed as separate units by his heirs. As stated earlier, inheritance in north-east Thailand is usually matrilineal and residence uxorilocal. Land is not held in common by any unit larger than the extended family (in most cases the nuclear family is the common productive and consumptive unit) : there are no clans, lineage groups or other supra-family productive and consumptive units within the north-eastern village. There may of course be communal ownership of pasture within the village (this is largely confined to verges of rough pasture) and common rights to the source of water, be it well (<u>bǫ</u>) or <u>nong</u> (natural pond), but in general individual ownership of the means of production is the rule, including uncleared forest land. Nor is there any form of co-operative ownership. Co-operatives are not as yet well established and their initial aims are modest (<u>vide</u> Chapter 10). Similarly, no land is owned by absentee landlords outside the village or large landowners within the village who sublet their land to tenant farmers, as is the case in the Central Plain of Thailand. The system of inheritance therefore provides an essential object of study to explain the mechanism of land-distribution within the past and the more far-reaching changes that will doubtless take place in the future.

The Thai rural people do not have any firm mystical ritual attachment to their farm land, whereby the identity of the individual, family and lineage is tied up with that of the land and to sever the two would be sacrilegious.(1) On the contrary, land to the Thai farmer is a commodity: it can be bought and sold freely and without compunction. Similarly, the Thai rural people are rather more mobile than many

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(1) Such a mystical attachment is common among various traditional societies,particularly in Africa. Bohannan's study of the Tiv of Nigeria is perhaps the best documented case of this, but similar beliefs are found among the Tallensi of Ghana, the Ashanti of Ghana and the Lugbara of Uganda, as well as in New Guinea.
Bohannan, L. and P.J., <u>Tiv Economy</u>, Evanston, 1968.
Fortes, M., <u>The Dynamics of Clanship among the Tallensi</u>, Oxford Univ. Press, 1945.
Rattray, R.S., <u>Ashanti</u>, Clarendon Press, 1923.
Middleton, J., <u>The Lugbara of Uganda</u>, Stanford Univ. Press, 1965.
Hogbin, I. and Lawrence, P., <u>Studies in New Guinea Land Tenure</u>, Sydney, 1967.
It would be of value to attempt a cross-cultural comparison of traditional attitudes to land to see to what extent the 'ritually-attached' and the 'commodity' views are related to other socio-economic variables and to what extent the two attitudes are mutually independent or mutually evolutionary.

traditional peoples.[1] Since villages are not exclusive kin groups (although a study of surnames within each village indicates that each village is characterized by relatively few kin groups), the outsider may enter the village and purchase land without undue opposition. (Perhaps significantly, the same word, khaek, is used for both 'stranger' and 'guest' in Thai). One individual in Ban Tum has bought and farms land in changwat Maha Sarakham, whilst one of the largest farmers in Ban Tum is a comparative newcomer (in fact many of the villagers do not know his name).

Accordingly, the area planted to glutinous rice per household was correlated with the following variables: the number of people per household, the size of the labour force per household, the number of dependents per household, and the age of the household head.

The Coefficient of Correlation between area planted to glutinous rice per household and the number of people per household is 0.24, which is significant at the 1% level. The statistics reveal, however, that there are very large families apparently subsisting on small areas of paddy (in fact they may have outside sources of income) and small households which cultivate extensive paddy lands. The bulk of the households lie in the range of five to ten persons, but in this range the whole range of paddy sizes is exhibited.

Of less significance is the relationship between the size of the labour force (both male and female) and the area planted to glutinous rice per household. The Coefficient of Correlation is 0.19 which is significant at the 5% level. Equally significant is the relationship between the number of dependents per household and the area

(1) Fisk, E.K., "The mobility of rural labour and the settlement of land in underdeveloped countries", JFE, Nov. 1965.

planted to glutinous rice: Coefficient of Correlation is 0.16, significant at the 5% level.

It might be considered that there is a relationship between the area planted to glutinous rice and the age of the household, as illustrated by the age of the household head. This in turn depends upon the mechanism of inheritance. However, it does not take into account the history of the household, i.e. the number of generations that have farmed and passed on a particular farm.[1] Land tenurial changes occur at two scales: on the larger scale changes occur, sometimes slowly, sometimes dramatically, over the generations; on the smaller scale, the holding goes through a cycle each generation, whereby the young married man or woman inherits his/her plots, seeks to expand them (if the environment is appropriate), when raising children; when some or all of these children are 'adult' (over 15 years of age), the household, at its point of maximum potential, may seek to optimize production by expanding the holding still further; finally, the children marry and the original holding may be subdivided; then the process begins anew. It is this smaller scale that is reflected in the age of the household head.

The ages of the household heads in the Lam Pao Sample range from 20 years to 78 years of age. Naturally, in this area of settled agriculture the 'middle-aged' group is most numerous. (Conversely, one would expect younger farmers to be more numerous in an area of 'pioneer' agriculture). 26 farmers are between the ages of 20 and 30 years, 58 between 31 and 40 years, 71 between 41 and 50 years, 56 between 51 and 60 years and 19 over 61 years of age. Within these five age groups, the

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(1) There was not time in the field to follow up this particularly interesting point, which could constitute a vast field of research in itself.

20 to 30 years group has the lowest mean area planted to glutinous rice, being 11 rai, whilst the 41 to 50 year age group has the highest mean, being 14 rai. All the other groups average 13 rai. This is as would be expected from the postulated cycle. However, the Coefficient of Correlation between the age of the household head and the area planted to glutinous rice is 0.16, significant at the 5% level.

It might be supposed that the area devoted to glutinous rice cultivation would have an inverse relationship with the emphasis upon cash crops, of which kenaf is the only one important enough to warrant statistical consideration. Accordingly, households were subdivided into those that cultivate kenaf and those that do not. The Difference of Means Test was applied to these two independent categories with respect to area planted to glutinous rice. The value of 't' obtained was 0.34, which is not significant.

The same statistical test was applied to distinguish between those farmers who benefit from some form of off-farm income and those who do not with respect to area devoted to glutinous rice cultivation. The value of 't' obtained was 0.7, which is not significant.

Thus neither the cultivation of commercial crops nor the subsidization by off-farm sources of income appear to have any effect upon the area planted to glutinous rice per household.

The area planted to glutinous rice per household in most cases accords with the area of glutinous rice plots possessed: there is usually no paddy land left unplanted. In Ban Fai Taek, however, there were two cases in which 5 rai of paddy land were left unplanted, in the one case out of a total of 25 rai of paddy land, in the other out of a total of 14 rai. In the former household there were four workers and four dependents; in the latter case there were four workers and no dependents. Both farms were characterized by having no cash crop income from kenaf, but having off-farm sources of income. In the former case two adult members of the family have left the farm for non-farm employment and send back remittances. Both these farms were characterized by old household heads, 78 and 63 years of age respectively.

In Ban Chuak Nuea there are 8 cases in which paddy land is left unplanted. In all these cases the available paddy land is large, ranging from 12 rai to 67 rai and averaging 27 rai. The paddy land left unplanted per household ranges from 1 rai to the surprisingly large figure of 32 rai, averaging 16.2 rai. Most, but not all, are characterized by off-farm sources of income and a few by cash crop income, but in one case, in which 13 rai are left unplanted, there is no supplementary source of income at all. The ages of the household heads range from 24 years to 51 years, averaging 36 years of age. However, what distinguishes most of these families is a favourable adult/dependent ratio. In no cases are the dependents a burden upon the work force, with the exception of one case where the adult/dependent ratio is 2/5 - here only one rai is left unplanted. In no other cases are the adults per household outnumbered by the dependents, the ratios being 4/2, 7/5, 3/3, 4/3, 2/1, and 3/2. Thus it is apparent that in the Ban Na Chuak Nuea cases the favourable adult/dependent ratio lessened the subsistence needs of the households. The surplus labour in these households, however, instead of maximizing glutinous rice production for sale, let sections of paddy land, small or large, lie fallow and instead made itself available for off-farm work, principally at the Lam Pao dam site.

The fallow paddy land of Ban Na Chuak Nuea is thus very different from the fallow paddy land of Ban Fai Taek. In Ban Na Chuak Nuea it represents a deliberate and innovative decision in order to take advantage of increasing off-farm economic opportunities. In the case of Ban Fai Taek it is rather the case of the old farmer no longer needing and no longer desiring to cultivate his full paddy complement, when his subsistence requirements are fairly small.

However, with the exception of the few cases just cited, the farmer usually needs to and desires to cultivate all the paddy land he possesses. Thus the range of areas planted to glutinous rice per household is more or less identical with the range of paddy plots owned per household and the explanation of this range can only be sought in an examination of the history of the households concerned. However it arose, the present range of paddy areas per household can be taken as the given reality on the ground. It is the starting point which influences every other factor in the farm economy and will strongly influence the openness to innovations of the individual farmer and his direction and pace of change. It is expected that this present range of paddy areas per household will change relatively and absolutely in the near future as the economy of the Lam Pao area becomes more diverse.

IV. Yields

If the area of paddy possessed and cultivated per household is the most crucial factor providing an opportunity for or a bar to development, then next in importance must be the productivity of these paddies. The factors which may influence the yield of paddy include the size of the paddy, traditional inputs and the productivity of labour.

i. Yields and areas of paddy:

There is a quite marked correlation between the area planted to glutinous rice per household and the yield of glutinous rice per household. The Coefficient of Correlation is -0.45, which is significant at the 1% level. It is plausible that, *ceteris paribus*, a small holding will be cultivated more intensively than a large holding, especially if labour is not relatively more scarce on the smaller holding. (It has already been demonstrated that labour is not relatively more scarce on smaller holdings in the Lam Pao Sample).

ii. Yields and traditional inputs:

Taking the traditional inputs of paddy cultivation (excluding the purchased inputs which are an innovation), it is apparent that there is a considerable range within the Sample.(1) The total mandays per paddy, varying according to the size of the plot, range from 2 to 160, averaging 11. It has already been demonstrated in Chapter 3 that increasing inputs of labour in paddy cultivation are rewarded with

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(1) Labour, of course, may be either a traditional or a purchased input. However, it is the quantity of labour input which affects the paddy yield. Whether the labour is family labour or hired labour one may assume, lacking evidence to the contrary, has no effect upon productivity. The quality of the labour - the age, sex, health and temperament of the labourers - does have some effect, but this is hardly subject to quantification. Moreover, it probably evens itself out in a large, fairly homogeneous sample.

increasing yields and that the state of zero marginal productivity has not yet been achieved in the Lam Pao Sample. On average, 2.5 days per year are spent ploughing, 4 days planting and 4 days harvesting. These figures vary according to the size of the plot and cannot be regarded as significant variables which will affect the yield of rice.(1)

Whether the plot is weeded or not and the amount of labour expended in weeding are usually considered among the most significant traditional variables affecting the yield of rice. In the Lam Pao Sample in fact only 39% of paddy plots are weeded, the mean number of mandays spent in weeding being 3.6.

The paddy plots in the Sample were subdivided into five groups, viz. 0-5 rai, 6-10 rai, 10-15 rai, over 16 rai (the maximum size of plot is in fact 42 rai). In the group below 5 rai there are 82 weeded and 70 unweeded plots, in the 6-10 rai group there are 49 weeded and 78 unweeded plots, in the 10-15 rai group there are 15 weeded and 35 unweeded plots, in the group of 16 rai and over there are 12 weeded and 61 unweeded plots. In only the group of smallest plots is weeding more common than not weeding; in the other groups the importance of weeding diminishes as the area of the plot increases.

The Difference of Means Test was applied to each of these groups. In the group below 5 rai the mean yield for weeded plots is 182 kg./rai, the mean yield for unweeded plots 275 kg./rai, giving a value of 0.48 for 't', which is not significant.

In the group of 11 to 15 rai the mean yield for weeded plots is 207 kg./rai, the mean yield for unweeded plots 273 kg./rai, giving a value of 0.1 for 't', which is not significant.

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(1) The period prior to transplanting might be important.

In the group of 16 and over rai the mean value for unweeded plots is 273 kg./rai and for weeded plots 207 kg./rai, which gives a value of 0.23 for 't', which is not significant.

Thus it may be stated that weeding in the Lam Pao Sample has no effect upon the yield of glutinous rice. It is surprising, however, that the mean yields for unweeded plots are higher in all groups than those of weeded plots (vide Chapter 7).

iii. Yields and labour productivity:

It is axiomatic that under particularly adverse environmental conditions yields of a particular crop may be low, whilst the labour applied to cultivation of that crop is extremely productive. Conversely, under particularly favourable physical conditions (as prevail on the lava-based paddy soils of Java, for example) yields may be high, whilst excess labour maintains low productivity. In simple terms, extensive agriculture is often classified as having low returns per unit of land and high returns per unit of labour, whilst intensive agriculture is classified as having high returns per unit of land and low returns per unit of labour. In paddy cultivation yields per unit of land are usually substantially higher than yields per unit of labour. This is true for the Lam Pao Sample. The maximum yield per unit of land is 1,000 kg.; the maximum yield per unit of labour is 473 kg. However, the Coefficient of Correlation between yields per rai and yield per manday in the Lam Pao Sample is 0.22, significant at the 2% level. Thus, although yields per unit of land are higher than yields per unit of labour, there is a positive rather than negative relationship between the two variables. Increasing productivity in rice cultivation in the Sample is associated with more productive use of both land and labour. This is comprehensible in the Lam Pao context for two main reasons: there is not a problem of surplus labour in rice cultivation (vide Chapter 3); rice cultivation is not 'intensive' in comparison with many other traditional rice-producing areas, e.g. the Central Plain of Thailand, the Mekong Delta, Java, Bengal. (It is in such truly intensive rice-producing areas that most of the economic research on rice cultivation has been formulated).

Within the Sample the paddies were subdivided into four yield per unit of land categories, viz. 0-199 kg./rai, (44 cases), 200-299 kg./rai (81 cases), 300-399 kg./rai (51 cases) and over 400 kg./rai (54 cases).

In examining the range of yields per unit of labour time for each of these yield per unit of land categories, it was found that there was a relationship with the size of the paddy.

Thus for the 0 to 199 kg./rai group the Coefficient of Correlation between yield per manday and size of paddy was 0.79, significant at the 0.1% level. For the 200 to 299 kg./rai group the Coefficient of Correlation is 0.23, significant at the 1% level. For the 300 to 399 kg./rai group the Coefficient of Correlation is 0.53, significant at the 0.1% level. For the group over 400 kg./rai the Coefficient of Correlation was 0.64, significant at the 0.1% level.

Thus within each yield per unit of land category the yield per unit of labour time increases withthe size of the paddy holding.

V. Sale of Glutinous Rice in the Lam Pao Sample

The amount of rice produced is dependent upon area cultivated and yield. The amount of rice that is available for sale then depends upon these two factors and the subsistence requirements of the farm. To express and measure the relationship between the size of the paddy holding and the size of the family the variable 'paddy rai per adult equivalent' was derived. The 'adult equivalent' was calculated on the basis of two children under fifteen years of age being equal to one adult. Of course, this calculation overlooks the enormously different food-requirements and productive capacities of babies and fourteen year old adolescents and the decreased food-requirements and capabilities of ageing adults. Nevertheless, these complications would beset most measures chosen.

There is a wide range of paddy rai per adult equivalent, varying from zero to 11.3 rai. The mean value is 2.61 rai, standard deviation 1.79 rai. These Lam Pao figures are comparable to the paddy rai per caput figures issued by the Ministry of Agriculture: for the north-east these range from 0.7 rai in changwat Loei to 2.6 rai in Roi Et, with 2.2 rai for Kalasin.

The Coefficient of Correlation between paddy rai per adult equivalent per household and percentage of glutinous rice produced which is sold per household is 0.28, significant at the 0.2% level. This demonstrates the expected fact that the more favourable the relationship between paddy area and family size, the more rice is likely to be sold.

From 'paddy rai per adult equivalent' the variable, 'glutinous rice available per adult equivalent' may readily be derived. However, account must be taken of loss of rice: milling loss is taken to be 34% and 5% of production is estimated to be utilized for seed, animal feed and loss in storage. The conversion factor is therefore 62.7%.(1) The consumption requirements of rice per person is taken to be 160 kg. per annum, which is the rather modest figure based upon the 1954-'68 mean figures of rice available per caput per annum, issued by the Ministry of Agriculture.

Fig. 4.4 shows the surpluses and deficits of glutinous rice in the Lam Pao Sample. (cf. Fig. 3.1) Clearly, there are households which failed to satisfy the modest subsistence requirements of 160 kg. per caput per annum. In this category fall 8% of the farms in the Lam Pao Sample, 8% of Ban Na Chuak Nuea farms, 10% of Ban Tum farms, 3% of Ban Um Mao farms, 12% of Ban Fai Taek and Ban Lek farms, 6% of Ban Non Sung farms and 27% of Ban Lao Yai farms. Many more households are just above the 160 kg./caput/annum line. As expected, the proportions of households with a rice deficit in Ban Um Mao, the predominantly rice-producing village, is low. The high proportions of such households in Ban Na Chuak Nuea and Ban Tum, however, does not signify deprivation, since in the former village these deficits are off-set by off-farm income, in the latter village by commercial cultivation of field crops. In the case of Ban Lao Yai and Ban Lek, however, these figures probably reveal genuine deprivation. In Ban Na Chuak Nuea and Ban Um Mao there are numerous households which have substantial surpluses of rice.

It was pointed out in Chapter 3 that it is difficult to establish the case for a ceiling to the demand for rice. Whatever minimum or mean requirements may be, actual consumption rates are very elastic. Nevertheless, one can assume that farmers with modest rice

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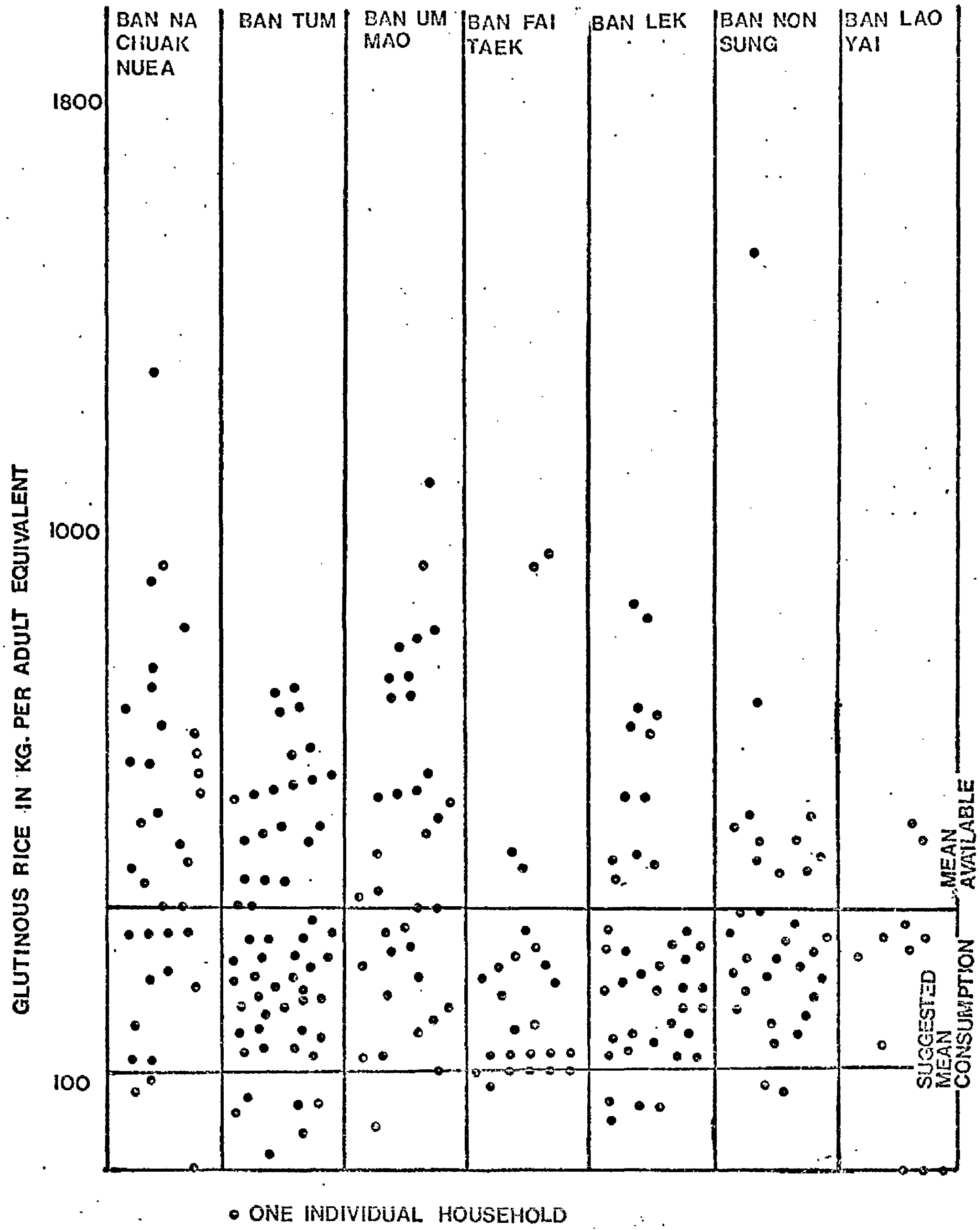
(1) The conversion factor is from National Income of Thailand, NEDB, 1965. This is based upon Min. of Agr. statistics revised by NEDB to correct underestimation.

Figure 4.4 Surplus & deficit of rice in Lam Pao Sample



production will prefer to satisfy their own requirements from it rather than convert it into cash income (there would be little point in selling 'subsistence rice' and then converting the income gained back into food); conversely, those with surplus production will sell their crop rather than hoard it. The Coefficient of Correlation between glutinous rice per adult equivalent and percentage of glutinous rice sold per household is 0.34, significant at the 0.1% level. That this is not more significant is a result of the large number of non-sellers in the Sample.

VI. The Reciprocal Effect of Commercialization of Rice on Resource Use

Park in his study of 277 semi-subsistent farms in South Korea convincingly demonstrated that commercialization has a reciprocal effect upon resource use in semi-subsistent agriculture.(1) He found that the yields of rice were higher on farms that sold more of their total rice production; this was the case for all paddies but most markedly the case for the smaller paddies. He further found that, as commercialization increased, the total value product per man equivalent increased significantly, most significantly on the smallest holdings. He concluded that the farmer was trying to utilize his limited resources for the best alternatives and that increasing commercialization of semi-subsistent farms results in increasing labour-productivity on a given land area. Hence it is positively associated with the growth of the agricultural economy.

It was decided to test Park's hypothesis in the Lam Pao Sample, which, incidentally, appears to be significantly more subsistent than the Korean sample. Table 4.6 shows the relationship between commercialization, size of holding and yield of glutinous rice. As in Park's sample, overall productivity is higher on the smaller holdings. In the case of the smaller holdings it is difficult to see any relationship, partly because there are no cases in the category of 11% to 20% sale of glutinous rice. Moreover, the small holdings which have no sale of rice have a higher yield than those that sell 1% to 10% of their rice. For the other two 'size of holding categories', however, commercialization is associated with higher yield up to a certain point. Thus in the 11 to 20 rai group over 20% sale of rice is associated with

(1) Park, J.H., "Effects of increasing commercialization on resource use in semi-subsistence farms in South Korea", in Subsistence Agriculture and Economic Development, op.cit.

Table 4.6 Relationship between % of rice sold, size of glutinous rice holding and yield per unit of land in Lam Pao

% of rice sold	Size of glutinous rice holding			
	0-10 rai	11-20 rai	over 21 rai	all
	Yield of glutinous rice in kg./rai			
0	378	259	221	325
1 - 10%	339	340	228	295
11 - 20%	0	328	305	274
21 - 50%	407	317	234	314
over 51%	384	67	147	245
All	380	270	221	311

a slightly lower yield. However, more markedly, in both the 11 to 20 rai group and the above 21 rai group farms with over 50% sale of rice have considerably reduced yields.

Thus it is possible that increasing commercialization has a reciprocal effect upon yield in the larger farms. That this is less clear in the case of the smallest farms may be a result of the fact that such holdings are more likely to be subsistent anyway and, hence have less incidence of sale. However, the most commercial of the larger holdings have considerably reduced yields. No evidence in the Lam Pao Sample was found to support Park's contention that labour productivity increased with increasing commercialization.

VII. Improved Varieties of Rice as an Innovation

The first improved varieties of rice were introduced into Thailand in 1940.[1] In 1950 a modern system of breeding was initiated,[2] although there had been a rice-breeding programme in existence since 1916.[3] Improved varieties are now used throughout the country and account for 30% to 40% of the total area under rice, although some of the improved varieties are in no way superior to the traditional ones.

A great deal of attention throughout Monsoon Asia has been given to the so-called 'miracle rices', which are able to treble existing yields. These varieties - IR5, IR8, IR20 and IR22 - were produced at the International Rice Research Institute at Los Baños, Philippines.[4] The value of these 'miracle rices' has been disputed by some writers.[5] At present in Thailand, however, they have not achieved great importance, partly because of the lack of a domestic market for the somewhat

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(1) Bain, D.H., Agricultural Economic Survey of Sarapee district, Chiengmai province, Thailand, FAO, 1951.

(2) Love, H.H., "A report on plans and progress with rice improvement in Thailand", Natural History Bulletin, Siam Society, 16, 1954.

(3) The Agricultural Economy of Thailand, U.S. Dept. of Agriculture, Economic Research Service, 1972.

(4) The International Rice Research Institute was established by the Ford and Rockefeller Foundations in the University of the Philippines in 1960 and was joined by the U.S. Agency for International Development (USAID) in 1970.

(5) An article in Business in Thailand points out that, although 'miracle rices' yield threefold, they require inordinately large applications of fertilizer and, in fact, are of lesser protein value than traditional varieties. It considers them to be unsuited to monsoonal flooded lands. The article proceeds to point out the 'miracle rice' is nevertheless a considerable boost to big business: the petro-chemical industry has an enlarged market for fertilizer and other oil by-products are required to heat the seeds to break dormancy or treat them chemically, provide insecticide and rat poisons, since all kinds of pestilences are encouraged by the 'miracle rices'. "Looking a Gift Horse in the Mouth", Business in Thailand, May 1972.

'acquired' taste of 'miracle rice', but just as significantly because these 'miracle rices' require good water control, which is not yet available throughout Thailand. This point further underlines the inter-dependability of innovations and the crucial rôle of the availability of irrigation to the success of innovations.

Within Thailand plant breeders have striven to backcross IR varieties with some of the best local strains, such as Laungthong, to retain the high-yielding capacity of the IR variety and quality of the native strain. By the end of 1969 the Rice Department had officially accepted three new varieties of rice resulting from these backcrosses. These new varieties, known as RD1, RD2 and RD3, are of high quality and have a higher yield than IR8. RD1 and RD3 are non-glutinous, whilst RD2 is glutinous.(1) Table 4.7 shows the recommended improved varieties of rice for use in north-eastern Thailand.

In the Lam Pao Sample farmers were asked whether they had heard of the new varieties of rice, whether they had ever used them and whether they had used them in the year of study. Fig. 4.5 shows the results. The rejection rate of the innovation in the Sample is 2%. This may not, however, represent an outright rejection of the innovation *per se*, but merely an inability to purchase new seed each season.(2)

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(1) The Agricultural Economy of Thailand, *op.cit.*

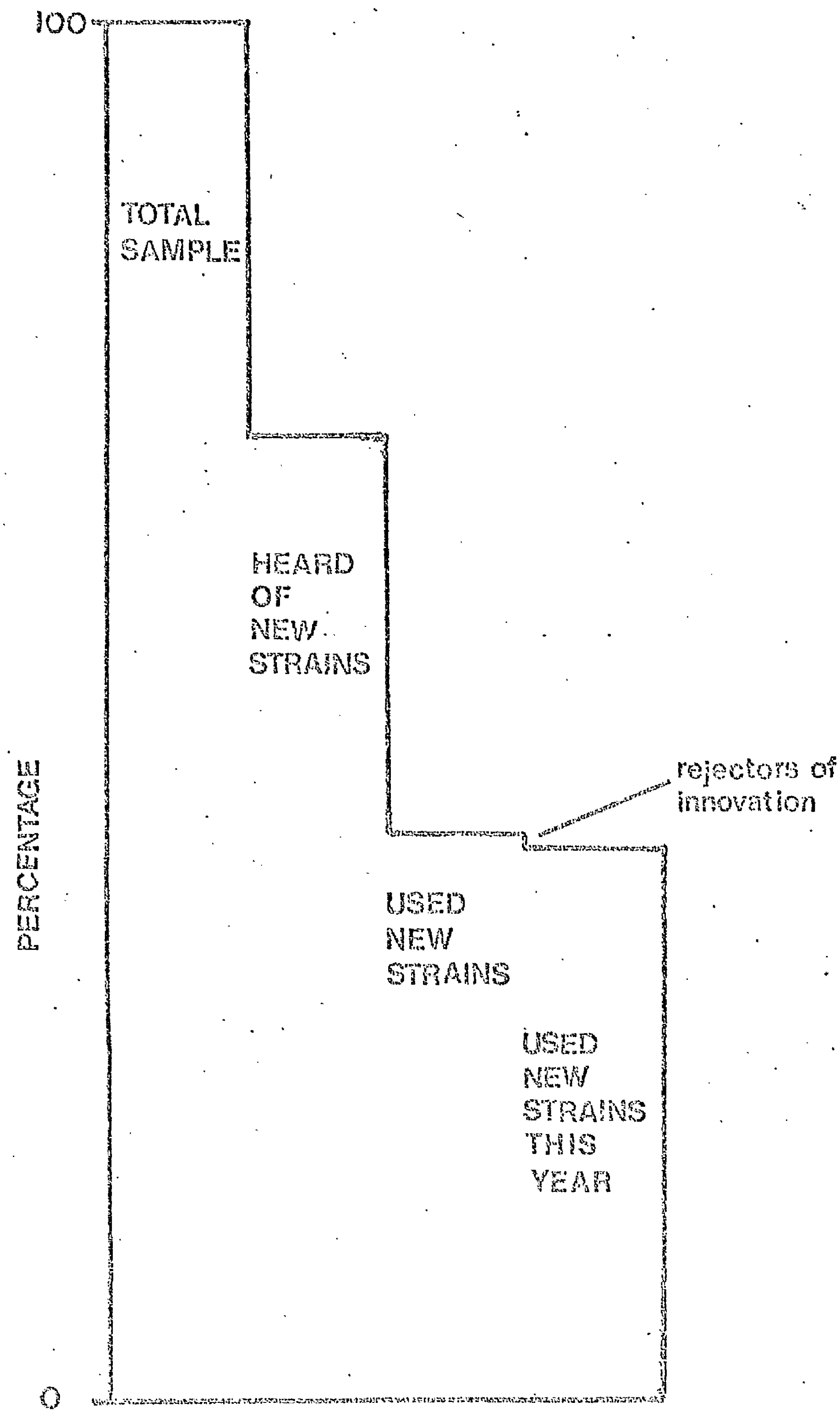
(2) It has been noted in Thailand as a whole that once farmers have received their improved varieties of rice (which is multiplied and distributed by the government in co-operation with farmers' seed committees) they do not thereafter buy certified seed every year, but prefer to grow their own seed once they have obtained an improved variety. Of course, this can only lead to a fairly rapid deterioration of the variety and an ultimate plant which is inferior to both the improved and the traditional varieties.
ibid.

Table 4.7 Recommended Varieties of Rice for the north-east

Name	glut. or non-glut.	Harvest date (approx.)	Yield (ave.) (kg./rai)
Khi Tom Yai 98	glut.	18th Nov.	266
Niew Sampahtawng	glut.	25th Nov.	246
Gam Pai 41	glut.	30th Nov.	305
Khao Dawk Mali 105	non-glut.	20th Nov.	258
Jao' Leuang	non-glut.	26th Nov.	281

(data from regional variety trial).

Figure 4.5 Knowledge and adoption of new strains of rice in the Lam Pao Sample



VIII. Non-Glutinous Rice as an Innovation in the Lam Pao Sample

Most of the new varieties of rice which are being promoted in the Lam Pao area are of the glutinous variety. Non-glutinous rice itself must be considered an innovation in the Lam Pao Sample, since only 7.6% of the Sample cultivate it. Table 4.8 illustrates the place of non-glutinous rice in the rice economy of those farms in the Sample which cultivate it.

There are no cultivators of non-glutinous rice in Ban Na Chuak Nuea, one in Ban Tum, two each in Ban Fai Taek and Ban Lek, three in Ban Lao Yai, four in Ban Um Mao and six in Ban Non Sung. The lack of importance in Ban Na Chuak Nuea and Ban Tum is explicable in terms of the profitable alternatives to agricultural innovation in the form of off-farm work in the former village and the emphasis upon field crops in the latter village. The higher figures in Ban Um Mao and Ban Non Sung, which have traditionally large rice areas, represent definite innovation. In the case of Ban Lao Yai this relatively high figure merely represents a subsistent village's attempts to provide itself with all its requirements, since, where glutinous rice is the staple, non-glutinous rice may be used on the farm when converted into confectionery or liquor. (Conversely, in regions and countries of predominantly non-glutinous rice production it is glutinous rice which is cultivated as a minor domestic crop for production of confectionery and liquor).

There is a considerable range apparent in the proportion of the paddy land per farm which is devoted to non-glutinous rice, ranging from 6% in Ban Na Chuak Nuea to 68% in Ban Lao Yai. However, in half of the cases there is no sale of non-glutinous rice at all; in seven of these cases there is no sale of any rice. In five cases the entire income

Table 4.8 Non-glutinous rice in the rice economy of Lam Pao

non-glutinous rice area as % of total rice area	income from non-glut. rice as % of total income from all rice	(1) inputs in non-glut. rice cultivation as % of inputs in all rice cultivation
6	100	no inputs at all
5	0	13
50	100	0
20	0+	none
53	26	26
25	0+	36
9	100	0
20	0+	0
22	0+	6
14	18	0
10	29	0
7	31	0
14	0	0
20	100	7
25	100	0
20	0+	none
68	0+	none
30	0+	none
Mean 21	Mean 55	

(1) the 'inputs' here referred to are 'purchased inputs' as defined in Chapter 3. The principal purchased input is hired labour.

+ refers to holdings on which there is no sale of rice, glutinous or non-glutinous, at all.

'none' refers to households where there are no purchased inputs at all.

0 refers to households which have purchased inputs only on the glutinous rice plot.

from rice is derived from non-glutinous rice sale, but in these cases the actual areal importance of non-glutinous rice varies from 6% to 50% of the total area under rice. Of the nine sellers of non-glutinous rice, however, six sell 100% of their non-glutinous rice, eight sell over 80%; the remaining one sells only 16%. Thus it is possible to divide non-glutinous rice cultivators into two categories of equal size: those who sell all or most of their crop and those who consume all or most of their crop.

Although it might be expected that purchased inputs would be greater for an innovation produced for sale than for a traditional staple, the figures belie this. Five farmers do not supply any purchased inputs for their paddy cultivation at all, but of the thirteen who do have purchased inputs in only four of these cases are any of these purchased inputs directed towards non-glutinous rice cultivation and then the proportion of total purchased inputs in rice is very small. However, there is no relationship in these cases between the importance of purchased inputs and sale of non-glutinous rice. The farmer that invests most heavily in non-glutinous rice cultivation is in fact entirely subsistent with respect to it.

Thus it would seem from this admittedly small sample of non-glutinous rice cultivators, that farmers are more prone to invest in their subsistence cultivation than in their commercial rice cultivation. Probably, they realize that investment in their subsistent crop must, providing no natural disasters occur, bring high returns and security, whereas the returns from investment in the commercial non-glutinous rice crop are dependent upon external market forces outside the farmers' control. Thus such investment is more risky. In cultivating this commercial innovation crop in the first place the farmer takes a calculated risk; he therefore seeks to minimize this risk by minimum investment in the innovation rather than compound the risk. Thus doing, he is in fact tying himself down to low returns from his innovation crop with consequent dissatisfaction with the innovation. Similarly, he thus finds it increasingly difficult to break out of the cycle of subsistence.

The mean yield for non-glutinous rice in the Lam Pao Sample is 339 kg./rai, which is similar to the mean yield of 327 kg./rai for glutinous rice in the Sample. Table 4.9 brings out the lack of pattern in the comparison of glutinous and non-glutinous rice yields among farmers in the Sample who cultivate both varieties. In seven cases the yields are similar for both types of rice; in six cases yields of glutinous rice are considerably lower than yields of non-glutinous rice; in two cases the reverse holds true; in two cases there is a crop failure affecting both types of rice. A comparison of Tables 4.10 and 4.11 brings out the fact that the cases of high yielding glutinous rice are not related to the sale of glutinous rice, but that the high yields of non-glutinous rice are in fact associated with high degrees of sale.

Table 4.11 brings out the inverse relationship between the returns from non-glutinous rice cultivation and the relatively small investment in it in the form of purchased inputs, when compared with glutinous rice cultivation, both in terms of total investment and investment per unit area.

A further index of the importance attached to non-glutinous rice is the amount of labour expended upon it. Table 4.12 compares the total labour expended in glutinous and non-glutinous rice cultivation among the 18 farmers who cultivate both types, the intensity of labour per unit of land and the productivity of that labour expressed in Baht return per manday. Of course, Baht return per manday could be calculated

Table 4.9 Comparison of yields for glutinous and non-glutinous rice for 18 farmers who cultivate both in the Lam Pao Sample

Yield of glutinous rice kg./rai	Yield of non-glutinous rice kg./rai
116.2	400
289.5	500
250.0	156.3
500	500
416.7	385.7
288.9	133.3
333.3	400
312.5	500
176.5	160
361	166.7
384.6	666.7
384.6	700
214	300
250	666.7
533	200
0	0
600	272
0	0

Table 4.10 Comparison of sale for glutinous and non-glutinous rice for 18 farmers who cultivate both in the Lam Pao Sample

Percentage sale glut. rice	Percentage sale non-glut. rice
0	100
36.4	0
0	80
0	0
60	15.6
0	0
0	81
0	0
0	0
46.2	100
40	100
40	100
33.3	0
0	100
0	100
0	0
0	0
0	0

Table 4.11 Comparison of income from sale, inputs in total and inputs per rai for glutinous and non-glutinous rice for 18 farmers who cultivate both in the Lam Pao Sample

glutinous rice			non-glutinous		
income from sale	inputs total	inputs per rai	income from sale	inputs total	inputs per rai
Baht	Baht	Baht/rai	Baht	Baht	Baht/rai
0	0	0	700	0	0
0	240	12.6	1060	36	36
0	300	18.8	1400	0	0
0	0	0	0	0	0
795	795	0	294	294	42.9
212	212	23.6	122	122	40.7
0	360	17.1	455	0	0
0	100	12.5	0	0	0
390	390	22.9	26	26	5.2
3180	421	11.7	700	0	0
1060	260	20	700	0	0
1060	115	8.8	490	0	0
1060	1060	15.4	-	0	0
72	72	6	242	242	80.7
0	115	38.8	140	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

Table 4.12 Comparison of total labour inputs, mandays/rai and Baht per manday returns for glutinous and non-glutinous rice for 18 farms which cultivate both in the Lam Pao Sample

glutinous rice			non-glutinous rice		
total labour	mandays per rai	Baht/ manday	total labour	mandays per rai	Baht/ manday
10	2.6	0	88	4	70
150	7.9	17.8	12	12	26.2
146	9.1	0	150	9.4	11.7
111	13.9	0	31	15.5	0
87	14.5	15.2	99	14.7	16.7
83	9.2	0	32	10.7	0
260	12.4	0	31	15	14
128	16	0	32	16	0
130	130	0	35	35	0
387	10.8	16.7	62	10.3	11.3
116	8.9	20.6	14	9.3	50
135	10.4	18.8	17	17	28.8
169	6	16.3	52	10.4	20.2
37	3.1	41	44	14.7	26.3
30	10	24.4	7	7	20
70	3.5	0	25	5	0
89	17.8	17.9	151	13.7	13.9
60	4.3	4.3	20	3.3	3.3

hypothetically even where there is no sale of rice, but, since this is a concept which has no practical significance for the farmer, the writer has merely calculated returns for the cases where there is sale. Table 4.12 indicates that, although overall far more labour is utilized in glutinous than in non-glutinous rice cultivation, this merely reflects the larger area under glutinous rice. The intensity of labour input per rai of the two types is very similar. Baht returns per rai are also similar but slightly higher for non-glutinous rice. Table 4.13 summarizes the findings with respect to glutinous and non-glutinous rice cultivation among the 18 farmers who cultivate both types.

However, of equal importance in this study is the nature of the farmers who have adopted non-glutinous rice cultivation and the effect that this has had upon cultivation of glutinous rice in these households when compared with glutinous rice cultivators who do not cultivate non-glutinous rice. Table 4.14 summarizes the results. There is no appreciable difference between these two discrete groups with respect to size of household, number of workers or number of dependents per household. Area of glutinous rice cultivated, yield of glutinous rice, labour inputs, intensity of labour inputs and productivity of labour are also very similar for both groups. The age of the household head is likewise unimportant. It was considered that the mean glutinous rice available per adult equivalent might be an important variable in that those farmers who had above average surplus of glutinous rice for domestic consumption would be the very farmers who would be most likely to innovate with respect to non-glutinous rice. However, there was found to be no appreciable difference between these two groups. For the glutinous rice cultivators who also cultivate non-glutinous rice two figures were taken for the mean glutinous rice available per adult

Table 4.13 Overall comparison of glutinous and non-glutinous rice cultivation on 18 farms which cultivate both types in the Lam Pao Sample

	glutinous rice	non-glutinous rice
Mean area (rai)	16	4.4
Mean yields (kg./rai)	327	339
Mean income (Baht)	495	294
Mean inputs (Baht)	167	40
Mean inputs per rai (Baht per rai)	11	11.4
Mean mandays	122	48.9
Mean mandays/rai	9	10.8
Mean Baht/mandays	11	17.1

Table 4.14 Comparison of glutinous rice cultivation for farmers who do and do not cultivate non-glutinous rice in addition to glutinous rice in the Lam Pao Sample

	glutinous rice on farms which also cultivate non-glutinous rice	glutinous rice on farms which do not also cultivate non-glutinous rice
Percentage of glutinous rice cultivators	7.6%	92.4%
Mean area of glutinous rice cultivation	16 rai	13.6 rai
Mean yield of glutinous rice	327 kg./rai	302.6 kg./rai
Mean income from glutinous rice	495 Baht	187 Baht
Mean inputs in glutinous rice	167 Baht	199.5 Baht
Mean inputs/rai in glutinous rice	11 Baht/rai	8.7 Baht/rai
Mean mandays on glutinous rice	122 mandays	111.7 mandays
Mean mandays/rai on glutinous rice	9 mandays/rai	9.8 mandays/rai
Mean Baht/mandays on glutinous rice	11 Baht/mandays	18 Baht/mandays
Mean size of household	8 persons	7 persons
Mean number of adults	4 persons	4 persons
Mean number of children	4 children	3 children
Mean age of head	50 years	45 years
Mean savings	656 Baht	1592.98 Baht
Mean glutinous rice available per adult equivalent	414 Baht	435 Baht
Mean glutinous rice available per adult equivalent excluding crop failures in non-glutinous rice cultivators of glutinous rice	466 Baht	435 Baht

equivalent, since for this group there has been excessive total crop failure. If crop failures are excluded, the non-glutinous rice cultivators have marginally less glutinous rice available per adult equivalent; if crop failures are included they have slightly more glutinous rice available per adult equivalent.

However, the most important differences are with respect to income from glutinous rice and mean savings. As far as income from glutinous rice is concerned, it is apparent that those who do cultivate non-glutinous rice gain four times as much income from their glutinous rice as those who do not cultivate non-glutinous rice. However, this difference is brought about largely by the considerable number of farmers in the Sample who do not sell any rice at all. More important is the fact that farmers who do not cultivate non-glutinous rice have on average almost three times as much savings as those who do so. This would suggest that these farms are at a stage where investment in innovation is making inroads into capital savings without a corresponding incremental return. If innovations are successful, one would expect the innovator to have more capital savings than the non-innovator.

IX. Summary

The north-east of Thailand clearly emerges as a disadvantaged area with respect to rice cultivation, both on account of adverse physical environment, and inadequate institutional infrastructure. Productivity is accordingly low, although on the increase. The production of glutinous rice and non-glutinous rice within the north-east of Thailand is increasing.

Within the Lam Pao Sample the range of paddy size varies considerably, but the area cultivated is related directly to the size of the labour force and the number of dependents per household. Smaller holdings are farmed more intensively and are more productive than larger holdings. Productivity of land is in turn closely connected with productivity of labour, whilst within each yield per unit of land category the yield per unit of labour time increases with the size of the farm. Sale remains relatively unimportant and is not in fact related to the degree of investment in rice farming. However, sale is obviously related to subsistence needs, expressed as glutinous rice available per adult equivalent. Increasing commercialization of glutinous rice holdings has in turn led to increasing productivity, most markedly on the smaller holdings.

Improved strains of glutinous rice and the cultivation of non-glutinous rice are both innovations within the area and both have as yet made little impact. Their rate of adoption is, however, increasing. Although non-glutinous rice is essentially a commercial crop, the degree of investment in cultivation in the form of purchased inputs is generally lower than is the case for the glutinous rice plots on the same holding, albeit the intensity of labour inputs for glutinous and non-glutinous rice are not dissimilar. The yields of glutinous and non-glutinous rice are very similar.

There is no evidence that cultivation of non-glutinous rice has led to neglect of glutinous rice cultivation or decreasing productivity on the same holding. It appears to be an innovation which is adopted only when subsistence requirements with respect to glutinous rice are fully satisfied.

On the whole, therefore, although methods of cultivation are similar throughout the area, there is considerable diversity in rice production as a result of the difference in size of holding. Consequently, the relative prosperity of rice farmers varies. It is the existence of a surplus above and beyond subsistence needs which enables a farmer to take advantage of the opportunity to innovate if he wishes. There are of course many other ways in which he can expend his surplus.

Although many other factors are involved, the relative prosperity of the subsistence glutinous rice holdings seems to be the most crucial factor in determining development and innovation within the farm as a whole. This development and innovation may be directed towards upland crop production, small scale vegetable production, <u>suan</u> crops or livestock. In rice production, however, there has so far been only slight change, development and innovation.

CHAPTER FIVE

CASH CROP INNOVATIONS

I. Kenaf as an Innovation in the Economy of Thailand

Kenaf is an agricultural innovation which has assumed considerable importance in the economy of Thailand and is the single most important innovation to have gained a footing in the agricultural economy of north-east Thailand. Zimmerman in his 1932 survey made no mention of its presence or potential.[1] Fig. 5.1 indicates how the value of kenaf exports have increased considerably over a ten year period.

Kenaf is the name used in the trade for the fibre obtained from the stems of two closely related species of the family Malvaceae, *Hibiscus cannabinus* L. and *Hibiscus sabdariffa* L. var. *altissima*. The second species predominates in Thailand.[2] The plants are herbaceous annuals with straight stems and may reach a height of 8' to 12' or even more (*vide* Plate 5.1). The fibre is extracted from the stem of the plant by 'retting' in water. When the retting process is completed, the fibre is stripped from the stems, washed in clean water and dried. Yields of fibre vary but a reasonable figure to work on is 4% by weight of the green matter harvested. The fibre is comparable in quality to the lower and medium grades of jute, but is somewhat coarser and rather less supple than the high grades, although, if it is well prepared, kenaf has more lustre.

Like most so-called crop innovations in Thailand, kenaf is not

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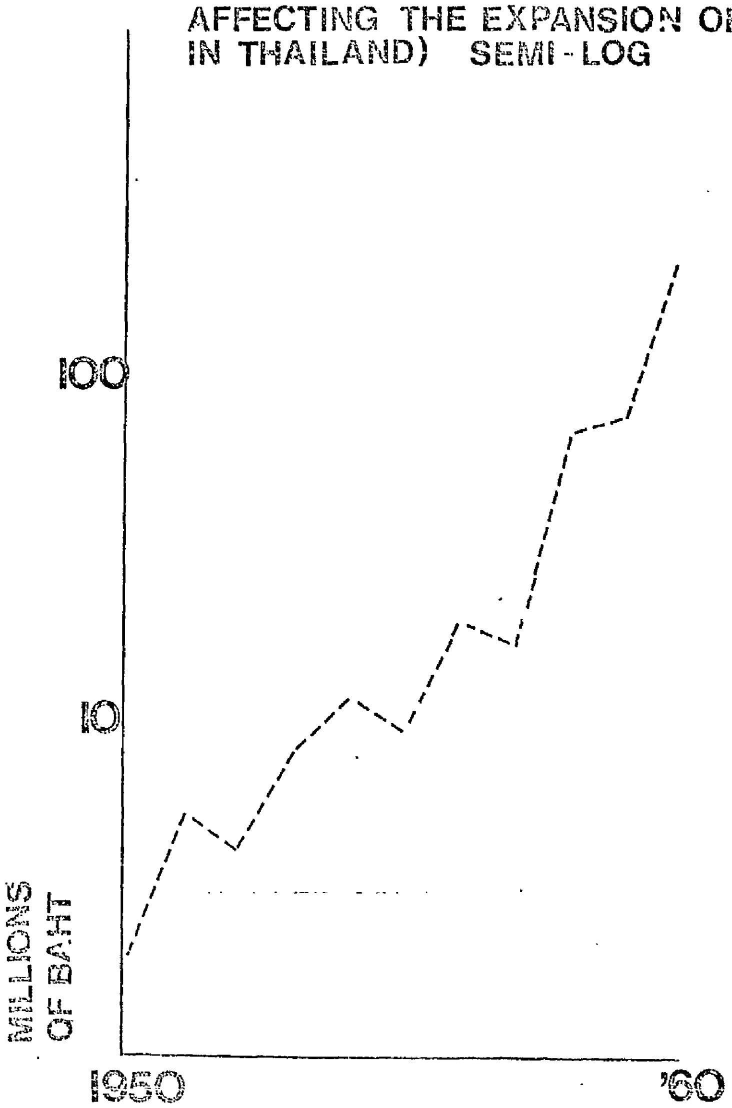
(1) Zimmerman , C., *op. cit.*

(2) Atkinson, R.R., *Jute - Fibre to Yarn*, Temple Press Books, 1964.

FIG. 5.1 INCREASE IN VALUE OF KENAF EXPORTS FROM THAILAND

(SOURCE: PRODUCTION & MARKETING PROBLEMS AFFECTING THE EXPANSION OF KENAF & JUTE IN THAILAND) SEMI-LOG



Source: O'Reilly, dry season, 1971.

Plate 5.1 Kenaf in upland field, Ban Tum new. The Thai and the Chinese varieties have grown wild for centuries, whilst the Cuban variety was introduced into Thailand by USOM in 1951. According to Behrman, the native type still predominates,(1) whilst Sato considers that the Cuban type has almost entirely replaced the native and Chinese varieties.(2)

The production of kenaf on a commercial scale can be considered to have commenced in 1951 when 31,000 rai were planted to the crop. This area increased rapidly from 1956 onwards until it reached its peak in 1966 with a total area of 2,300,000 rai and a total production of over 650,000 metric tons.(3) Owing to excellent jute crops in 1967/'68 in India and the then East Pakistan and resulting low fibre prices, production in Thailand fell to 350,000 metric tons during that season.

However, by 1966 kenaf ranked third after rice and rubber as an export earner with a total value of 1,646 million Baht and contributed 16.5% of the coarse fibres reaching world trade.(4)

From the beginning kenaf was primarily a north-eastern crop. In 1957 the north-east produced 17,504 metric tons out of a total national production of 17,774 metric tons or 98% of total production.(5)

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(1) Behrman, J., op.cit.

(2) Sato, T., Field Crops in Thailand, The Centre for south-east Asian Studies, Kyoto Univ. Reports on Research in south-east Asian Natual Science, Series N-1, 1966.

(3) Sitton, G. and Chuchart, C., The Growing Importance of Upland Crops in the Foreign Trade of Thailand, USOM, 1960.

(4) Shotton considers that the increasing sales of Thai kenaf abroad contributed to the disturbances in India and the former East Pakistan and contributed to the demand for lower grade material at a cheaper price to dilute high-priced jute.
Shotton, E.J., Kenaf in Thailand, USOM, 1968.

(5) An Atlas of Thailand's Agricultural Resources, Dept. of Commercial Intelligence, Bangkok, 1959.

In 1960 the percentage remained the same but by then the north-east produced 39,100 metric tons.[1] In the peak year of 1966 the north-east produced 649,141 metric tons, again 98% of the total production.[2]

Although the north-east remained dominant in kenaf production, this does not mean that it was ubiquitous throughout the north-east, nor that production was insignificant locally in other areas. Thus in 1957 changwat Phrae in the northern region produced 141 metric tons, which exceeded production in many north-eastern changwat. Since then kenaf production outside the north-east has increased and become more widespread. In 1966, the peak year, changwat Nakhon Sawan was the principal non-north-eastern producer with 5,853 metric tons, which exceeded production in the peripheral north-eastern changwat of Loei, Sakon Nakhon and Nong Khai, whilst there was also significant production in changwat Phichit (902 m. tons), Chiang Mai (627 m. tons), Phrae (363 m. tons) and Uthai Thani (147 m. tons), all outside the north-east. In all, kenaf has been produced in 26 changwat outside the north-east.[3] The importance of this observation lies in the fact that, although kenaf can withstand and even thrive in the adverse environment of the north-east, it will naturally be more productive in more inherently fertile areas. Thus it is possible that if kenaf cultivation prospers through a favourable world market situation then, although the north-east of Thailand will thereby benefit, this situation will induce farmers in more favoured regions of the country to cultivate the crop, which might be to the comparative disadvantage of the north-eastern farmer.

Maps 5.1 to 5.3 indicate the diffusion of the innovation

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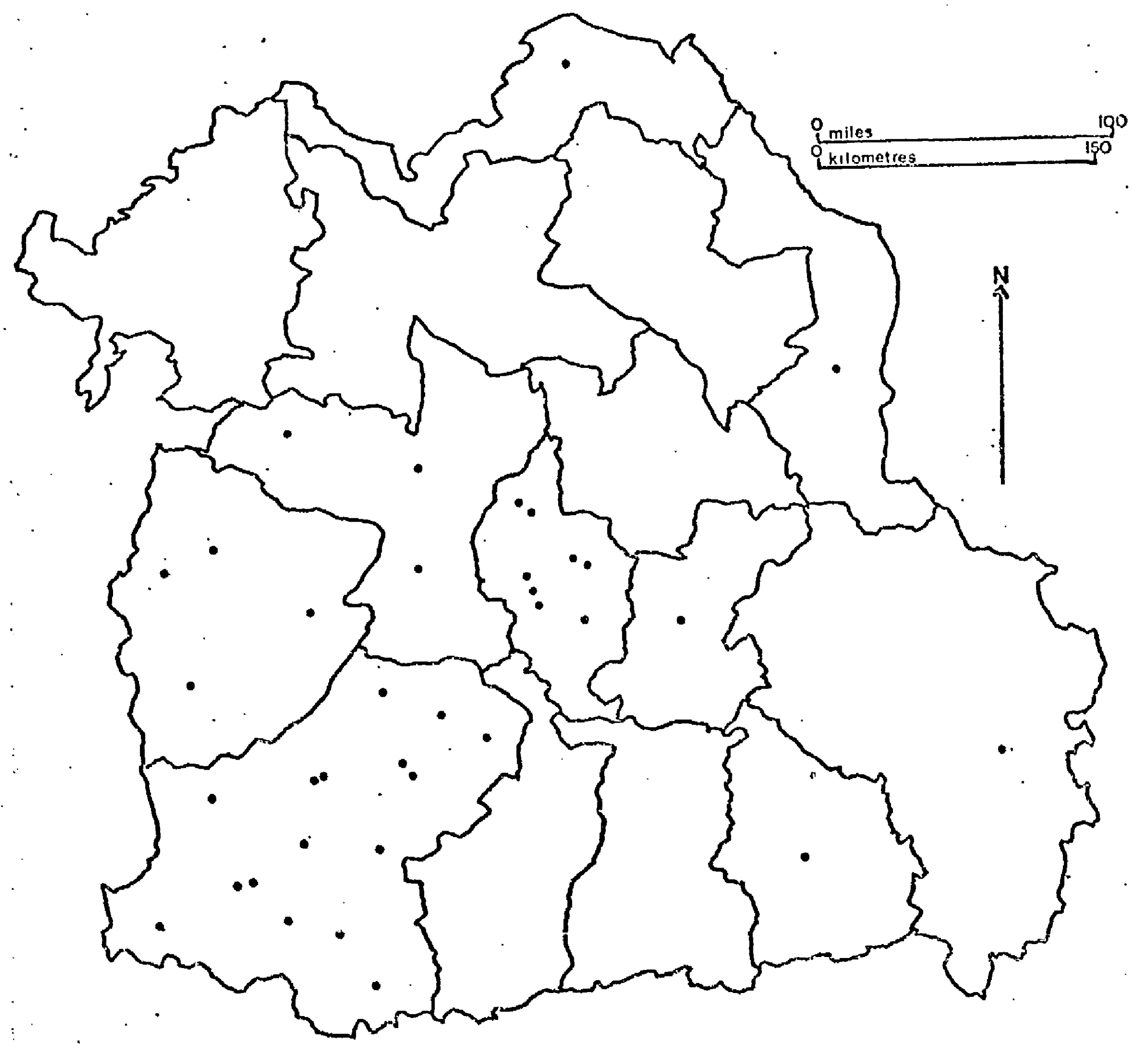
(1) Sitton and Chuchart, op.cit.

(2) Statistics of Upland Crops and Vegetables, Min. of Agr., 1966 (in Thai).

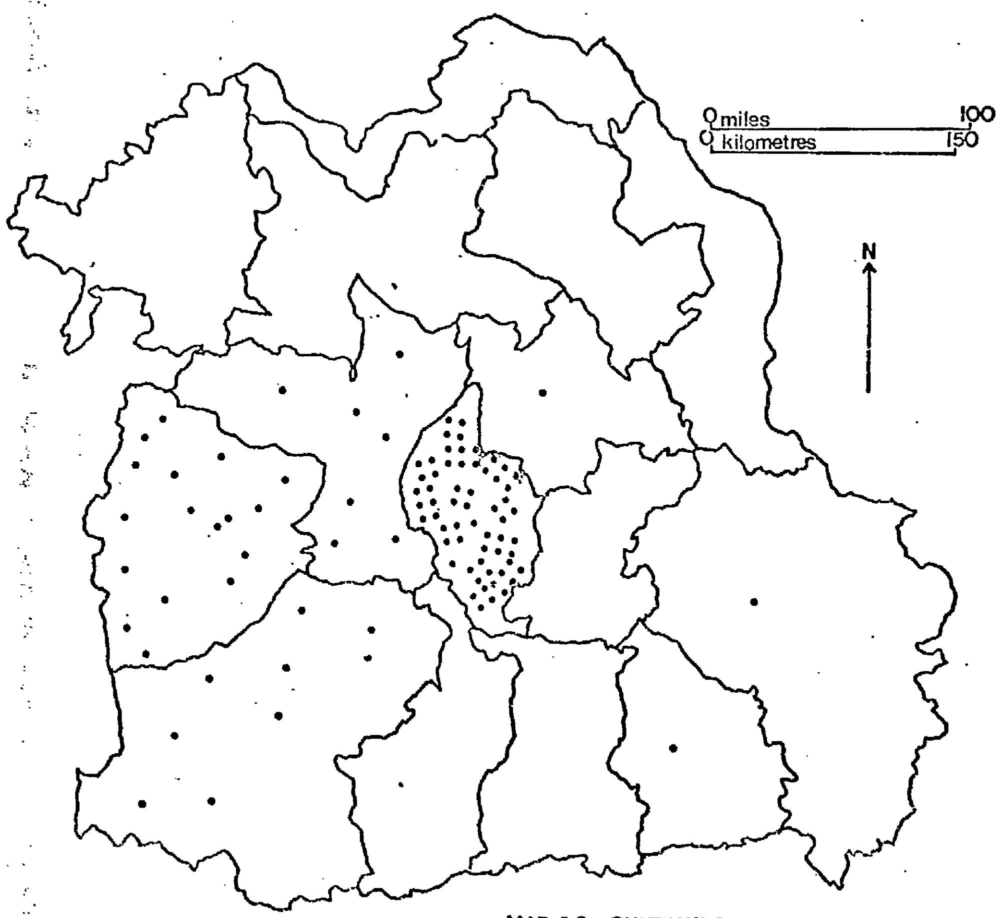
(3) Sitton and Chuchart, op.cit.

MAP 5.1 CULTIVATION OF KENAF IN NE THAILAND 1957



• 500 metric tons

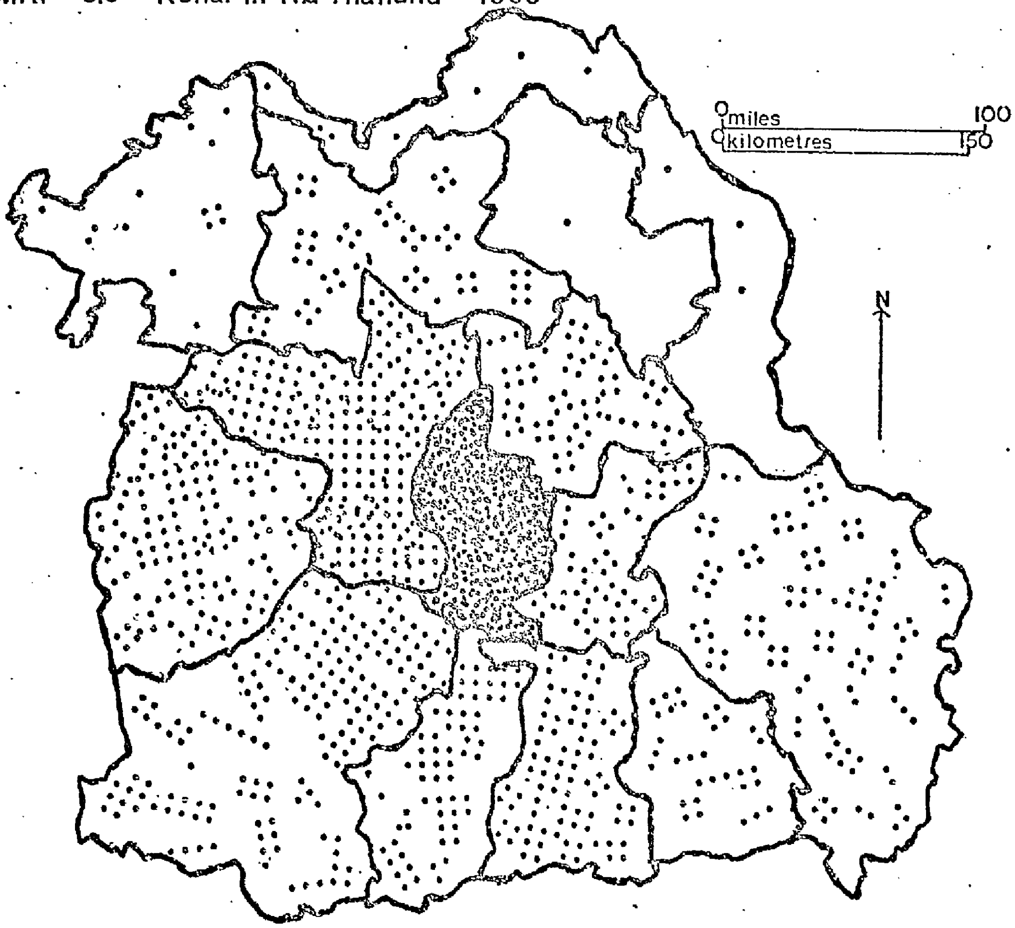
SOURCE: STATISTICS OF UPLAND CROPS & VEGETABLES



• 500 metric tons
SOURCE: as MAP 5.1

MAP 5.2 CULTIVATION OF KENAF IN NE THAILAND 1960

MAP 5.3 Kenaf in NE Thailand 1966



• 500 metric tons

Source as Map 5.1

throughout north-eastern Thailand. Changwat Nakhon Ratchasima emerges as the entry point for the innovation in 1957, although by then the crop was established in changwat Chaiyaphum, Khon Kaen, Maha Sarakham and Roi Et, as well as the peripheral changwat of Nong Khai, Sakon Nakhon and Buri Ram.

By 1960 production had decreased in Nakhon Ratchasima, become more concentrated in a core area of Chaiyaphum, Khon Kaen and Maha Sarakham, and further spread to Udon Thani and Kalasin, but fallen off in Nong Khai and Sakon Nakhon, whilst remaining constant in Buri Ram.

By 1966 kenaf was grown throughout the north-east of Thailand. Production had increased in Nakhon Ratchasima, but a definite core area based upon Maha Sarakham and Khon Kaen had emerged, whilst only in the northern changwat of the north-east did production lag.(1)

Physically, kenaf is suited to the poor environmental conditions prevailing in the north-east of Thailand, since it is fairly drought-resistant. Similarly, it fits in well with subsistence paddy cultivation, since the type of land it requires is upland rather than lowland paddy soils (although it is not unknown for north-eastern farmers to cultivate kenaf on paddy soils), the cycle of growth of paddy and kenaf are different and hence their labour requirements do not clash, although there may be some competition at harvest time. However, as well as being a crop which is exhaustive of soil nutrients, kenaf is a crop which from the time of land preparation to processing and final sale is particularly demanding in time and labour for optimum results, so that in some ways it is a far from ideal crop for the north-east, especially since the farmer often receives but inadequate recompense for his efforts.

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(1) It would have been desirable to have obtained more recent statistics, if field work opportunities had permitted.

II. Identification of the Kenaf Innovators in the Lam Pao Sample

Within the Lam Pao Sample 141 farmers cultivate kenaf (60% of the total Sample). In Ban Na Chuak Nuea 51% of farmers grow the crop, in Ban Tum 89%, in Ban Um Mao 28%, in Ban Fai Taek 40%, in Ban Lek 45%, in Ban Non Sung 75%, and in Ban Lao Yai 82%.

Considering the Lam Pao Sample as a whole, kenaf growers are readily distinguished from non-growers. This was demonstrated by applying the Difference of Means Test to the two discrete samples for a wide variety of socio-economic variables.

As would be expected, kenaf growers have larger total holdings than non-growers, since kenaf is usually cultivated on land newly cleared from the forest for that specific purpose rather than on land already under paddy, suan crops or field crops. The mean size of holding for kenaf growers is 35 rai, whilst for non-growers it is 18.4 rai. This gives a value of 4.73 for 't', significant at the .001 level.

Also significant at the .001 level is the size of the household. The mean number of household members for non-growers is 7, compared with 6 for growers. Although it might be thought that insufficient adult labour coupled with a large number of dependents would be powerful constraints preventing farmers from engaging in kenaf cultivation, this is not the case, since non-growers have both a larger male labour force (2.2 men as opposed to 1.1 men) and a larger female labour force (2.1 women as opposed to 1.0 women) than growers. The mean number of dependents per household for both growers and non-growers is 3 persons.

Growers of kenaf are on the average young family men, their mean age being 30 years. This contrasts markedly with the mean age of non-growers, which is 43.8 years. This gives a value of 10.83 for 't', significant at the .001 level.

Equally significant is the difference between the area devoted to second crop on both upland and paddy in the two groups. The mean area of second crop for non-growers is 0.2 rai; for growers 0.0 rai. This suggests that in this case farmers make a choice between two commercial innovations.

Similarly, it would appear that non-growers of kenaf are more likely to use fertilizer than growers. The mean application for non-growers is 143.3 kg. and for growers 100 kg. This gives a value of 2.54 for 't', significant at the .01 level. Since fertilizer is rarely used on kenaf, this indicates that the farmer may choose between kenaf cultivation and investing in his traditional rice production.

Of the 18 farmers who cultivate non-glutinous rice, fourteen of these also cultivate kenaf. However, the mean area under non-glutinous rice for these fourteen growers is only 3.5 rai, compared with 5.67 for non-growers of kenaf. The mean area under kenaf for these kenaf growers who also cultivate non-glutinous rice is 3.9 rai, compared with 6.21 for kenaf growers as a whole. Thus it appears, as might be expected, that the farmers who have adopted the two innovations, kenaf and non-glutinous rice, cultivate each of the two crop innovations on a smaller scale than the farmers who have only adopted one of these two crop innovations.

It would seem that a choice may be made between utilizing available farm labour in kenaf production or seeking off-farm work. The mean number of 'absentees' for growers, i.e. family members who have left the farm either temporarily or permanently in search of work, is 1.25 and for non-growers 0.0.

Kenaf growers have a significantly greater total income from crops than non-growers. They have 3299.8 Baht, compared with 1751.2 Baht for non-growers. This gives a value of -6.87 for 't', significant at the .001 level. Moreover, a greater proportion of kenaf growers' total income is from crops. Thus 69% of their total income is from crops, compared with 48% for non-growers. This gives a value of -5.23 for 't', significant at the .001 level. Conversely, non-growers of kenaf are more likely to seek income from other sources than growers. 26% of non-growers' income comes from "other sources", compared with 14% for growers. In the same way, albeit less markedly, non-growers are more likely to gain income through rearing animals for sale. 17% of the total income of non-growers is from the sale of animals, compared with 13% for growers. ('t' = 1.22, significant at the .02 level).

However, there was no significant difference between growers and non-growers with respect to the percentage of their total income from fishing[1] or handicrafts. Similarly, remittances from off-farm work were equally important in the two groups. There was no significant difference between the two groups with respect to their area under other

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(1) This presumably also applies to fishing for domestic consumption, but no figures are available for this, since farmers are unable to remember how much time is spent in fishing. Moreover, women and children can take part in this activity, whilst it would also appear that fishing is regarded as a pleasurable leisure time activity. The catch includes frogs from the marsh, cap (<u>pla duk</u>), serpent head (<u>pla chon</u>), Thai climbing fish (<u>pla mo thai</u>) and shrimps from the Lam Pao reservoir and eels from the <u>nong</u>. It would appear from the writer's observations that the catch is not commensurate withthe time spent in this activity.
Incidentally, people fishing in the reservoir lay themselves open to bilharziasis, a disease due to the presence in the body of flukes of the family Schistosomidae, transmitted by a type of snail. The Lam Pao populace seem by and large unaware of this danger and ridicule the idea that "harmless" snails could be the purveyors of such a danger. However, Mr. John Pilgrim, formerly of the Mekong Secretariat, reported that in other irrigation areas in Thailand where the populace are convinced of the danger and aware of the method of transmission, they nevertheless declare that they will continue to fish in the customary manner: economic considerations outweigh health considerations.

field crops or their percentage of glutinous rice produced sold. Thus farmers who cultivate the best established field crop, kenaf, are not more likely to cultivate other new field crops than those who do not cultivate kenaf. Similarly, although a farmer may have to choose between investing in kenaf or in traditional glutinous rice production, it does not follow that the kenaf innovators and the glutinous rice innovators are two discrete groups. On the contrary, a farmer must have achieved a modicum of security through production of a glutinous rice surplus before he is able to innovate with respect to a purely commercial field crop like kenaf.

III. Study of Small Sample of Kenaf Growers in the Lam Pao Area

A small intensive survey (to be referred to as the Small Sample) was made of 25 kenaf growers in the Lam Pao area. Of these seven were in Ban Na Chuak Nuea, eight in Ban Tum, six in Ban Um Mao, three in Ban Fai Taek, three in Ban Non Sung and one in Ban Lao Yai. The Small Sample was randomly selected independently of the larger Lam Pao Sample; nevertheless, some individuals occur in both the Small Sample and the Lam Pao Sample. The purpose of the Small Sample was to study in greater detail the history of kenaf in the Lam Pao area and to determine the attitudes of the farmers in the Small Sample towards new field crops. It was not pre-determined that the Small Sample should be limited to 25 farmers. On the contrary, a larger sample would have been desirable and the aim was to interview 60 farmers. However, since most of the field work time was of necessity devoted to the larger Lam Pao Sample it was impossible to achieve this goal. Appendix II shows the questionnaire used in the Small Sample.

Questions were asked regarding the year of adoption of kenaf and the responses are plotted in Fig. 5.2. Neither the year 1966 when production was at its peak in Thailand nor the 1967/'68 season when production fell sharply owing to good crops in India and the then East Pakistan stand out on this graph. Instead 1960 stands out as the year of greatest adoption. This data was confirmed by questions asked of farmers in Ban Tum during the Ban Tum Soil Survey of 1972.

Fig. 5.3 shows the rate of adoption and rejection of the innovation of kenaf among the Small Sample. Up to the peak year of 1967 it reproduces the familiar S-shaped curve of innovation adoption. It cannot be said with certainty whether the decline after 1967 is a minor fluctuation or the beginning of a new S-shaped curve of rejection.

FIG. 5.2 DIFFUSION OF KENAF IN SMALL SAMPLE

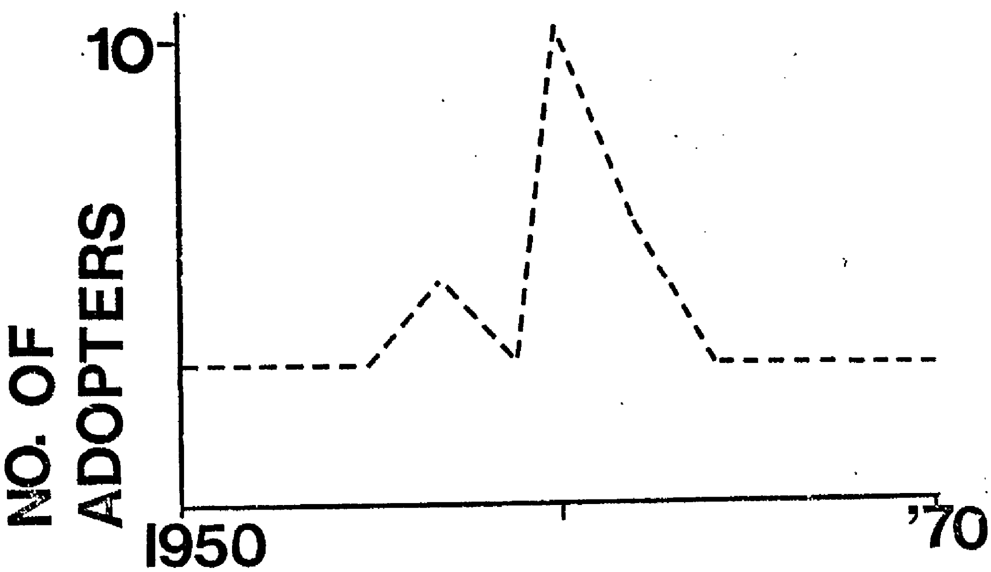


FIG. 5.3 RATE OF ADOPTION OF KENAF IN SMALL SAMPLE SEMI-LOG

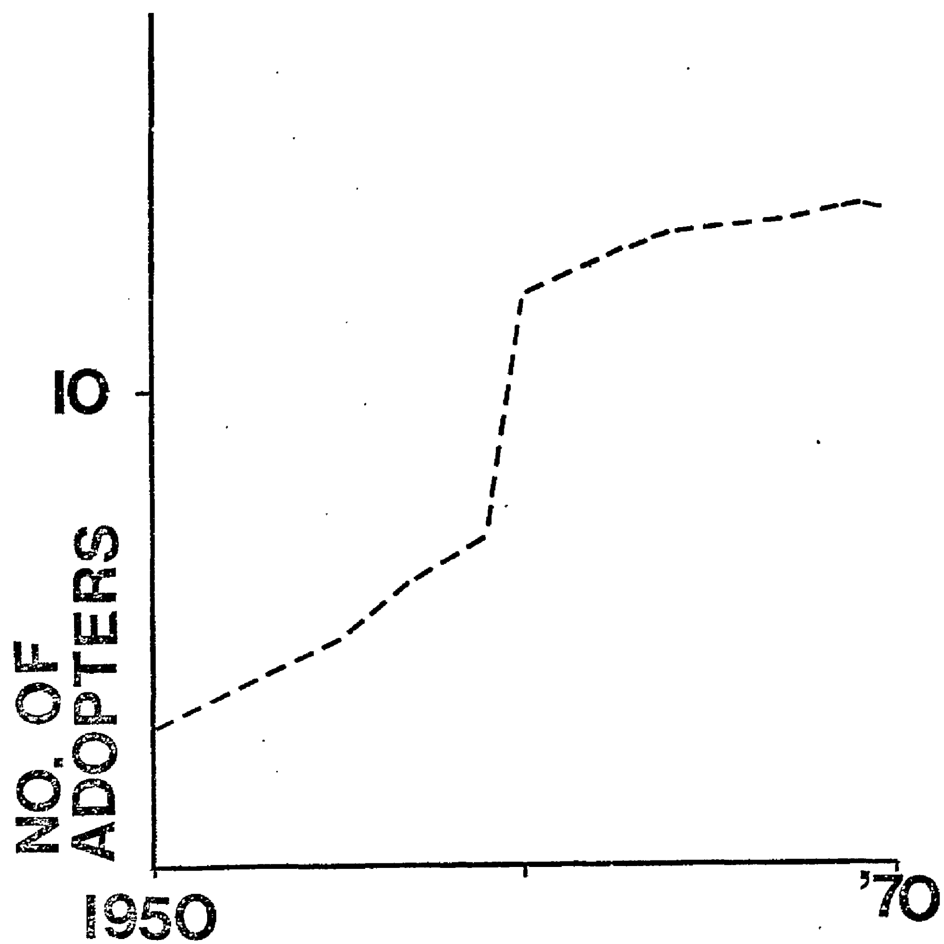


Fig. 5.4 shows the variations in the area of kenaf cultivated in the Small Sample since the onset of cultivation. The actual total area cultivated in the Small Sample has remained fairly constant but there have been considerable fluctuations with regard to individual cultivators. In six cases the area cultivated in the year of survey has increased since the first year of cultivation. In eleven cases it has decreased. All the cases of decreasing area, however, are cases in which the farmer started off with fairly large areas under kenaf, i.e. over 8 rai and with a maximum of 28 rai. The decreases have been quite large, by about one half in most cases. The increases occur in cases where the farmer usually started off with a fairly small area, i.e. below 8 rai, and increases may have been either slight or considerable.

Questions were asked regarding the area cultivated in the year before the survey. In 17 cases the area cultivated in the year of the survey was the same as that of the preceding year. In three cases it was less, and in four cases it was more. Only in one case was the area cultivated in the year preceding the survey the same as in the first year of cultivation but different from that in the year of survey, whilst in seven cases the area cultivated in the preceding year was different from both that in the year of survey and in the initial year of cultivation.

The price received for kenaf from 1950 (the first year of cultivation of any farmer in the Small Sample) to 1970 has fluctuated considerably: Fig. 5.5 illustrates this. It brings out the high price in 1959 which stimulated adoption in the Small Sample. Thus 1960 was the year of greatest adoption, albeit the price received in this year was low. 1962-'64 was the nadir of prices, whilst there was a rise in 1966, the year of maximum production in the Kingdom as a whole, but a fall in 1968 and 1969, which were bad years throughout the Kingdom. Thus in

Figure 5.4 VARIATIONS IN AREA UNDER KENAF IN SMALL SAMPLE

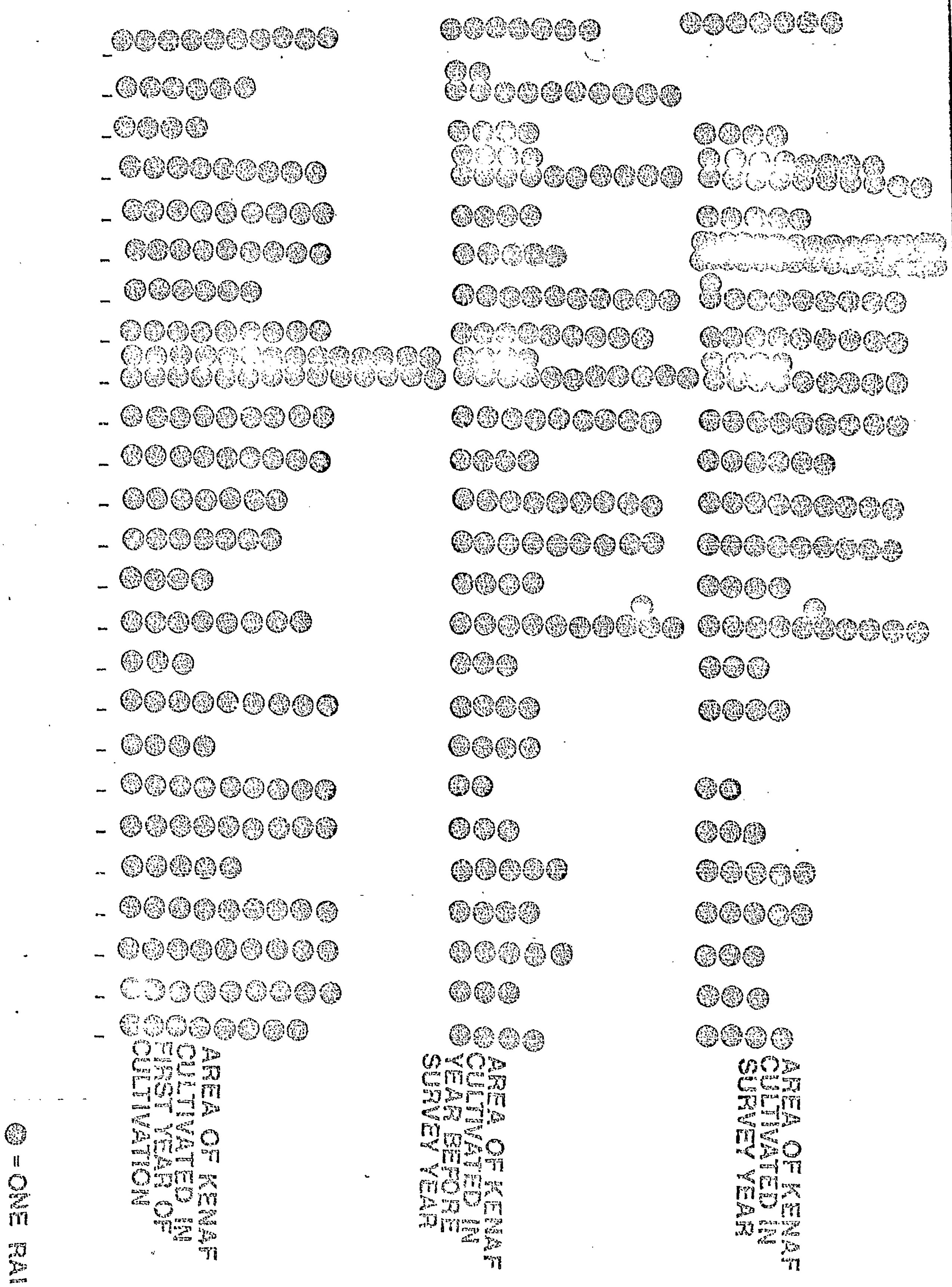
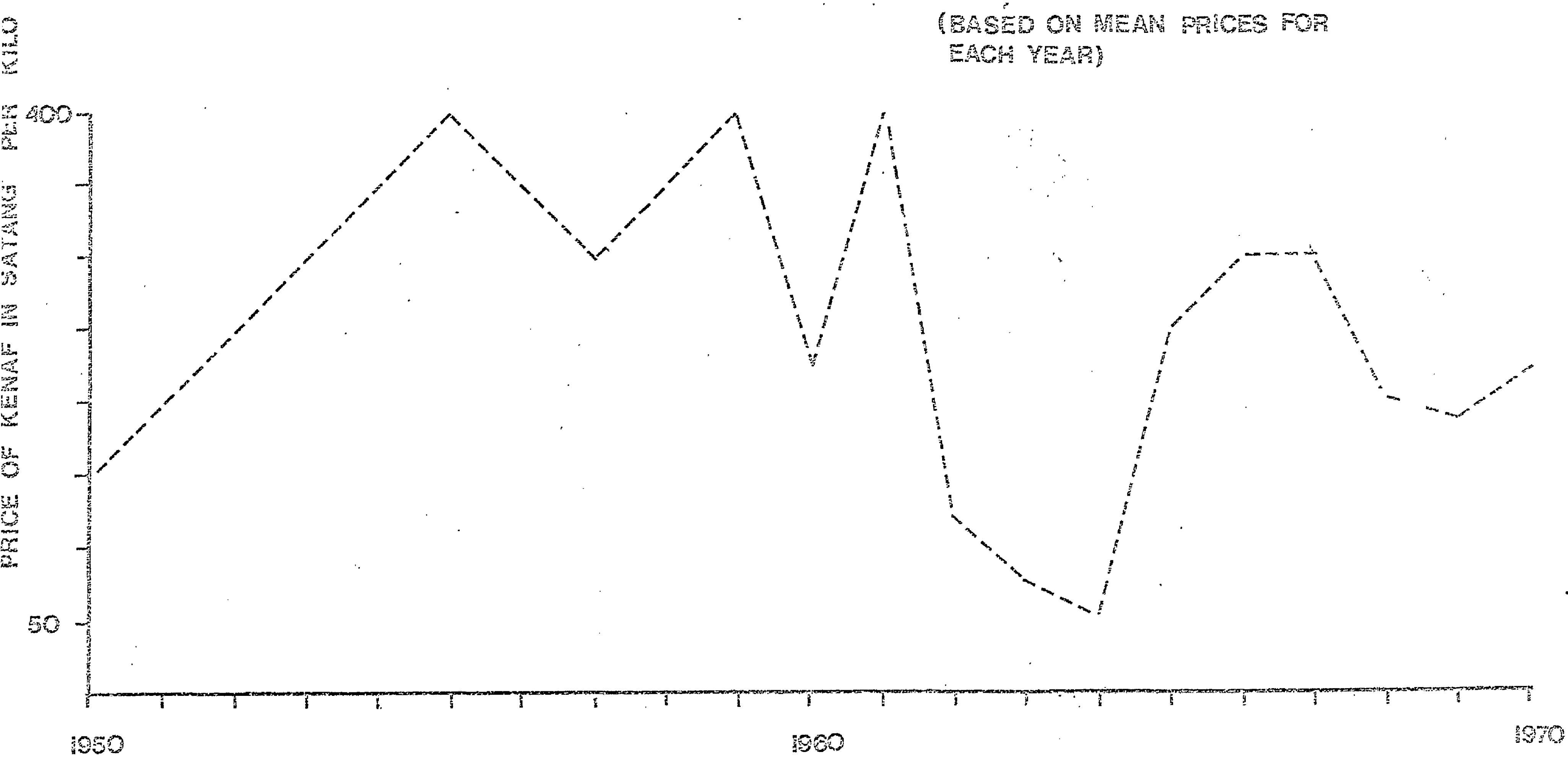


FIGURE 5.5 FLUCTUATIONS OF KENAF PRICES IN SMALL SAMPLE

(BASED ON MEAN PRICES FOR EACH YEAR)



the main the trends in production, area and price of kenaf in this Small Sample reproduce trends within the Kingdom as a whole. A larger sample would, however, have been more conclusive.

It is clear, however, that all farmers in the Small Sample do not receive the same price for their produce in the same year. There are of course differences in the crops produced by different farmers, but the actual date of sale of the crop and the type of buyer or middleman would seem to be more significant in explaining these price differences. Fig. 5.6 compares the best and worst years for kenaf based upon the price received. Although 1961 and 1965 emerge clearly as the best years and 1963 as the worst year, it is clear that what may be the best year for some farmers may in fact be the worst year for others as is the case in 1965. This phenomenon admits of no ready explanation; it requires further research.

Fig. 5.7 compares the best, worst and first prices received for kenaf by farmers in the Small Sample. Although 50 satang was usually the worst price received, two farmers commenced cultivation when the crop was sold at this price. Nevertheless, they did not reject the innovation and subsequently benefitted from the high price of 4 Baht per kilogram. Since they did not attain such a high price again, they later cut down on their area. The numbers involved in the Small Sample are too small to make any valid generalizations, but it may be that a farmer's response to this innovation is linked to his experiences in the first year of cultivation. If his first year is a very bad year, he may reject the innovation or persevere. If he perseveres, then most subsequent years will be better than his initial year and he may be relatively satisfied. If, on the other hand, he commences cultivation in an exceptionally good year, then it may be unlikely that ensuing years will be equally good.

FIGURE 5.6 BEST & WORST PRICES RECEIVED FOR KENAF BY FARMERS IN SMALL SAMPLE

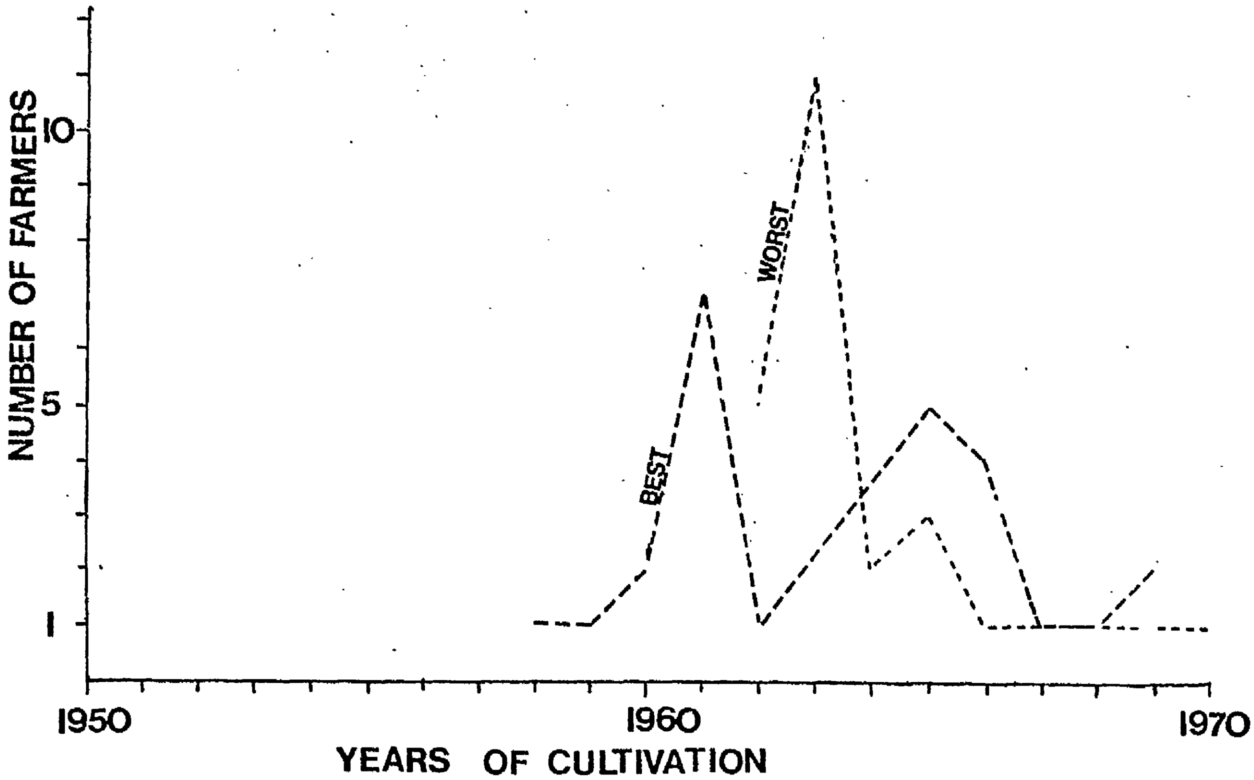
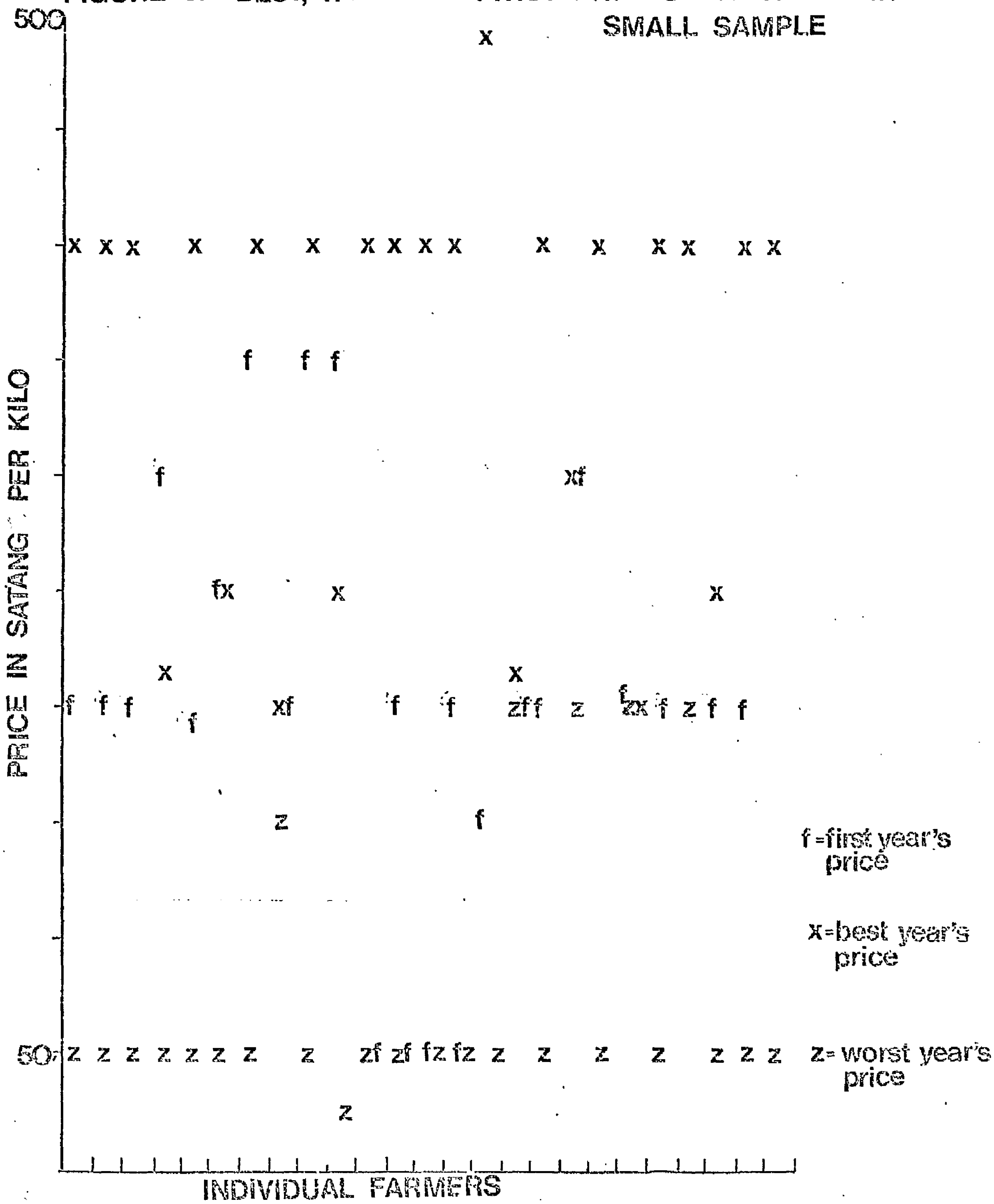


FIGURE 5.7 BEST, WORST & FIRST PRICES FOR KENAF IN SMALL SAMPLE



Thus he may limit his production or reject the innovation altogether. The writer merely postulates this as a hypothesis, which merits further investigation.

It might be considered that soil deterioration would set in with kenaf cultivation and thus yields would fall in relation to the number of years that the crop has been cultivated in a particular field. Fig. 5.8 illustrates that no such relationship exists in the Small Sample. Possibly, a larger sample would show a relationship or perhaps other factors are more instrumental in influencing yield than is soil quality. Nevertheless, the Ban Tum Soil Survey of 1972 suggested that kenaf cultivation does lead to soil deterioration.

One such external factor which influences yield considerably is the incidence of damage to the crop. Only 8 farmers in the Small Sample suffered no damage to their kenaf crop at all, whilst 3 farmers had their crops damaged by drought, disease and insects, one farmer by drought and insects alone, 9 farmers by disease and insects, 6 farmers by insects alone and 2 farmers by disease alone.

Fig. 5.10 illustrates the response of farmers in the Small Sample to falling prices of kenaf. Most of the Small Sample stated that they would continue growing until the price fell to 1.50 Baht/kg. Roughly half would continue growing at 1 Baht/kg. and, surprisingly, 2 farmers would continue growing at 50 satang per kg., and even one if the price fell below 50 satang per kg. Such decisions are not totally irrational, since the farmers, realizing the fluctuations in the price of kenaf, would presumably think a price below 50 satang/kg. only a temporary phenomenon, which would be rectified in future years. It would have been useful to ascertain how many years farmers would be prepared to cultivate kenaf if the price remained low year after year.

FIG. 5.8 RELATIONSHIP BETWEEN YIELD OF KENAF & NO. OF YEARS OF CULTIVATION IN SMALL SAMPLE

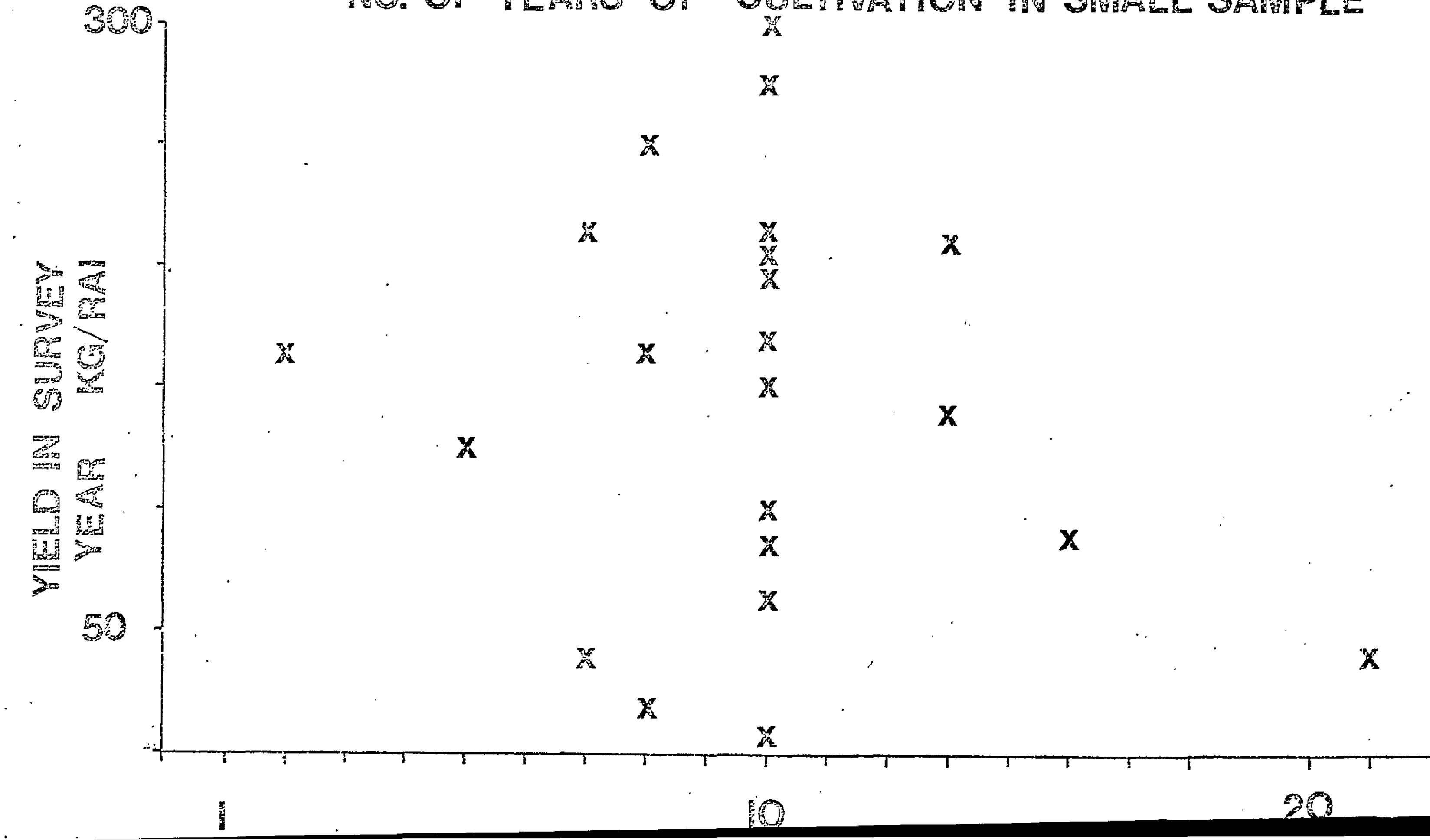


FIGURE 5.9 Damage to kenaf in Small Sample

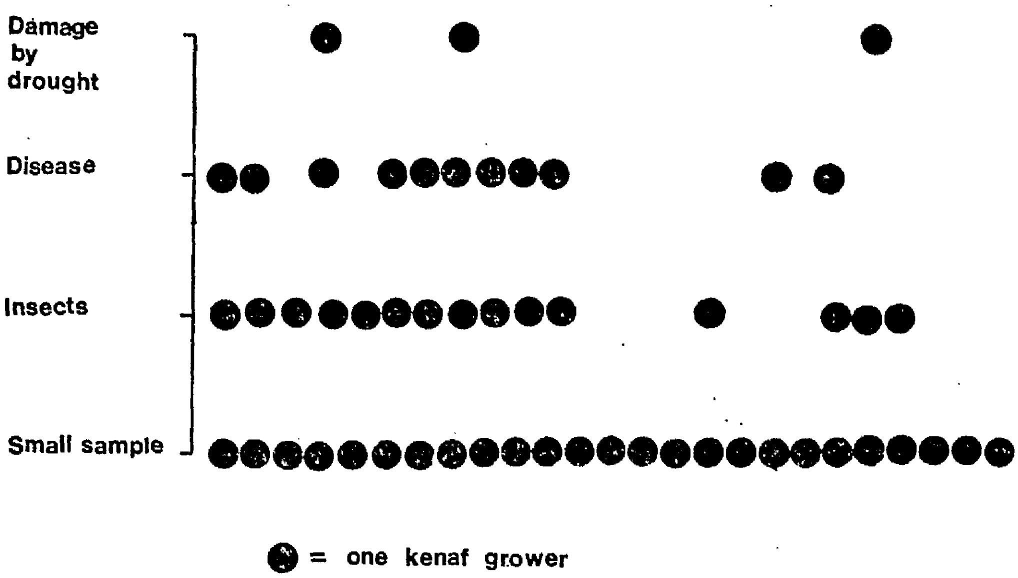


FIGURE 5.IO STATED RESPONSES TO FALLING KENAF PRICES IN SMALL SAMPLE

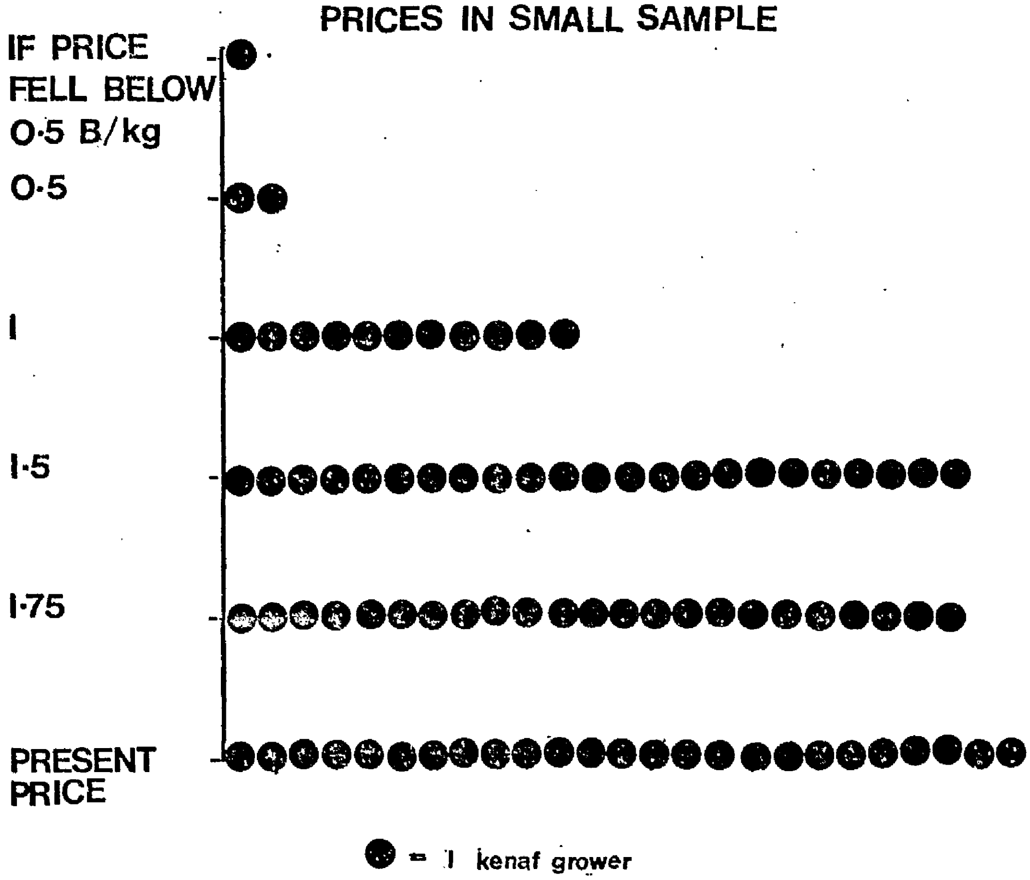


Fig. 5.11 illustrates the kenaf growers' responses to rising prices. 13 farmers stated that they would clear more land, use a tractor and use fertilizer, if the price of kenaf rose. 4 farmers stated that they would clear more land and use a tractor and 3 farmers stated that they would clear more land and use fertilizer, whilst one farmer stated that he would merely clear more land. The difficulty of interpreting these responses lies in the fact that farmers consider that they are expected to give a positive rather than a negative answer to such a hypothetical question. They are conscious of the reputation the north-eastern farmer has for unprogressiveness and (quite unjustly) laziness. They therefore wish to give the impression that if they were to be presented with favourable opportunities, such as rising prices, their response would be dynamic; in fact they might believe this. It is more fruitful to study actual than intended responses.

The retting of kenaf often poses serious problems, since it is often difficult to find adequate available water. Moreover, retting is crucial for the quality of the kenaf. The farmer will use any available water for the retting process, be it lotus pond, pit, nong, khlong (canal), or flooded paddy. This source of water may often be situated at an inconvenient distance from the kenaf plots.(1)

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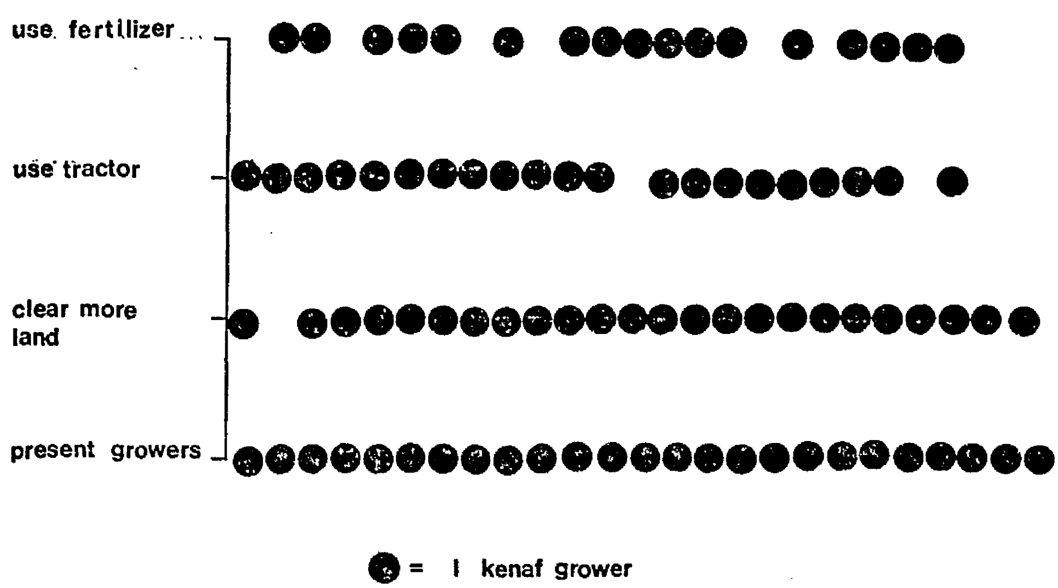
(1) Research has been carried out into means of improving retting facilities. It is suggested that improved paddy seedbeds could be used for kenaf retting, whilst on upland farms ponds lined with clay or other sealing materials could be used. Present community retting tanks (the design of which is based upon that of flax retting tanks) are thought to be unsuitable and trenches are proposed, which may involve the provision of a well or reservoir, perhaps with a clarifying tank and a small diesel powered motor. A fibre-washing machine is also proposed as part of this "retting-innovation" and the whole cost is estimated at 40,000 Baht.
Greenhill, W.L., Krishnakan, B. and Darragh, P., Inexpensive Methods of Water Conservation for Kenaf Retting, Co-operative Research Project No.1/2, ASRCT, 1966.
In the writer's opinion, such an investment hardly seems either practicable or prudent.

Figure 5.11 Stated responses to rising kenaf prices in Small Sample



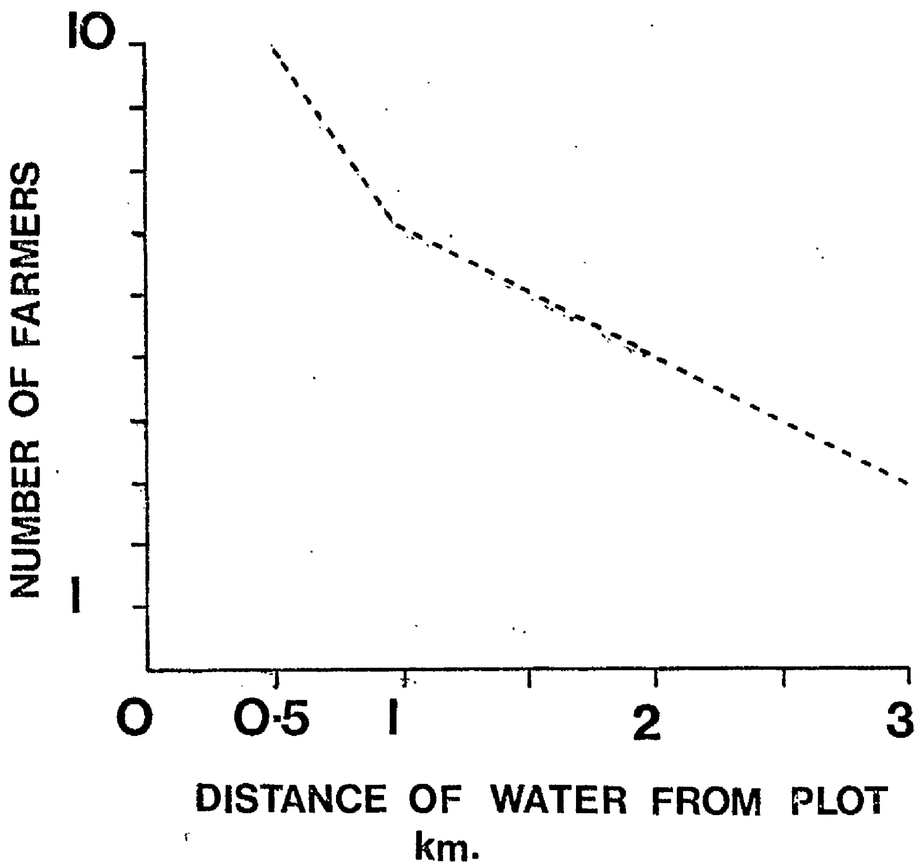
Although it is traditionally believed that dirty water assists the retting process, in fact clear water is essential with an optimum depth of 75 cm. Present methods of retting are crude: clods of earth may be used to hold the bundles under the surface of the water. These clods disintegrate and fall to the bottom of the pond, gradually filling it up until it is too shallow to be useful. It would probably be better to use heavy logs or stones for this purpose. Retting is not carried out communally: this is a reflection both of the relative newness of the crop and the general lack of concerted communal enterprise in Thai villages. The future of the crop, moreover, would make the construction of communal retting facilities not worthwhile.

Fig. 5.12 shows the distance of retting water from the kenaf plots of farmers in the Small Sample. In only five cases did farmers consider their retting water to be unsatisfactory. In three cases the distance factor was a major problem, the water being over 3 km. away. In the other two cases the water was $\frac{1}{2}$ and 1 km. away respectively.

Farmers in the Small Sample use a wide variety of retting ponds, including pits by the irrigation canal in Ban Na Chuak Nuea and Ban Tum and the nong in Ban Non Sung. Plates 5.2 and 5.3 show types of retting ponds used in Ban Tum. This contrasts with the concrete retting pit constructed at the Tha Phra Experimental Farm in Khon Kaen, shown in Plate 5.4.

For most of the farmers in the Small Sample kenaf was the first crop grown on those particular fields. In fact 24 farmers cleared the land from the forest specifically for kenaf cultivation. Only one farmer was growing another crop on his fields prior to kenaf, viz. water melons.

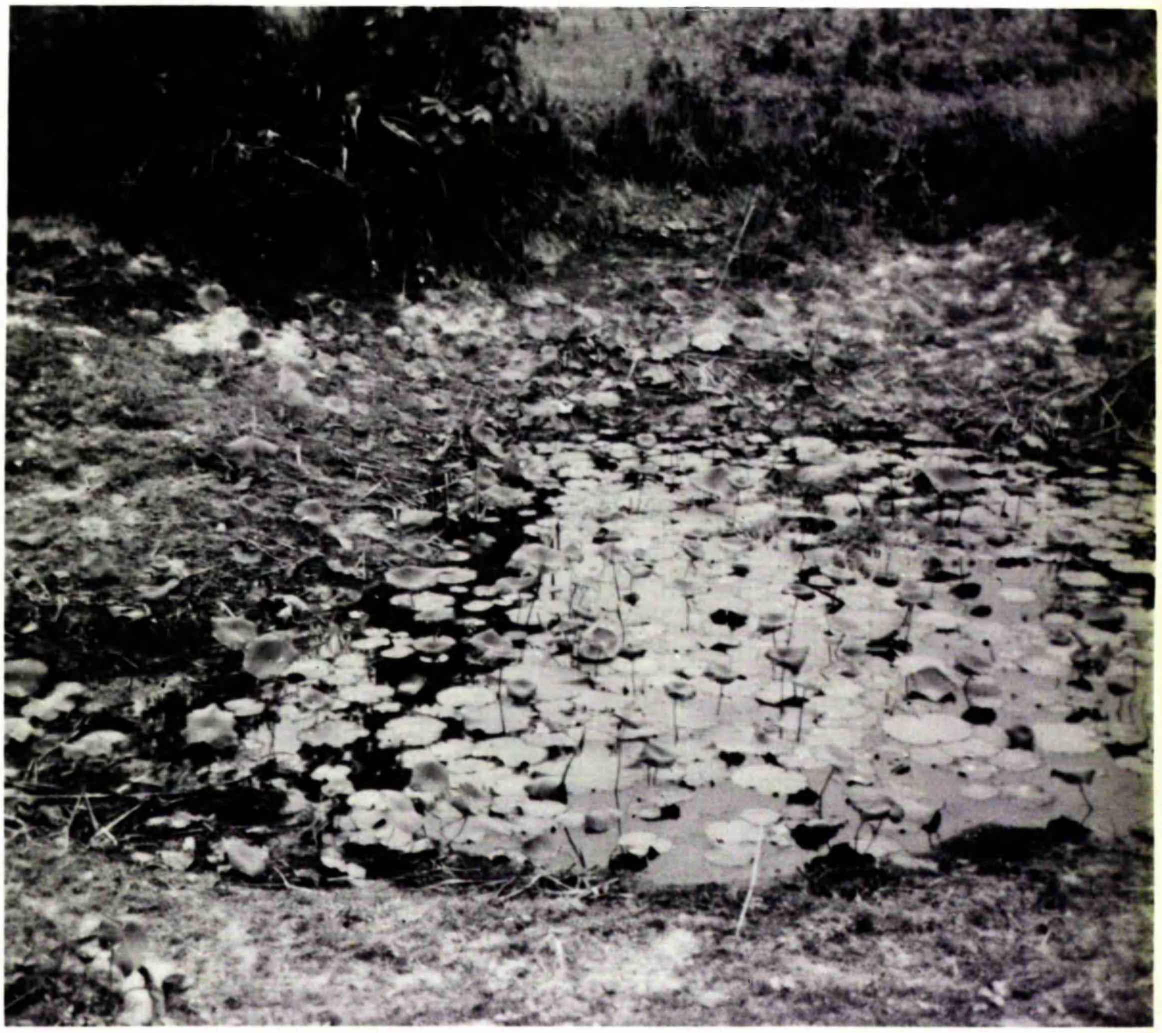
FIGURE 5.12 DISTANCE OF RETTING WATER FROM KENAF PLOT IN SMALL SAMPLE



Source: O'Reilly, dry season, 1971.

Plate 5.2 Kenaf Pit, Ban Tum

In this village retting is carried on in pits, probably man-made, between the edge of the paddies and the RID canal. In the wet season, of course, the water in this pit will be much deeper.



Source: O'Reilly, dry season, 1971.

Plate 5.3 Lotus Pond, Ban Tum

Lotus ponds are a particularly aesthetic feature of the north-eastern countryside. However, they may also be utilized for retting kenaf.

Source: O'Reilly, dry season, 1971.

Plate 5.4 Retting Pit, Tha Phra

This concrete retting pit was designed at the Tha Phra Experimental Farm, Khon Kaen.

In the Small Sample 15 farmers used their own seed, 7 farmers obtained seed from relatives, friends or neighbours, 1 farmer purchased seed from a village merchant and 1 purchased it from the market. One farmer went as far afield as Maha Sarakham to purchase his kenaf seed, presumably considering that he could obtain high quality seed from that changwat in which kenaf is well established.

Six farmers grow a second crop on their kenaf plot and 19 do not. Of these six farmers, five grow only water melons and one grows water melons and sweet corn.

IV. The Future for Kenaf

Kenaf is grown in a wide variety of countries to satisfy local requirements, as Table 5.1 shows. However, Thailand is by far the largest producer, although the future of the crop in the People's Republic of China remains problematic.

Thailand is virtually the only exporter of kenaf. It would seem, however, that the market is not secure. The increased production in 1966/'67 put a severe strain on Thailand's handling and grading capacity with the result that grades deteriorated badly, whilst jute cuttings became cheaper to buy than kenaf. Problems are also provided by the increased use of multi-walled paper bags, plastic bags, and the development of polypropylene which can be woven into sacks. The effect on kenaf will be two-fold: directly by substitution and indirectly in that if the price of jute falls to meet competition and supplies of jute exceed the demand the spinners will be able economically to use all jute instead of mixing it with kenaf. Also there is the development of bulk-handling, reducing the need for sacks.

It is possible, however, that the expansion of agriculture and industry in developing countries will produce an upsurge in the demand for sacks, whilst research goes on into new uses for kenaf.(1)

The conclusion reached in a survey carried out by the United Kingdom Tropical Products Institute is that for a few years there will be

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(1) It is suggested that kenaf stalks may find a market as a raw material for pulp in the existing paper industry in Thailand and that any kenaf waste and low grade fibre may be disposed of in pulp production at a lower cost than imported wood pulp. Moreover, it is suggested that kenaf plantations should be established to be integrated with the existing pulp and paper mills. At present the Kanchanaburi Paper Mill uses bamboo as a raw material, whilst the Bang Pa-In Paper Mill (changwat Phra Nakhon Si Ayutthaya) uses rice straw. Chu, C., Propsects of Utilizing Kenaf for Pulp and Paper, Research Project No.1/17, ASRCT, 1968.

Table 5.1 Major Producers of Kenaf 1966/'67 (1)

Thailand	541,000 tons
People's Republic of China (2)	280,000 tons
India (3)	215,000 tons
Pakistan (3) (4)	65,000 tons
Iran	5,000 tons
Republic of Vietnam	3,000 tons

(Source: Commonwealth Secretariat - Industrial Fibres 1968).

(1) The tonnage produced by the Soviet Union is thought to be considerable. The crop is also produced on a small scale in the United Arab Republic, Morocco, Mozambique, Rhodesia, Ghana, Nigeria, Ethiopia, Angola, Spain and Mexico.

(2) Published figures showed only combined output of jute and kenaf. It is estimated that 2/3 of the total crop is kenaf and this estimate provides the above figure. It is understood that China has plans for increasing its tonnage.

(3) Production figures are for 'Mesta' which includes fibre from *Hibiscus sabdariffa* as well as that from *Hibiscus cannabinus*.

(4) The kenaf is produced in East Pakistan which is now Bangladesh.

an increasing world demand for kenaf, provided that it is of good quality, that regular supplies can be relied upon and that a suitable price differential is maintained between kenaf and jute.(1) The long term prospects for the crop seem less promising. Thus expansion of area and production of kenaf in north-east Thailand would seem to be only a temporary palliative for that region's economic ills. For this reason the writer considers that investment in kenaf production on the village level in the form of improved retting facilities or machinery may not be worthwhile. Investment in fertilizer is worthwhile, since as well as increasing productivity considerably,(2) it maintains the fertility of the soil, which is necessary, whatever the cash crop happens to be.

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(1) Allan, J.L., The Market for Kenaf in the United Kingdom, TPI Report G40, 1969.

(2) In Taiwan Cuban kenaf grown on upland soils without irrigation but with fertilizer gives an average yield of 400 kg. of retted dry fibre per rai (1,170 kg./acre). In Thailand, where kenaf is usually grown without fertilizer, the average yield of retted dry fibre is 200 kg./rai.
Chu, C., op.cit.

V. Other Cash Crop Innovations in the Lam Pao Sample

In the Lam Pao Sample 23 farmers cultivate other cash crops. In most cases the bulk of the crop is sold and a small proportion kept aside for domestic consumption, but in a few cases all the crop is sold and in a few cases none is sold. In addition the farmer cultivates a wide variety of vegetables and possesses a few fruit trees in his suan, the production being intended for domestic consumption (*vide* Plate 5.5 and Plate 5.6). In this category also falls the so-called "local tobacco", which is widely cultivated and consumed within the village - the sale of this product would be illegal because of the state Tobacco Monopoly.

Of the cash crops sweet corn is grown by three farmers, pumpkins by one farmer, soyabeans by twelve farmers, cucumber by four farmers and long yard cucumber by seven farmers. Most farmers cultivate only one such crop, but three cultivate two crops and one cultivates three crops.

All of these cash crops are characterised by small planted areas and little damage or loss. Growers of these crops appear to have larger than average areas under glutinous rice. However, it is impossible to relate cultivation of these cash crops in any way with cultivation of kenaf or non-glutinous rice.

Although it might be considered that this type of cultivation would be capital-intensive, in most cases there are no capital inputs. In cases where there are capital inputs, however, these inputs constitute either a very large or a very small proportion of the total capital inputs on the farm.

Most of these cultivators are characterized by large farm holdings. However, it is impossible to relate cultivation of these crops to either the labour force per family or the number of dependents

Source: O'Reilly, dry season, 1972.

Plate 5.5 Stunted coconut palms, Ban Tum

These coconut palms, planted in an upland field, were intended as a commercial crop. According to the owner, they were planted 15 years ago. Their stunted growth indicates soil deficiencies. In fact the trees are dying with large parts of the palms turned brown.

Source: O'Reilly, dry season, 1971.

Plate 5.6 Kapok, Ban Non Sung

Kapok consists of the silky hairs lining the inside of the silk cotton tree (Ceiba pentandra). This tree is widespread in the suan of the area. The kapok is produced for sale. The floss is vermin-proof and is widely used for bedding and upholstery, life-saving equipment, sleeping bags and for sound and heat insulation. The seeds yield a non-drying edible oil. The market for the crop is fairly stable but restricted and unlikely to expand. In addition raising the silk cotton tree precludes cotton cultivation, since the silk cotton tree is a host plant for the cotton stainer (Dysdercus cingulatus).

per family. There is a considerable range in the amount of labour expended upon cultivation of these crops and the intensity of labour use per unit of land. However, in most cases hired labour constitutes only a small proportion of the total labour. There is no real concentration of labour use within the year.

About half of the cultivators borrowed money. Some borrowed fairly large sums. However, borrowing was usually from non-official sources. Twelve farmers are in debt.

Ten cultivators are members of agricultural associations, which is of some importance , since such associations are not well represented in the Lam Pao Sample as a whole.

Farmers in the Lam Pao Sample were questioned as to what price would have to be offered for potential new cash crops before the farmer would commence cultivation. Most stated that they would grow a new cash crop if the price were 2 Baht per kg. and the remainder would grow if the price were 2.50 Baht per kilogram. However, few seemed aware of what the current market prices of the various new crops were. Most of the would-be adopters stated that before they commenced cultivation of the new crops they would seek advice from government officials. Three farmers stated that they would seek advice from the Lam Pao Resettlement Area (an upland area in which the farmers were resettled whose farms were submerged in the construction of the Lam Pao reservoir). One stated that he would seek advice from the village headman.

Farmers seemed equally willing to undertake cultivation of these new crops by clearing more land from the forest, by practising double-cropping on the upland, by cultivating a second non-paddy crop on the paddy, or by substituting the new crop for an existing crop.

The most frequently mentioned potential crops were groundnuts, cassava, soyabeans, sweet potatoes and water melons. On the whole the area that the farmer was prepared to devote to the new crop was small, viz. 1 to 4 rai.

At present these other cash crop innovations are not of statistical significance in the Lam Pao Sample. It is likely that they will be of increasing importance as irrigation water becomes more available in the future. Certainly, many farmers are genuinely interested in these potential new crops. Their knowledge about the crops is, however, slight. Their ignorance of the market price and prospects of the crops is an effective deterrent to cultivation.

VI. Assessment of Potential Cash Crop Innovations in north-east Thailand

Possible cash crops in the north-east include sweet and fodder corn, cotton, mulberry for silkworm breeding, pumpkins, water melons, groundnuts, mung beans, soyabeans, cucumber, long yard cucumber, peppers, string bean, sugar cane, garlic, shalott, onion, parsley, tomatoes, eggplant, sweet potato, potato, vegetables, sorghum, castor bean, sesame and cassava.

Of these possible crops the cucumber, the long yard cucumber, the garlic, shalott, onion, water melon, parsley, tomato, eggplant and miscellaneous vegetables are all crops which would be grown on a small area of the farm. Many of them would be grown on the suan, but could, alternatively be grown as a second crop on the paddy or on the upland in conjunction with a field crop. They may be grown unirrigated in the wet season or irrigated in the dry season. Most would require intensive care for optimum results but would provide a remunerative source of income. However, it is obvious that the market they could serve would extend no further than the nearby towns of the north-east. The Bangkok market can be satisfied by areas nearer the capital. The local north-eastern market, therefore, although it will be expected to rise with the development of the north-eastern towns, will remain fairly restricted. It is thus inconceivable that any of these crops could become major cash crop innovations throughout the north-east. This could come about, however, if expansion took place in the canning industry for export. However, Thailand as a whole has not realized its potential as a supplier of canned fruit and vegetables for the world market. Competition is severe and standards very high. If the canning industry were to develop in Thailand, it is unlikely that the north-eastern farmer would thereby benefit; he would be unable to produce the high-quality and standardized product that canning requires. Instead the benefits would accrue to those areas of the country, the agricultural economy of which is already relatively developed.

Experiments were carried out at the Thai-Israeli experimental farm at Khon Kaen University to assess the profitability of the commercial production of tomatoes and eggplants.(1) A number of varieties of tomatoes and two varieties of eggplants were grown on an experimental basis with irrigation. The market price of eggplants was considered to be 1 Baht or 2 Baht per kg. and for tomatoes to vary from 5 Baht to 15 Baht per kg. It was concluded that the total variable costs including labour for tomatoes would approximate 5,562 Baht per rai and for eggplants 3,131 Baht per rai. Thus on this basis profitability measured in terms of gross margin per rai (gross revenue minus variable costs) would for eggplants approximate either to 4,541 Baht/rai, 9,101 Baht/rai, 12,213 Baht/rai or 21,333 Baht/rai, depending upon variety and price. Profitability for tomatoes would vary from 2,421 Baht/rai to a maximum of 71,548 Baht/rai, depending upon variety and price. The profitability of the enterprise has theoretically been proven, and even the minimum prices possible are high. However, it is doubtful if many farmers would be willing to take on the 'variable costs', including labour (425 hours for eggplants, 1,090 hours for tomatoes), fertilizer, irrigation, insecticide, fungicide, improved seed, and, in the case of tomato, construction of a wooden trellis. Only those farmers who are already fairly prosperous could undertake such costs.

This case brings out two main points. On the one hand, it

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(1) Oshrat, E. and Crump, D.K., An Assessment of the Profitability of the Commercial Production of Tomatoes and An Assessment of the Profitability of the Commercial Production of Eggplants, Thai-Israeli Farm, University of Khon Kaen, 1971.

indicates a certain remoteness of agricultural research from actual living conditions. On the other hand, it underlines the truism that great returns can usually only come from great investments. Since the average north-eastern farmer has not the capital for such investment, this capital must be injected into the local economy from outside.

Of the other suan crops it might be considered that capsicums, chillies and various peppers would be insignificant. However, such spices are not only an important source of income for a particular producer but also an important source of foreign exchange for the exporting country. Moreover, they can stimulate processing industries prior to export. In 1971 Thailand accounted for 10% of the world's exports of capsicums and chillies. The principal world market consists of Sri Lanka (28%), West Malaysia (14%), U.S.A. (23%), and West Germany (16%), all countries which could provide a ready market for Thai produce. Thailand's exports of peppers are insignificant but Thai peppers might find a market in Singapore, which takes 29% of the world total exports, U.S.A. (30%) or Japan (3%).(1) Within Thailand the north-eastern region could without great difficulty assume importance in production of these crops.

Cotton is an example of a crop which has declined in the north-east, since villagers no longer produce all their own clothing. It is doubtful whether Thailand could enter the world market for raw cotton but it certainly could develop more extensively its own cotton textile industry and possibly find a market in the West - cheap cotton clothing from India, Hong Kong and both Koreas is already on sale here. It is possible that the north-east could contribute to this growth, since in

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(1) Plantation Crops: A Review, Commonwealth Secretariat, 1973.

1966 it had 24% of the total area planted to cotton in the whole Kingdom.(1) The important proviso is that cotton production faces severe problems of insect attack - the leaf-sucking jassid (Empoasce devastans) makes cultivation of certain varieties impossible without a complete spray programme. Thus progress in cotton cultivation in the north-east would have to be preceded by heavy investment, both in insecticide and in genetic research.

It is doubtful if silkwork production could ever become anything other than an occasional sideline in the north-east. High quality silk is already produced in the north of Thailand (where it is a major tourist attraction).

It would seem that the two main activities which would prove most profitable in the north-east are the production of animal feedstuffs, including both cassava and grain feedstuffs like maize and sorghum, and the production of oilseeds, one use of which is also as animal feedstuff. Table 5.2 indicates both that Thailand has a relatively insignificant place in world exports and that the north-east has so far only a limited area under these crops.

At present maize is grown mainly in the northern part of the Central Plain. Behrman considered that maize production in Thailand followed the opening up of areas free from malaria and that in maize-growing areas the limestone content of the soil is much higher than in the north-east. In 1961 much cultivation in the north-east actually shifted from maize to kenaf.(2) The Thai government with the advice of the Board of Trade and the Thai Maize and Produce Traders' Association

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(1) Statistics of Upland Crops and Vegetables, Min. of Agr., Bangkok, 1966 (in Thai).

(2) Behrman, J., op.cit.

Table 5.2 Comparison of Grain Feedstuffs

	Maize (1971) provisional	Sorghum (1968/'69)
North-east as percentage of total planted area (1)	11%	8%
Thailand's exports as percentage of total world exports	3.4%	1%
Main exporters (percentage of total world exports in brackets)	U.S.A. (48%) Argentina (23%) France (15%)	U.S.A. (59%) Argentina (28%)
Main importers (percentage of total world imports)	Japan (19%) Italy (17%) U.K.(12%)	Japan (53%) Western Europe (26%)

(Source: The information about maize is from Grain Crops, Commonwealth Secretariat, 1973.
The information concerning sorghum is drawn from Survey of Export Markets for Sorghum, F.A.O. Commodity Bulletin Series, Rome, 1971.
The information on the north-east's planted area is from Statistics of Upland Crops and Vegetables, Ministry of Agriculture, Bangkok, 1966 (in Thai language).

(1) The figure of the north-eastern planted area is for 1966.

decides at the beginning of each year how much maize Thailand will export to Japan, Taiwan and the rest of the world.(1)

Thailand, however, has experienced difficulty in developing an export trade in maize, arising over the inability to predict accurately the export availabilities, either because of inaccurate production estimates or of variations in the rate of delivery of grains at the export outlets. Whatever may be the future of the crop in the Kingdom as a whole, it is likely that the north-eastern contribution will not assume great importance.

Sorghum (which includes all species of the family Gramineae) is the second most widely grown coarse grain crop in the world after maize, but the demand for it is highly variable, depending upon the cereal/livestock price relationship and the price relationship between sorghum and other feedgrains and feedstuffs. The Thai (and the Australians) have obtained contracts for future deliveries of sorghum as a means of obtaining Japanese capital for developing expertise in the production of sorghum.(2)

At present sorghum production in Thailand is plagued by internal marketing difficulties and pest attacks. It would seem, moreover, that Thailand will face severe competition from Australia in the Japanese market, whilst study of imports of agricultural produce into Japan in the last two decades reveals that Japan is unique not only in the wide fluctuations in its total imports of a particular agricultural commodity, but also in its rapid switch-overs from one exporting country to another: in short, the Japanese market remains one of the most

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(1) "The Maize Miracle Continues", Investor, March 1972.

(2) Thai exporters of sorghum have an arrangement with the Japanese on a price related in a specific manner to current U.S.A. sorghum prices. Tongpan, S., Thai Corn Problems, Cornell 1971.

difficult and insecure.

Table 5.3 compares the potential of the oilseeds in the context. They are castor bean or castor oil plant (Ricinus communis L. (Euphorbiaceae)), sesame or beniseed (Sesamum indicum L. (syn. S. orientale L.) (Pedaliaceae)), and soyabean (Glycine max L. Merrill (Leguminosae) or Glycine soja Sieb. & Zucc. (Leguminosae)).

All three crops can flourish under north-eastern conditions. Castor bean and sesame are fairly well established in the north-east but there is scope for expansion of the soyabean area. In addition to their industrial uses all have subsidiary uses as livestock feed.(1) Only with respect to castor beans is Thailand a significant exporter. It would appear that exports of sesame could be increased and so could exports of soyabeans as a human foodstuff in the Far Eastern market. (Soyabeans are also increasingly being processed to produce 'soyabean milk', a health drink sold in cafés in Thailand).

Thus, of the three crops castor beans would seem to be most promising crop for the north-east at present. Sesame is quite promising, but its yields do not compare favourably with other crops.

Groundnuts in addition to their use as human food (they are particularly popular in the Far East) can be used for livestock food. In 1966 the north-east of Thailand had 17% of the total planted area of the whole Kingdom.(2) As an exporter Thailand was not significant on a

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(1) Thailand has developed a vegetable oil industry based on soyabeans, groundnuts, cotton seeds and rice bran. Many oil mills cannot compete with exporters and are running at less than capacity - most work at 30% to 40% capacity and only one works at 50% capacity. It would be desirable to have greater liaison between firm and farm, perhaps with the firm providing the credit and farm technology. Seminar on "Industrial Plant" held by Agricultural Services Associations, Thai Industry Associations and ASRCT, Bangkok, 1970.

(2) Statistics of Upland Crops and Vegetables, op.cit.

Table 5.3 Comparison of oilseeds

	Castor bean	Sesame	Soyabean
Conditions of cultivation	Can flourish under dry conditions of north-east Thailand.	Can flourish under dry conditions of north-east Thailand.	Can flourish under dry conditions of north-east Thailand.
Principal use	Production of de-hydrated castor oil for paints, varnishes and other protective coating, as lubricant and chemicals.	Vegetable oil and pharma-ceutical ind.	Cooking oil, margarine, paints, food.
Subsidiary uses	Cake (castor pomace) resulting from commercial extraction can be used as fertilizer.	Press cake can be used as animal feed and fertilizer. Stalks can be used ground as livestock roughage (as in Venezuela) or ploughed under as source of organic matter.	Soyabean milk, soyabean meal, forage.
Trends	Increasing	Yields do not compare favourably with other oil crops.	Increasing.
Thailand's % of world's exports 1971	17%	insig.	insig.
Chief world exporters (% of world total in brackets)	Brazil (44%)	Sudan (43%) Venezuela (14%)	U.S.A. (94%)
Principal importers (% of world total in brackets) 1969	France (22%) U.S.A. (34%) U.K. (12%)	Italy (32%) Japan (21%)	Japan (28%) Western Germany (15%)
North-east Thailand's planted area as % of total planted area in Thailand (1)	32%	20%	1.7%

(1) These figures of planted area for 1966.

(Sources: General information about cultivation requirements, uses of crops and trends are from Oils and Oilseeds by Godin, V.J. and Spensley, P.C., Crop and Product Digests, No.1, Tropical Products Institute, 1971.
Data on exports of the crops are from "La Situation Mondiale des Corps Gras Statistiques et Problèmes", Report of International Association of Seed Crushers Congress in Kyoto (in French), Oléagineux, Revue Internationale des Corps Gras, August-September 1972, pp.405-418.
Data on imports of the crops are from Vegetable Oils and Oilseeds: A Review, Commonwealth Secretariat, London 1972.

world scale, but was important in certain markets. Thus in 1965 Thailand provided 45% of West Malaysia's imports, 67% of Sarawak's[1] and 26% of Hong Kong's.[2] However, whilst in 1956 Thailand provided 54% of Japan's imports, in 1961 this figure had fallen to 0.9% and in 1965 was still only 4.5%. Japan had turned to new sources in Sabah, South Africa, South Vietnam and the People's Republic of China. This further underlines the precarious nature of the Japanese market and the impossibility of predicting the prospects for any individual crop.[3] (However, Japan alone of Thailand's customers is of world stature, accounting for 13% of the world demand for groundnuts in 1965).[4]

The market for groundnuts is considered to be a difficult one.[5] Countries may make rapid incursions into the market only if the supply from an alternative source fails.[6] A new product cannot be developed quickly from the seed of groundnut grown elsewhere. On the contrary a new supplier will have to spend years developing a suitable produce. The presence of aflatoxin is a problem.[7] Leading suppliers at present

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(1) External Trade Statistics, Dept. of Statistics, Singapore.

(2) Hong Kong Trade Statistics, Dept. of Commerce and Industry, Hong Kong.

(3) Trade of Japan, Japan Tariff Association.

(4) The Market for Edible Groundnuts, TPI Report G6, London, undated.

(5) Ibid.

(6) For example, Nigeria benefitted from the withdrawal of Indian supplies.

(7) Aflatoxin is the term applied to the toxic metabolites produced by the fungus, *Aspergillus flavus*. This fungus is a powerful hepatotoxin and carcinogen for certain animal species, although its effect upon humans is not certain. Chinese, South African and some American groundnuts are regarded as always aflatoxin-free. Ibid.

export the bulk of their crop as edible grades (e.g. Malawi), export large quantities of milling grade groundnuts (e.g. Nigeria) or export as edible grade only a small part of their crop, the bulk of which is absorbed domestically for edible purposes (e.g. U.S.A.) or for milling and livestock feed (e.g. People's Republic of China). It would seem that Thailand to withstand market vagaries should divide its crop between export and domestic livestock feedstuff. However, in the case of groundnuts and indeed all other oilseeds and coarse grains the nature of the world market and, consequently, Thailand's and the north-eastern region's share of it, will depend on the extent to which the People's Republic of China enters into world trade, since its potential is enormous.

Experiments at the Thai-Israeli farm in Khon Kaen have assessed the feasibility of both wet season production of groundnuts and irrigated dry season production. The results are not promising.(1)

Cassava presents an example of a cash crop innovation which has proven successful in south-eastern Thailand in changwat Chon Buri and Rayong and become a major Thai export.(2) Its success is of interest,

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(1) The total 'variable costs' per rai exclusing labour for wet season production of groundnuts was 2,163 Baht, and for dry season irrigated production 2,098 Baht. Assuming the price to be 2.30 Baht per kg., the gross margin per rai was 668 Baht for one variety planted in July in the wet season (SK38) but losses were incurred for the other variety (Giant Dixie) and for other planting dates of both varieties. For the irrigated dry season groundnuts losses were made in all cases, reaching 870 Baht loss per rai in one case.
Oshrat, E. and Crump, D.K., Costs and Returns of Wet Season Production of Peanuts and Limsayhua, C., Oshrat, E. and Crump, D.K., Costs and Returns of Irrigated Peanuts in the Dry Season, Thai-Israeli Farm, University of Khon Kaen, 1971.

(2) The cassava in Thailand is usually thought to be *Manihot utilissima* although some suggest it is *Manihot esculenta* Crantz.
Pramanik, A., "Prospects for Tapioca Cultivation and Pelletization in Malaysia", *Planter*, 47, 534, 1971.

since it suggests that the success of an agricultural innovation may be more assured, if there is Western capital involved in the innovation.(1)

Tables 5.4 and 5.5 show the pre-eminence of Thailand in world exports. However, it appears the Thai farmer's returns from cassava compare unfavourably with other countries.(2)

Although at present the north-east of Thailand has only 8.7% of the total area of the whole Kingdom under cassava,(3) it seems in some ways an ideal crop for expansion in that region. It can tolerate the climate and edaphic conditions of the north-east and is fairly hardy.

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(1) The crop was probably first introduced into Thailand from Malaya as an intercrop between young rubber trees in the south. An improved strain of cassava was introduced into Thailand by the Japanese sometime between 1941 and 1945. It was processed by small plants in the Chon Buri area until the American company, Thai Tapioca Ltd., set up a plant in Rayong in 1954 and planted 2,000 acres to the crop. ('Tapioca' is the name applied to the product of processing cassava). The innovation was soon adopted by local farmers when the demand for cattle feed in Europe led to the production of dried chips. This also led to the emergence of lots of small Thai entrepreneurs with chipping plants (vide Plate 5.7). The latest move is the export of feedstuff in the form of compressed pellets which has led to investment in expensive pelletizers of which there are now 300 in Thailand.
Source: Personal communication from Mr. Peter Kirrage of Thai Tapioca Ltd., Bangkok.

(2) The Thai farmer obtains 11 to 12 U.S. dollars for farm-dried chips from a ton of fresh cassava, whereas for fresh cassava for human use the Jamaican farmer obtains 2 to 4 times the price.
Rankine, L.B. and Houng, H.M., A Preliminary View of Cassava Production in Jamaica, Dept. Agric. Econ. Occasional Series No.6, Univ. West Ind., Trinidad.
At certain times of the year the Colombian farmer may obtain 6 to 10 times the Thai price.
Pinstrup-Andersen, P., Agric. Econ, Unit. CIAT, quoted in Nestel, B.L., Current Utilization and Future Potential for Cassava, Paper 1, Chronic Cassava Toxicity Workshop, London, 1973.

(3) Statistics of Upland Crops and Vegetables, op.cit.

Table 5.4 Total Cassava Exports

Country	Percentage of total world exports	Year of data
Thailand	88.9	1970
Brazil	4.5	1969
Angola	2.0	1970
West Malaysia	1.9	1970
Malawi	1.4	1970
Malagasy Republic	0.6	1970
Togo	0.4	1969
Singapore (1)	0.2	1971
Tanzania	0.1	1971

(1) The Singapore exports consist mainly of re-exports from Malaysia.

Sources: For Thailand Foreign Trade of Thailand, Department of Customs.
For Brazil, Comercio Exterior do Brasil, Servicio de Estadistica economia & Financeira.
For Angola, Comercio Externo Reparticas Tecnica de Estadistica geral.
For West Malaysia, Annual Statistics of External Trade, Department of Statistics, Kuala Lumpur.
For Malawi, Annual Statement of External Trade, Central Statistical Office.
For Malagasy Republic, Commerce Extérieur, Ministero des Finances, Institut National de la Statistique et la Recherche Economique.
For Togo, Bulletin de Statistique, Service de Statistique Générale.
For Singapore, External Trade Statistics, Department of Statistics, Singapore.
For Tanzania, Annual Trade Report, East African Customs and Excise.

Table 5.5 Total cassava imports

Country	Year of data	Percentage of world's imports	Thai contribution (%)
West Germany (1)	1971	38	61.2
Netherlands (2)	1971	38	94
Belgium and Luxembourg (3)	1970	10	38
U.S.A.	1971	5	82
Japan	1970	3.7	100
France (4)	1971	3	84
United Kingdom	1971	0.5	0.7

(1) The West German figure includes "arrowroot, salep, Jerusalem artichoke, sweet potato, and other roots and tubers with high starch or imulin content".

(2) The Dutch figure includes "arrowroot, salep and similar roots".

(3) The figure for Belgium and Luxembourg includes "arrowroot, salep and similar roots".

(4) The French figure includes "arrowroot, salep and similar roots".

Sources: For West Germany, Aussenhandel Statistisches Bundesamt.
For Netherlands, Maandstatistiek van de In-uit-Voer, Centraal Bureau voor Statistiek.
For Belgium and Luxembourg, Commerce Extérieur, l'Institut National de Statistique.
For U.S.A., Bureau of the Census Report F.T.110, Department of Commerce.
For Japan, Trade of Japan, Japan Tariff Association.
For France, Commerce Extérieur, Direction Générale des Douanes et Droits Indirectes.
For United Kingdom, The Trade of the U.K., H.M. Customs and Excise.

Source: O'Reilly, dry season, 1972.

Plate 5.7 Cassava Chipping Plant, Lam Pao Re-settlement Area

Such small plants are an indigenous enterprise, operated in the main by family labour. In the foreground on the left are the harvested cassava roots; in the middle distance the woman is converting the roots into "chips"; in the foreground on the right are the resulting chips.
Information received from the Lam Pao area since the year of survey indicates the number of such chipping plants is on the increase.

It gives good returns of yield per area and per manday.(1) It grows well in light sandy soils and local varieties compare well with introduced ones.(2) It has few pests, although weed control poses a problem.

However, it has disadvantages. One such is the chronic toxicity in animals and humans on high cassava diets.(3) Cassava, moreover, requires a considerable amount of potash in the soil for starch production, but most north-eastern soils are deficient in potash.(4) At harvest the roots must be processed within 48 hours, lest they begin to ferment, mould and rot - this restricts the potential cultivating area somewhat. Also cassava must never be exposed to moisture during or

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(1) Raeburn et al. stated that the yield per manday of cassava exceeds that of other tropical staples.
Raeburn, J.R., Kerkham, R.K. and Higgs, J.W.Y., Report of a Survey of Problems in the Mechanization of Native Agriculture in Tropical African Colonies, HMSO, London, 1950.
This is confirmed by Clarke and Haswell in terms of FAO "standard wheat-equivalents".
Clark , C. and Haswell, M.R., The Economics of Subsistence Agriculture, MacMillan, London, 1964.
In addition, it appears that cassava productivity in terms of calories per unit of time is significantly higher than that of other staple food crops.
Vries, C.A. de, Ferwerda, J.D. and Flach, M., "Choice of Food Crops in Relation to Actual and Potential Production in the Tropics", Neth. J. agric. Sci., 15, 241, 1967.
Moreover, unlike grain crops, which have been subjected to considerable research to improve their genetic potential, scope is still considerable for cassava.
Coursey, D.G. and Haynes, P.H., "Root Crops and their Potential as Food in the Tropics", Wld Crops, 261, July/August 1970.

(2) At Huey Pong Experimental Station near Rayong no introduced varieties have been found to outyield the local varieties when grown in Thailand.
Harper, R.S., "Cassava Growing in Thailand", Wld Crops, March/April 1973.

(3) This toxicity is attributed to cyanogenic glucoside content.
Nestel, B.L., op.cit.

(4) Grace, M., Cassava Processing, Agricultural Services Bulletin No.8 (Ref. Ags/ASB/71/2) FAO, Rome, 1971.

after processing.(1) Probably most important of all, it is estimated that three consecutive crops of cassava will exhaust the soil.(2)

However, the crop will respond to fertilizer, whilst in Rayong contour-ridging has been used to combat soil erosion, but it is thought to lead to reduced yields.(3) Some form of rotation would appear to be desirable.

As well as physical problems the crop faces problems in the export field. The world market is for a definite amount and over-production leads to difficulties.(4) The American market has shrunk owing to the preference for corn flour for industrial uses and quota restrictions have been introduced in Japan.(5) Thailand is at present tied to the European Economic Community. This potential market may have been expanded with the entry of the United Kingdom, Denmark and the Republic of Ireland into the Community, but in 1972 Belgium refused further shipments from Thailand because of inferior quality.(6) The demand for cassava depends very much upon the price of cassava vis-à-vis

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(1) If exposed to such moisture, the starch is removed and the feeding value deteriorates. Moreover, moisture also encourages bacterial growth which is particularly dangerous and perhaps lethal for young pigs and poultry.
Butler, E.J., Brown, E.E. and Davis, L.H., An Economic Analysis of the Production, Consumption and Marketing of Cassava (Tapioca), Univ. of Georgia, College of Agricultural Experiment Stations, Research Bulletin 97.

(2) "The Precious Root - Thailand's Tapioca Industry", Investor, Dec.1971.

(3) Coursey, D.G. and Haynes, P.H., op.cit.

(4) Schmidt, H.E., "Erfahrungen in der thailändischen Tapiocastärke - und Tapiocamehlindustrie" (in German), Die Stärke, 17 (11), 1965.

(5) Harper, R.S., "Cassava Growing in Thailand", op.cit.

(6) Manson, E., "How the Thai Tapioca Industry Mixes the Good with the Bad and still Dances Dizzily on Top", Business in Thailand, May 1972.

grain. Since cassava is inherently inferior to grain, it must be supplemented by protein, but at present world prices of protein have risen, making cassava a less attractive proposition. This may, however, be only temporary.(1) Moreover, cassava would suffer, if the Common Agricultural Policy of the EEC were to be scrapped,(2) whilst the trend towards lean meat also mitagates against cassava, which produces fatty meat in the animals which consume it.(3) However, new uses for cassava are being explored.(4) Moreover, recently the People's Republic of China has submitted high quality starch on the world market, which could transform the world export situation.(5)

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(1) Recent computer studies of the compound feed market undertaken in the Federal Republic of Germany, the U.K. and Canada indicate that at present price level, provided that the Common Agricultural Policy of the EEC does not discriminate specifically against cassava, there may be a market demand of 4.3 million tons in the EEC by 1980, which may require significant increases in exports from West Africa and the People's Republic of China.
Hone, A. of the Institute of Commonwealth Studies, Oxford, quoted in Nestel, B.L., op.cit.
Nestel believes also that a six- to ten-fold increase in cassava exports by 1985 might easily be absorbed in the world market.
Ibid.

(2) Information from personal discussion with officials of the Tropical Products Institute, London.

(3) "Market Prospects for Malaysian Tapioca Products in the Netherlands", Journal of Ministry of Commerce and Industry, Malaysia, 3 (4), 1970.

(4) There appears to be some prospect for the increased use of cassava flour as a partial substitute for wheat flour in composite breads in those countries where wheat flour is in limited supply. (During manufacture most of the cyanogenic glucosides are destroyed and the toxicity is thus not significant).
Nestel, B.L., op.cit.

(5) Walker, H.; The Market for Cassava, TPI Report No.G21, April 1966.

VII. Diffusion of Cash Crop Innovations in N.E. Thailand

Within the north-east of Thailand cash crop innovations have made an uneven impact. Taking the total area under each cash crop innovation in each changwat, an attempt was made to indicate the relative importance of these crops in the economy of the north-east. However, figures for total holdings areas were only available for 1963. On the other hand, the figure for the total land area could not be used, since, as Table 5.6 shows, there is a considerable discrepancy between the relative size of the changwat and its area of holding expressed as a percentage. Accordingly, the 1963 figure for agricultural holdings was used with the 1966 figure for cash crop innovations. The results are presented in Table 5.7.

An Index of Cash Crop Innovativeness was derived by use of the taxonomic technique (*vide* Chapter 3). The results are shown in Map 5.4. This indicates that with the exception of changwat Nakhon Ratchasima and Loei, the former the 'gate way' from the Central Plain, the latter partaking of much of the character of the agriculture of the northern region of Thailand, cash-crop innovativeness in north-east Thailand is low.

Table 5.6 Comparison of total land area of province as percentage of total land area of north-east with total area of agricultural holdings of province as percentage of total area of agricultural holdings in north-east

Province	% land area of total north-east	% area of agricultural holdings of north-east total
Kalasin	4	4
Khon Kaen	9	8
Chaiyaphum	5	6
Nakhon Phanom	3	6
Nakhon Ratchasima	13	12
Nong Khai	2	4
Buri Ram	8	6
Maha Sarakham	7	3
Roi Et	8	5
Loei	2	6
Si Sa Ket	6	5
Sakon Nakhon	5	6
Surin	7	5
Udon Thani	9	10
Ubon Ratchathani	14	13

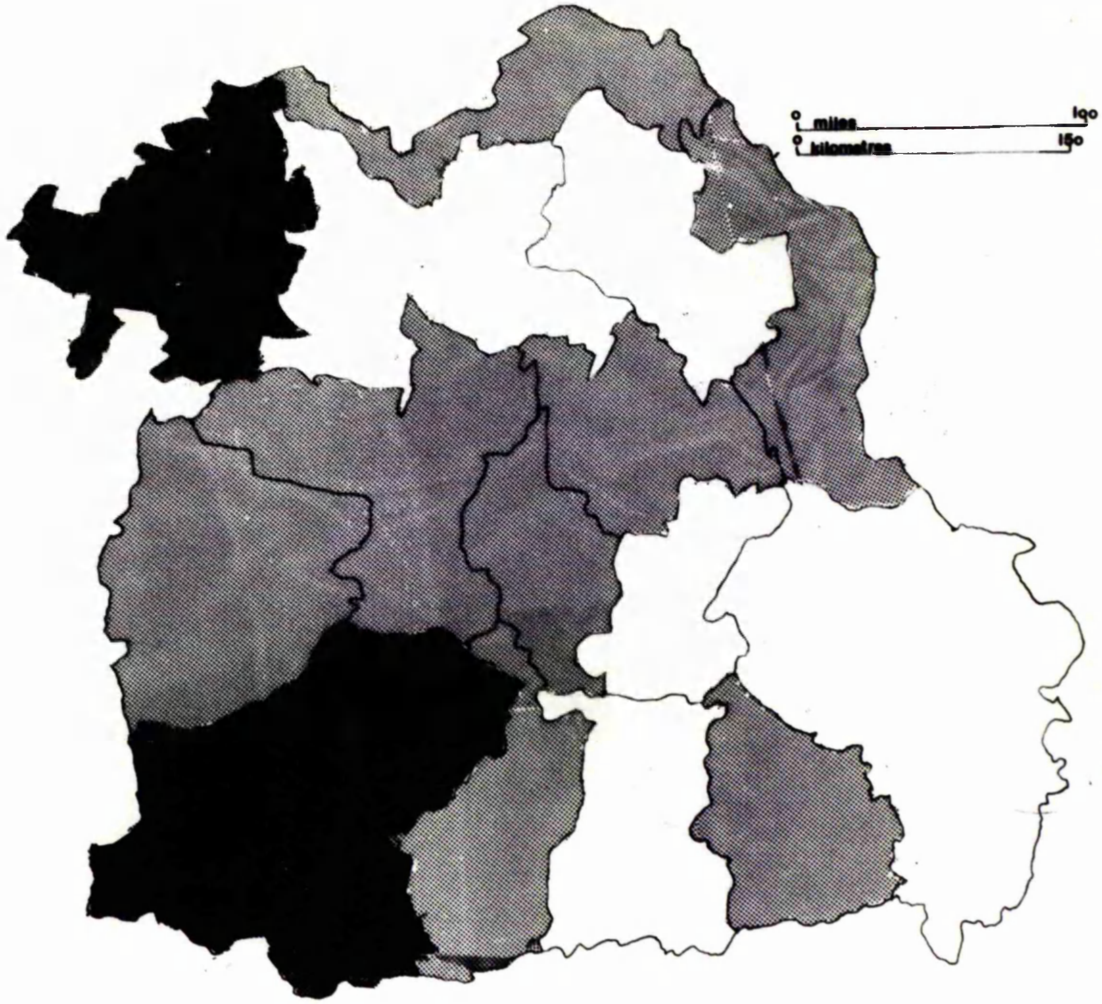
(Source: Thailand Year Book 1970.)

Table 5.7 Percentages of total cultivated land in province

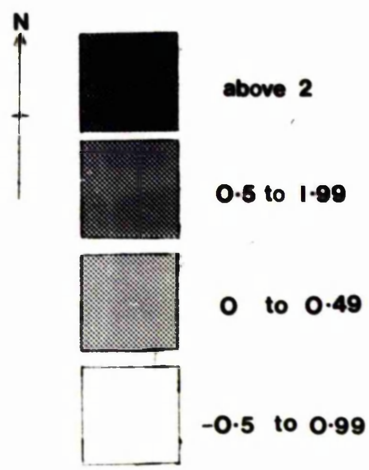
Province	Maize	Soyabeans	Groundnuts	Mungbeans	Castor beans
Kalasin	0.85	0.01	0.46	0.05	0.02
Khon Kaen	0.62	0.01	0.24	0.1	0.05
Chaiyaphum	0.98	0.03	0.82	0.06	0.22
Nakhon Phanom	0.77	-	0.29	0.03	0.03
Nakhon Ratchasima	9.4	0.05	1.97	0.23	2.34
Buri Ram	0.24	-	1.76	0.03	-
Maha Sarakham	0.53	-	0.47	-	0.01
Roi Et	0.21	-	0.18	0.02	0.02
Loei	5.77	0.17	2.22	0.7	1.26
Si Sa Ket	1.4	0.02	0.36	0.06	0.12
Sakon Nakhon	0.14	-	0.2	0.04	0.01
Surin	0.24	-	0.25	0.02	-
Nong Khai	1.7	-	1.56	0.37	0.05
Udon Thani	0.37	0.01	0.15	0.02	0.03
Ubon Ratchathani	0.18	-	0.05	-	-

	Sesame	Cotton	Sorghum	Cassava	Water-melons
Kalasin	0.07	0.28	0.02	0.03	1.26
Khon Kaen	0.11	0.39	0.23	0.02	0.37
Chaiyaphum	0.04	0.41	0.02	0.4	0.25
Nakhon Phanom	0.09	0.75	0.01	0.12	0.46
Nakhon Ratchasima	0.03	0.69	0.3	1.86	0.43
Buri Ram	-	0.01	0.02	0.02	0.14
Maha Sarakham	0.1	0.3	-	0.01	0.65
Roi Et	0.03	0.17	0.02	0.01	0.82
Loei	9.8	20.3	0.75	0.12	0.64
Si Sa Ket	0.04	0.2	0.31	0.02	0.34
Sakon Nakhon	0.03	0.33	0.01	-	0.27
Surin	0.02	0.05	-	0.01	0.10
Nong Khai	0.05	0.06	-	0.02	1.4
Udon Thani	0.06	0.26	0.17	0.02	0.14
Ubon Ratchathani	0.01	0.1	-	-	0.12

(Source: Statistics of upland crop cultivation were taken from Statistics of Upland Crops and Vegetables, 1966, Ministry of Agriculture (in Thai). The figure for the total planted area was taken from the Thailand Year Book 1970 - unfortunately the latest figure for this is from the 1963 Census of Agriculture. Thus this exercise can make no great claim to accuracy - it merely shows relationships between the provinces, which possibly have not altered, though total amounts have).



MAP 5.4:
AN INDEX OF
CASH-CROP
INNOVATIVENESS
IN NE THAILAND



VIII. Conclusion

Kenaf, though not new to Thailand, is the single most important cash crop innovation in north-east Thailand. In the Lam Pao Sample the kenaf-grower is likely to be a young family man, who possesses a relatively large holding. He is likely to be well-travelled and, possibly, a member of an agricultural association.

The rate of adoption of kenaf reproduces the S-shaped curve, familiar in the study of innovations. However, the individual farmer changes his total area under cultivation quite markedly from year to year. Once he has accepted kenaf, however, he seems to accept vicissitudes of price fluctuations without rejecting the innovation. There is interest in expanding the area under cultivation, if market prices are favourable.

The future of the kenaf crop in the world market is not promising, although there may be short-term increases in demand.

There are a wide variety of other cash crop innovations cultivated, but both in north-east Thailand as a whole and in the Lam Pao area their cultivation is on a small scale. So far changwat Loei and Nakhon Ratchasima have achieved the most diverse economies.

Of the potential crops for expansion in the Lam Pao area and in the north-east as a whole, it appears that sorghum, maize and various oilseeds offer the best prospects at present, although some of them have major disadvantages. Cassava might be a profitable innovation and may achieve the most immediate and rapid spread throughout both the north-east and the Lam Pao area. However, its effects upon the soil could be deleterious and its export prospects could conceivably decline.

CHAPTER SIX

LIVESTOCK AS AN INNOVATION IN THE LAM PAO SAMPLE

I. The Place of Livestock in north-eastern Thai Agriculture

Domesticated animals have long played an important traditional rôle in the Thai rural economy. The water buffalo has been ubiquitous as a work animal, being slaughtered in old age, whilst Brahmin cattle, although of considerable antiquity in the area, have a less significant rôle. Pig-rearing has been a more commercial option, but chickens and ducks have long supplemented the rural diet. Occasionally, also one may come across farmers who own horses,(1) or elephants.

Within the Kingdom the north-east has traditionally been the most important area for cattle and water buffalo production. Table 6.1 shows the situation in 1971.

In 1957 the north-east had had 2,828,105 water buffaloes (48% of the whole Kingdom's total), 2,393,560 cattle (48% of the total), 1,187,277 pigs (32% of the total), 9,988,000 chickens (42% of the total) and 3,615,000 ducks (39% of the total).(2) Thus only with respect to

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(1) The University of Kentucky Team at Khon Kaen in the north-east has promoted and assisted horse rearing in the locality. Thus many farmers in changwat Khon Kaen and Maha Sarakham raise a horse on their holding, feeding it on rice, and eventually selling the beast as a race horse or for riding clubs. The writer questioned the owner of horses for hire at the holiday resort of Pattaya on the Gulf of Thailand and found that all the beasts were purchased from Maha Sarakham.

(2) An Atlas of Thailand's Agricultural Resources, Dept. of Commercial Intelligence, Bangkok, August 1959.

Table 6.1 Livestock and Poultry in north-east Thailand as a Percentage of Whole Kingdom

	Whole Kingdom	North-east	N.E. %
Elephants	11,504	1,338	11.6
Horses	181,366	138,456	76
Cattle	5,172,661	2,444,264	47
Water buffaloes	7,060,868	3,495,783	50
Pigs	4,143,068	895,109	22
Ducks	10,487,772	2,816,424	27
Chickens	35,101,158	11,855,646	34

(Source: Statistical Yearbook of Thailand) water buffaloes has the north-east increased in importance.

The north-east has, moreover, long been an exporter of livestock into the Central Plain. In 1971 13,308 cattle (33% of total imports), 81,197 water buffaloes (85% of total imports), and 328,813 pigs (94% of total imports) were exported from the north-east into the Central Plain.(1)

However, it would seem that these cattle and water buffaloes from the north-east are mainly intended as work animals, whilst the pigs are sent to the Central Plain for fattening, since Table 6.2 shows that the number of beasts slaughtered in the north-east is low.

Within the north-east production varies. Maps 6.1 to 6.3 show surpluses of cattle, water buffaloes and pigs in the north-east. Those provinces bordering the Central Plain emerge as the leading sources of cattle and water buffaloes, although Roi Et has the greatest surplus of pigs. Deficits of cattle and pigs are found only in Nong Khai.

Although disease is generally reckoned as a major problem in Thai livestock breeding, the north-east is not, contrary to expectations, markedly bad on this score. Table 6.3 indicates that with the exception of cattle and water buffaloes diseased from foot-and-mouth disease, the incidence of disease and death from disease among water buffaloes and cattle in the north-east is disproportionately low. At the same time the proportions vaccinated against anthrax, haemmoriac, septocaemia and foot-and-mouth diseases are lower than expectations, but the proportions vaccinated against rinderpest among cattle and water buffaloes are markedly high. For pigs the rate of swine fever and vaccination against swine fever are both low, whilst both incidence of swine plague and

(1) Annual Report of Livestock, Livestock Dept., Min. of Agr. (in Thai).

Table 6.2 Comparison of animals slaughtered north-east and whole Kingdom 1968

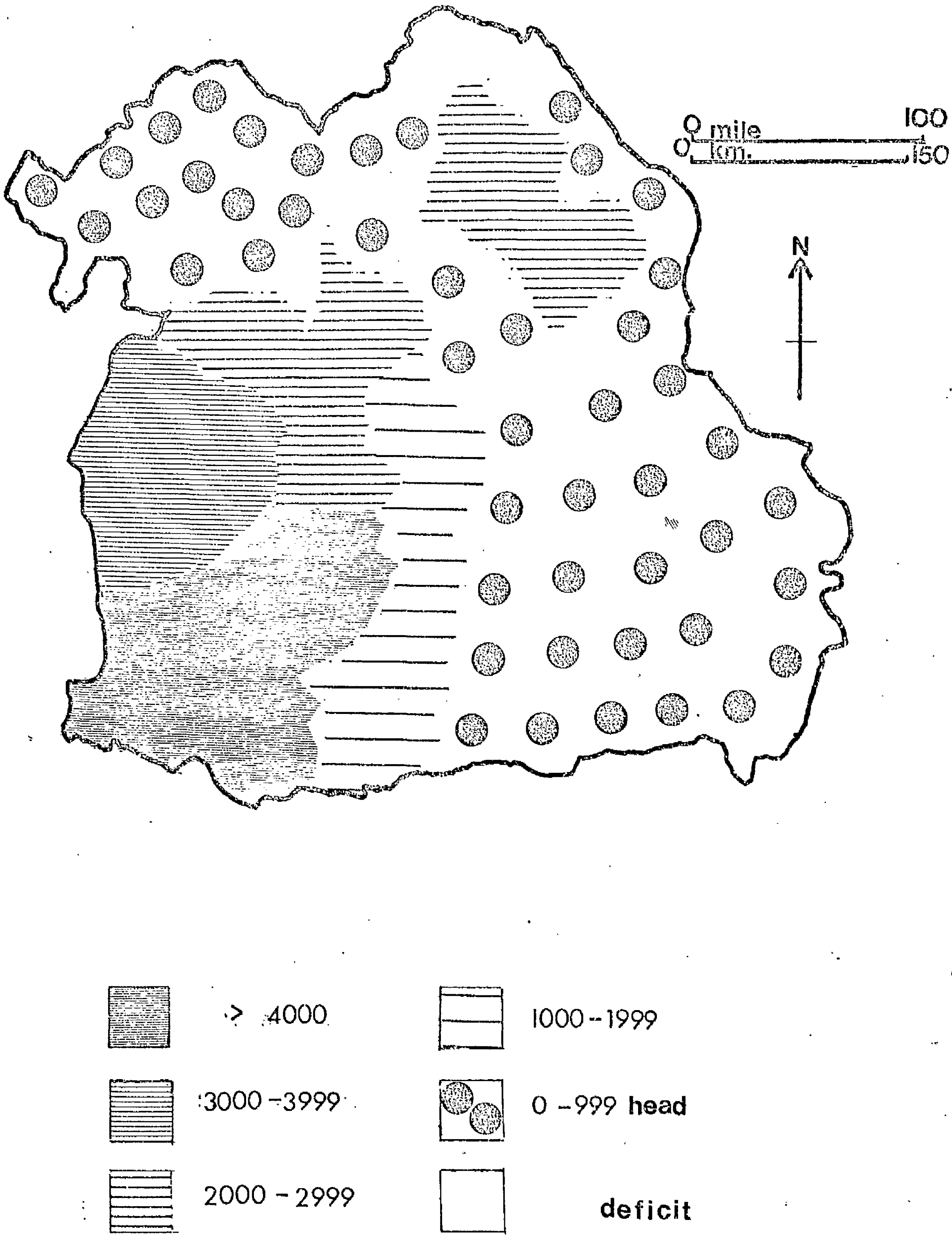
	Number slaughtered in north-east	% of number slaughtered in whole Kingdom
Cattle	71,605	29
Water buffaloes	7,393	8
Pigs	230,611	13

(Source: Annual Report of Livestock, Livestock Department, Ministry of Agriculture (in Thai).

Table 6.3 Incidence of Disease, Death from Disease and Vaccination among Cattle, Water Buffaloes and Pigs in the north-east

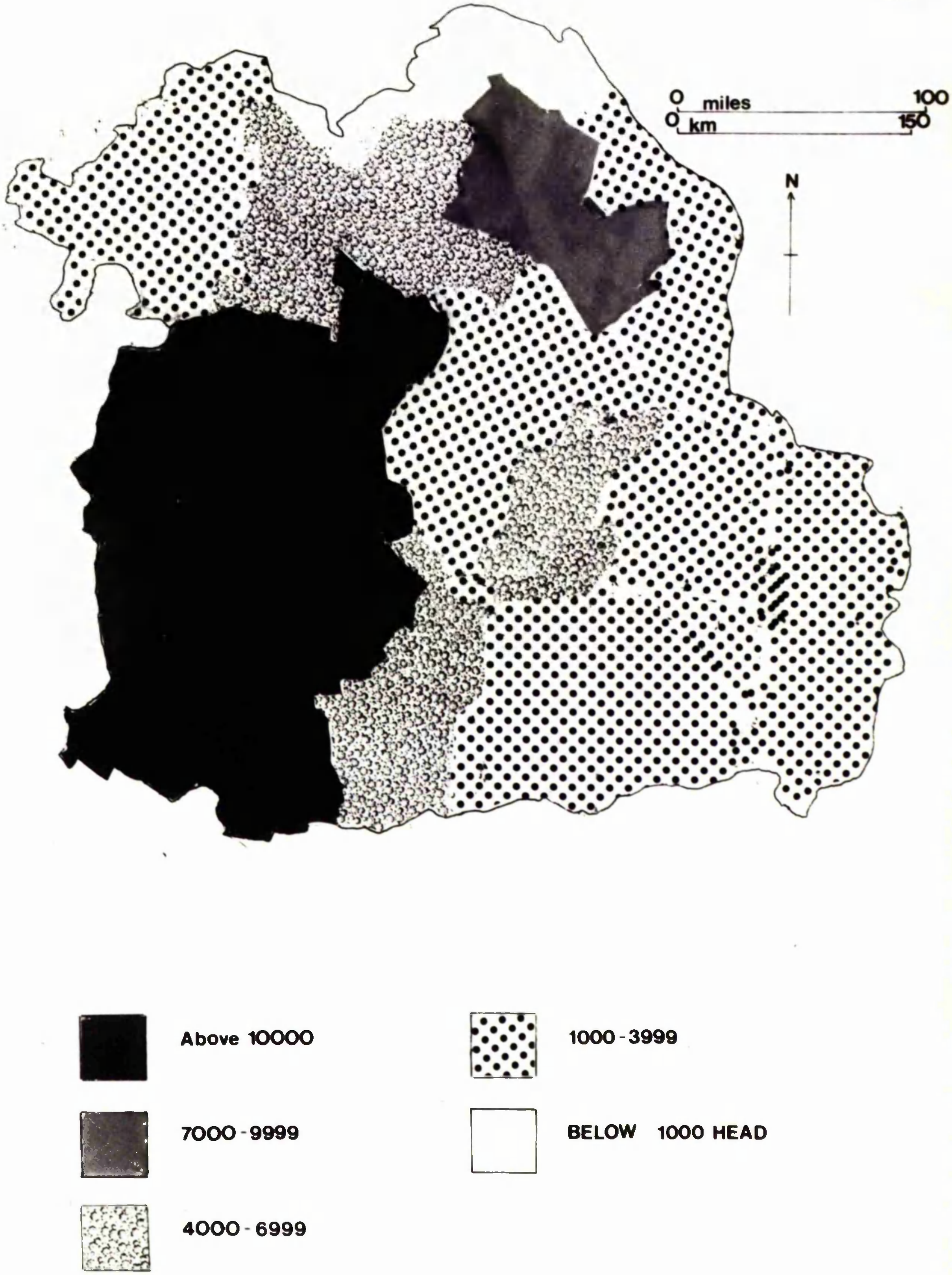
	Water Buffaloes	Cattle	Pigs
% north-east of total	50	47	22
% dead of anthrax	8	-	5
% vaccinated against anthrax	37	12	0.5
% dead of haemorriac septocaemia	35	38	
% vaccinated against haemorriac septocaemia	44	36	
% diseased with foot-and-mouth	55	46	
% vaccinated against foot-and-mouth	17	6	
% vaccinated for rinderpest	90	93	95
% dead of swine fever			4
% diseased of swine fever			13
% vaccinated against swine fever			4
% dead of swine plague			73
% vaccinated for swine plague			38

(Source: Livestock Report).

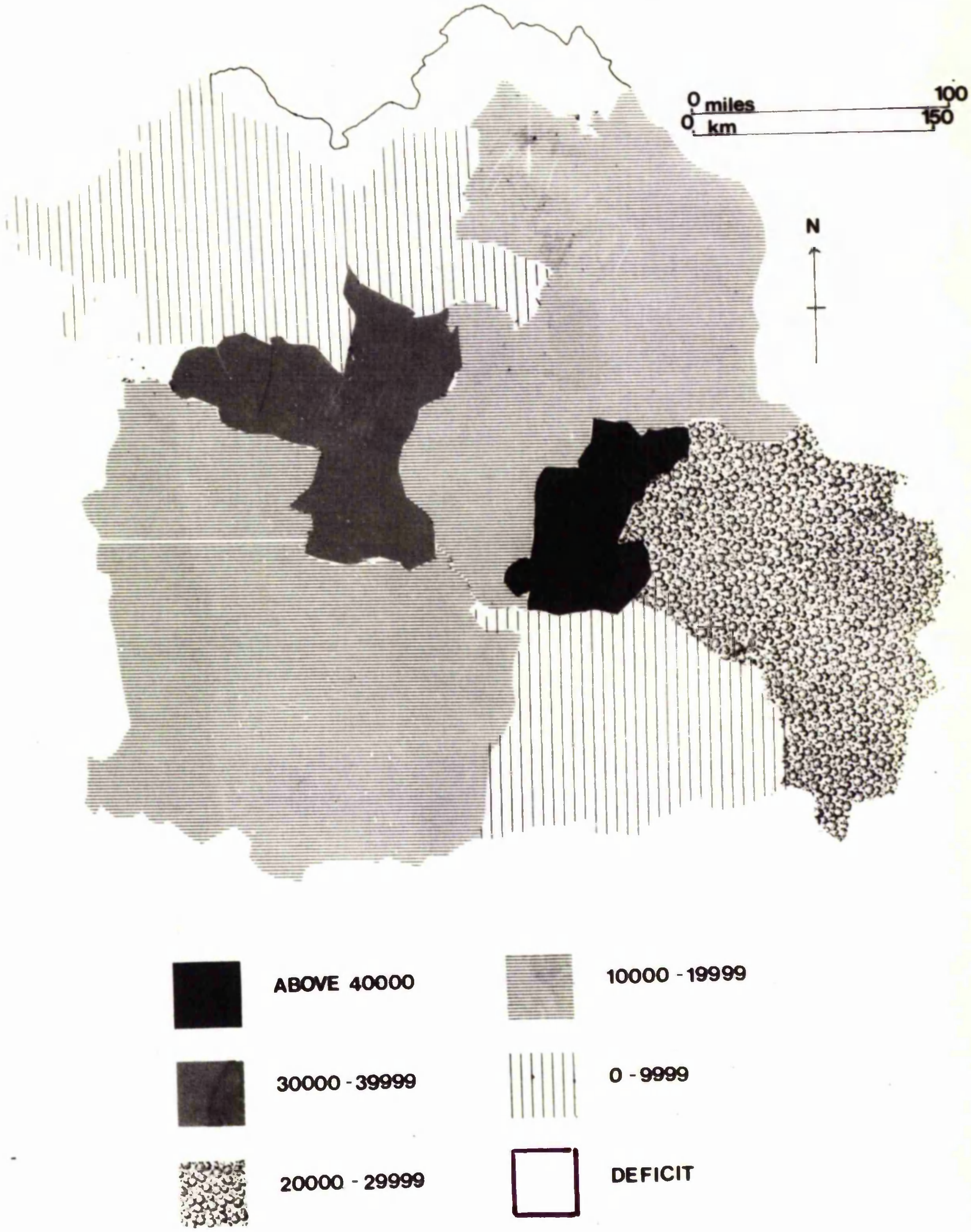


MAP 6.1 CATTLE SURPLUS IN NE THAILAND 1971

Source: Livestock Report



MAP 6.2 WATER BUFFALO SURPLUS IN NE THAILAND 1971
SOURCE: LIVESTOCK REPORT



MAP 6.3 PIG SURPLUS IN NE THAILAND 1971

Source: Livestock Report

incidence of vaccination against it are high. In the case of rinderpest, therefore, vaccination can be seen to be an effective preventive measure, whilst in the case of swine plague it is a belated response to an outbreak. It appears that effective vaccination against foot-and-mouth disease has not yet become widespread.

As Table 6.4 indicates, the only major disease afflicting poultry at present in the north-east is cholera.

However, although the value of livestock production has increased, its relative importance in the agricultural sector of the Kingdom as a whole has steadily diminished: this is in marked contrast to the situation with respect to crops and forestry, for which both the total value and the relative importance have increased, as Table 6.5 shows.

Livestock exports abroad are ill-developed. In 1970 Thailand exported 8,527 cattle, 25,805 water buffaloes and 15,802 pigs. Of these, 756 head of cattle (9%) and 2,145 water buffaloes (8%) went to Malaysia, 7,171 head of cattle (84%) and 4,641 water buffaloes (74%) to Singapore, 600 head of cattle (7%) and 19,019 water buffaloes (74%) and 15,620 pigs (99%) to Hong Kong and 182 pigs (1%) to Laos.(1)

(1) <u>Livestock Report</u>, <u>op.cit.</u>

Table 6.4 Incidence of disease among poultry in north-east Thailand

	Ducks	Chickens
% of total raised	27	34
% affected by Newcastle disease		24
% affected by smallpox		10
% affected by cholera	22	68
% affected by infected trachea		15

(Source: Livestock Report).

Table 6.5 Agricultural Sector Breakdown (Value-added) for Livestock in Thailand selected years 1960-'69

Year	(1962 prices) Millions of Baht	Increase %	% Value	Decrease %
1960	2,963.2		13.9	
1964	3,250.9		13.0	
1968	3,734.0		12.9	
1969	3,830.0	30	12.3	-11.5

(Source: National Accounts Division, N.E.D.B.)

II. Livestock in the Lam Pao Sample

Within the Lam Pao Sample 151 farmers (63%) do not have any cattle. Of the 87 farmers who raise cattle, 71 farmers have more than one beast, 44 more than two beasts, 26 more than three beasts, 10 more than four beasts, 5 more than five beasts and three more than six beasts.

On the other hand, 207 farmers have water buffaloes (87%). Of these, 137 have more than one beast, 64 more than two, 30 more than three and ten more than four beasts.

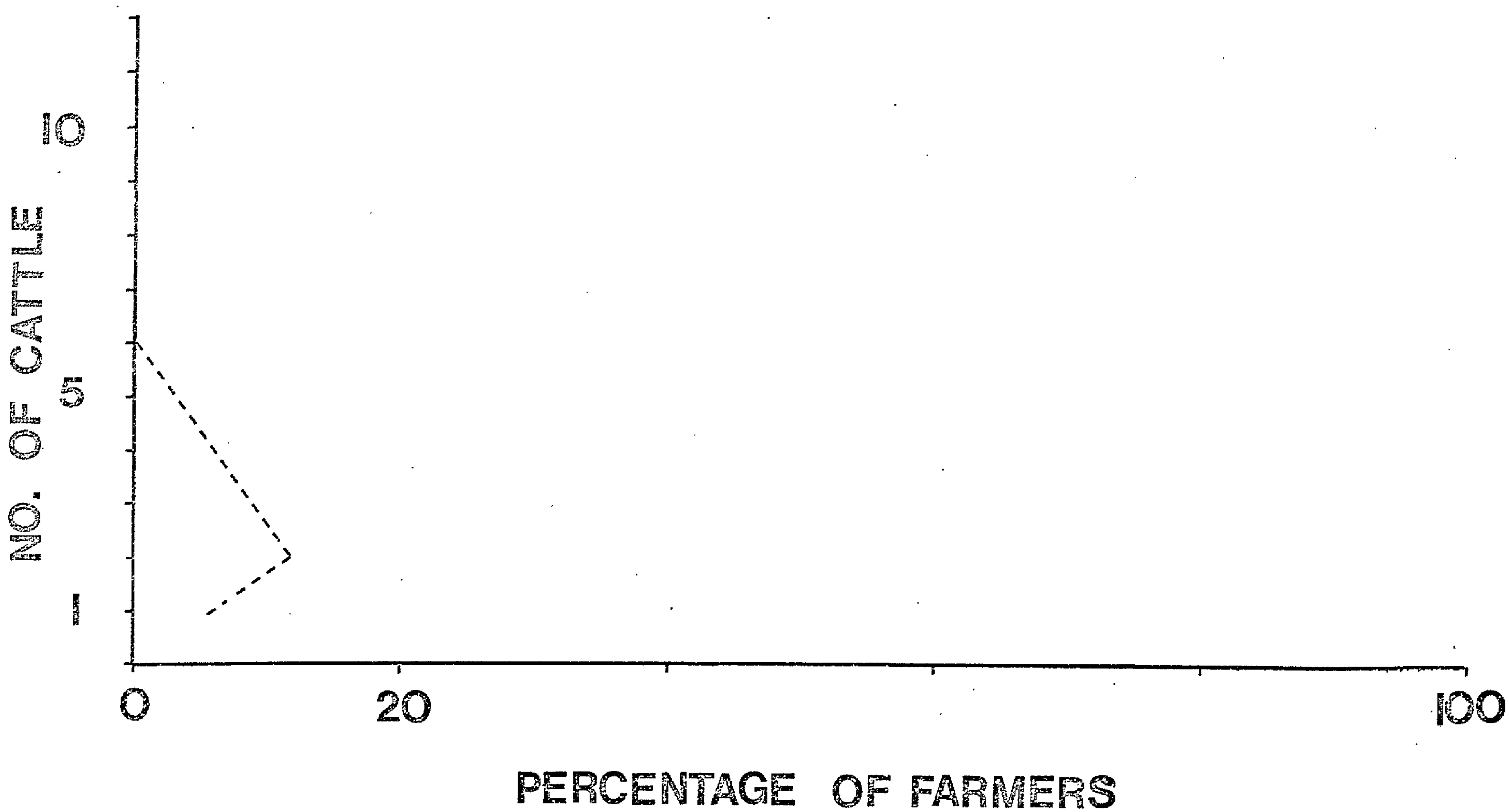
Pig-keeping is relatively undeveloped in the area. 202 farmers (85%) do not possess pigs. Of the 36 farmers who have pigs, 18 farmers have more than one beast, 9 more than two, and four more than three beasts. Fig. 6.1 to 6.3 illustrate the situation.

Within the Sample 198 farmers (83%) have chickens. Of these, 194 have more than one bird, 159 more than five birds, 134 more than 10 birds, 94 more than 15 birds, 66 more than 20 birds, 41 more than 30 birds, 17 more than 40 birds, 11 more than 50 birds and 2 more than 100 birds.

However, merely 51 farmers (21%) have ducks. Of these, 50 have more than one bird, 45 more than two birds, 37 more than three birds, 29 more than four birds, 24 more than five birds, 12 more than 11 birds, 9 more than 20 birds, four more than 100 birds and three more than 200 birds.

The Student's 't' test was carried out to examine the salient differences between farmers who raise and do not raise cattle. Most significantly statistically, it was found that cattle-raisers have a greater unplanted area than non-raisers of cattle. Raisers have 1.48 rai on average unplanted, non-raisers have 1.45 rai ('t' = 0.04, significant at the .20 level). This is to be expected, since the unplanted area, including forest and fallow, provides valuable grazing ground. However,

FIG.6.I CATTLE IN LAM PAO SAMPLE



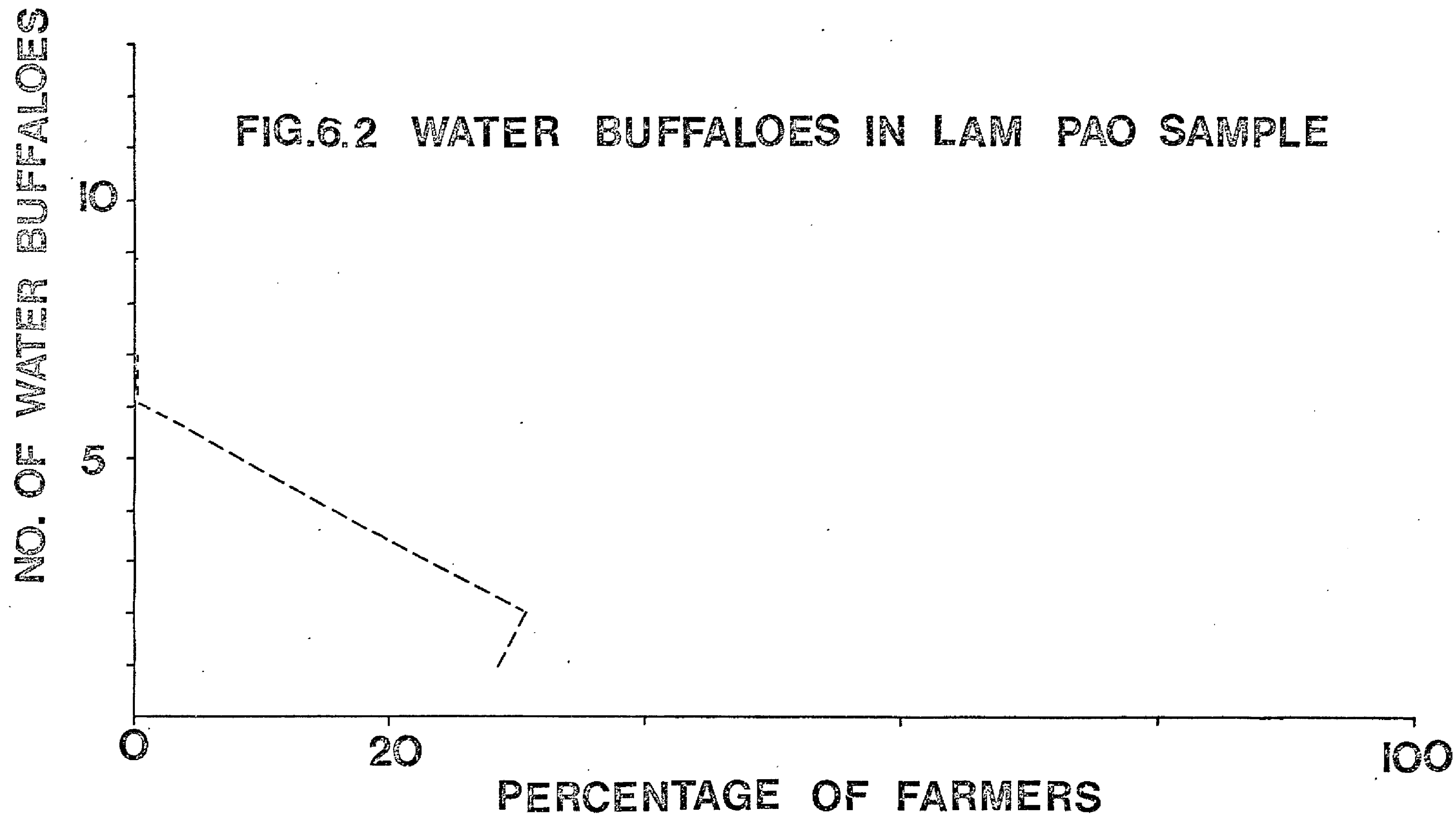
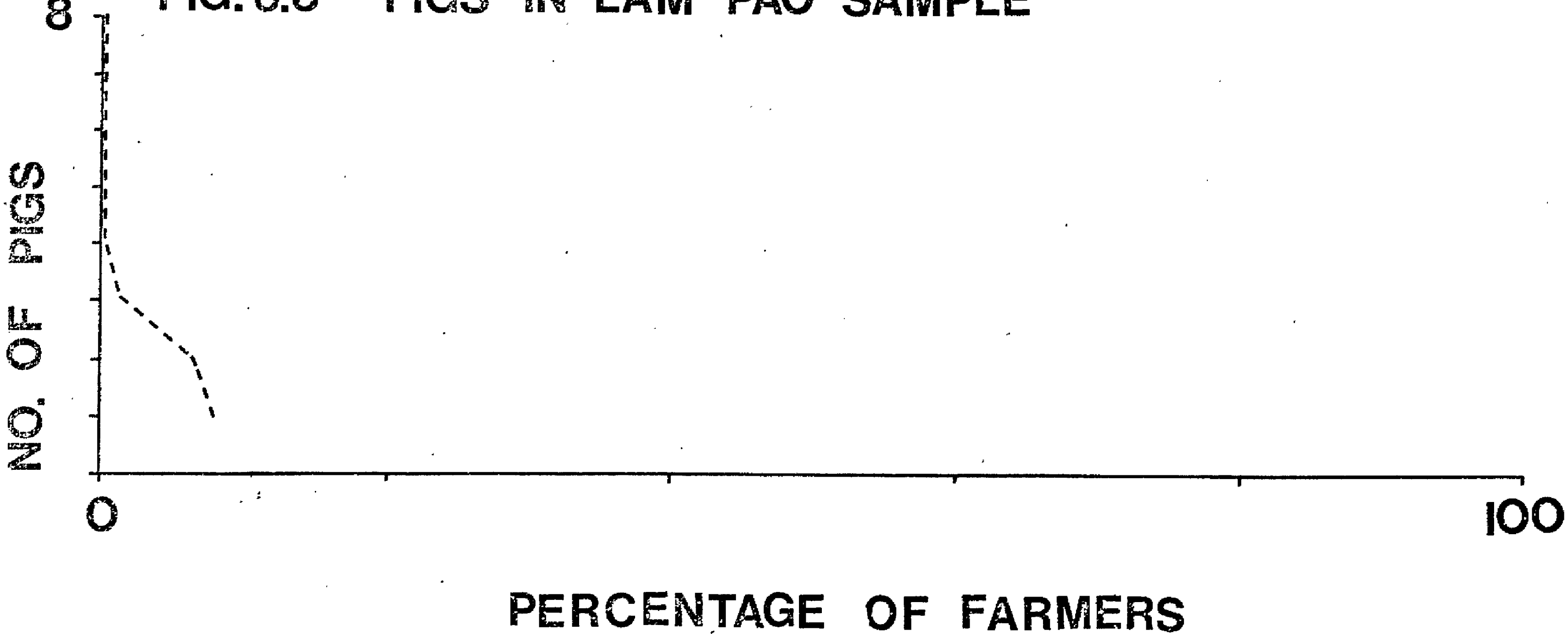


FIG.6.2 WATER BUFFALOES IN LAM PAO SAMPLE

FIG. 6.3 PIGS IN LAM PAO SAMPLE



Source: O'Reilly, dry season, 1971.

Plate 6.1 Cattle in Ban Tum

These cattle are freely grazing the natural vegetation on the verge of the RID highway in the Lam Pao Irrigation Area. They are Brahmin stock. Notice their lean build.

Source: O'Reilly, dry season, 1971.

Plate 6.2 Large scale duck raising in Ban Tum

This picture was taken towards the end of the dry season when a heavy downpour had partially flooded the paddies. Note the small frames of the ducks.

there is no significant correlation between the precise unplanted area per household and the number of cattle kept per household.

At a more significant level than the unplanted area, it was found that cattle-raisers sell a greater percentage of their glutinous rice than do non-raisers: they sell 9.78%, compared with 5.18% for non-raisers ('t' = 2.36, significant at the .02 level). This might suggest that at present cattle-raising and commercial rice cultivation are not commercial alternatives but complements: the farmer needs the surplus income generated by rice cultivation in order to purchase his beasts, whilst the steady income from glutinous rice acts as an insurance against failure in livestock enterprises, e.g. through disease or theft of animals.(1) This is confirmed by the fact that cattle-raisers have a significantly greater area under kenaf than those who do not raise cattle. Raisers have a mean area under kenaf of 3.54 rai, non-raisers have 2.52 rai ('t' = 1.97, significant at the .05 level).

Cattle-raisers on average have 0.41 pigs per holding, compared with 0.26 for non-raisers ('t' = 1.18, significant at the .1 level). Similarly, cattle-raisers have on average 2.3 water buffaloes per holding, compared with 1.8 for non-raisers ('t' = 2.64, significant at the .001 level).

However, non-raisers of cattle have on average more chickens and ducks than raisers. Raisers have 5.53 ducks on average, compared with 6.35 for non-raisers ('t' = 0.19, significant at the .2 level);

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(1) Farmers in the Lam Pao Sample expressed in conversation their concern over thefts of animals. Similarly, Thai newspapers frequently report cases of cattle and water buffalo rustling in north-east Thailand. It would appear that much of this organized theft has a political motivation. Social sanctions alone are sufficient to prevent the individual farmer from stealing from his neighbours in the same or nearby villages.

similarly, raisers of cattle have 15.14 chickens, compared with 16.45 for non-raisers ('t' = 0.56, significant at the .2 level).

The Student's 't' test was not carried out to determine differences between those who do and do not raise water buffaloes and chickens, since in both cases the non-raisers are too few. Nor was the test carried out on pig and duck raisers, since in both cases the raisers are too few.

These findings were further tested by applying the Student's 't' test to sellers and non-sellers of glutinous rice in the Lam Pao Sample. Those who sell glutinous rice have a significantly larger head of cattle than non-sellers: they have 1.45 head, compared with 1.01 head for non-sellers ('t' = 1.53, significant at the .2 level). However, non-sellers have a significantly greater number of water buffaloes, pigs, ducks and chickens than sellers. Thus sellers have 1.79 water buffaloes, compared with 2.02 for non-sellers ('t' = 0.95), 0.29 pigs, compared with 0.32 for non-sellers ('t' = 0.2), 1.83 ducks, compared with 7.41 for non-sellers ('t' = 1.16), 14.10 chickens, compared with 16.57 for non-sellers ('t' = 0.9). All these values of 't' are significant at the .2 level.

The 't' test was also carried out to determine differences between cultivators and non-cultivators of kenaf with respect to livestock variables. It was confirmed that kenaf growers have a greater number of cattle and ducks than non-growers. Thus kenaf growers have on average 1.15 head of cattle, compared with 1.06 for non-growers ('t' = 0.34, significant at the .2 level); growers have 7.35 ducks, compared with 4.16 for non-growers ('t' = 0.75, significant at the .2 level). In addition, kenaf growers have a greater number of water buffaloes than non-growers, 2.09 head as against 1.77 head ('t' = 1.55, significant at the .2 level), and a greater number of chickens, 18.26 birds as against 12.65 ('t' = 2.47, significant at the .01 level). On the other hand, non-growers of kenaf have a greater number of pigs on average than growers, 0.33 compared with 0.31 beasts ('t' = 0.19, significant at the .2 level). No correlation could be found between the exact area under kenaf and the number of any type of animal kept.

Thus it appears that the cattle-raiser is likely to be a commercial glutinous rice and kenaf cultivator. At any rate, he has adequate grazing land, either in the form of extensive paddy areas (on which the cattle can graze the stubble) and the bunds between paddies, or large areas of kenaf, on which cattle can graze the voluntary vegetation after harvest or areas of fallow (which provide natural pasture for cattle) or areas of woodland in which the cattle may browse. Possibly, also he is a man who has already had experience in the widespread activity of keeping water buffaloes.

Statements about the other animals must be more tentative. It can be safely said only that pig-keeping and cattle-raising are related activities. Concentration on chicken-raising appears to be associated with the neglect of cattle-raising. Chicken-raising is associated with kenaf cultivation rather than with commercial glutinous rice cultivation, simply because the commercial rice cultivator is more likely to divert his funds into cattle-raising. Duck-raising is also an alternative to cattle-raising and also, to a greater degree than is the case with chickens, duck-raising is positively associated with kenaf cultivation and negatively associated with commercial glutinous rice cultivation. Not only is chicken-raising a more well-established activity than duck-raising but farmers usually engage in both activities concurrently. Only 6% of the duck-raisers have no chickens, whilst 63% have more chickens than ducks and 35% have more than five times as many chickens as ducks. Of the 25% of duck-raisers who have more ducks than chickens, 6% of these have more than ten times as many ducks as chickens. This latter group includes farmers with over 200 ducks. Thus it would seem that chicken-raising precedes duck-raising as an activity in the area. When the innovation of duck-raising is adopted, it is first carried on as a sideline to chicken-raising, but, should the farmer wish to engage in large-scale duck-raising, then the decline of chicken-raising is absolute as well as relative.

III. Problems of Livestock Production in Thailand

In general livestock production in Thailand faces severe problems. As well as the problem of disease, already mentioned, there are the problems of small scale production operations, poor breeding practices[1] and lack of quality control and the fact that there is no price differential for different cuts and quality. The law prohibiting the moving of slaughtered beef and pork across province lines results in long cattle drives, causing weight loss and the risk of death and disease, as well as a reduction in the cattle buyers' price to the producer. In addition there is a lack of control over slaughtering and a "shadow taxing" by police on the highways, special fees charged by slaughterhouse inspectors to accept animals and alleged dishonest scales.[2]

Moreover, there is a lack of improved pasture for cattle. Fodder at the moment is mainly from natural pasture, including local grasses along ponds, on uplands, on voluntary vegetation after the cultivation of row crops and on bunds separating individual paddies,[3]

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(1) Thai cattle at least have deteriorated over the years, since in order to get as much as possible from exporters, herdsmen invariably castrated their best bulls whilst still young (to make them heavier) and sold them first.

(2) The North-east Economic Development Planning Advisory Group alleges that "shadow-taxing" results in an average charge of 250 Baht per truck between Nakhon Ratchasima and Bangkok, that slaughterhouse inspectors charge 200 to 300 Baht per truck and that the alleged dishonest scales average 15% to 20% off.
Source: Planning Report North-east Thailand, North-east Economic Development Planning Advisory Group Stage 3, Planning Report North-east Thailand, Sector Growth Rates and Targets, 1971.

(3) In the rainy season of 1970 H.M. Shelton of Queensland University carried out an experimental programme at Khon Kaen University on aspects of undersowing upland rice crops with perennial "stylo" (*Stylosanthus guyanensis*), a perennial pasture legume, as a possible technique for establishing the legume component of a pasture. His results indicated that rice yield was negatively related to stylo plant density.
Source: Pasture Improvement in Upland Rice Areas, New Zealand Colombo Plan Agricultural Notes, undated.

whilst some of the region's best grazing land is found in woodlots where tree growth is sparse enough to permit an abundance of sunlight and where the land has not been broken by the plough. Such land, however, offers low feed value during the greater part of the year. Little research has been carried out on the effective carrying capacity of upland crops and woodland, although the Pasture and Range Development Project was initiated to improve grazing land and encourage the introduction of temporary meadows into the crop rotation system.

At the same time there is a lack of feeding concentrates and several livestock stations in north-east Thailand are inactive. In addition, there are excessive slaughterhouse margins and lack of security in some areas to protect herds. Finally, a prevalent superstition about beef eating has hardly provided a stimulus to production.(1)

(1) Dire illness in old age is attributed to over-consumption of beef in younger days.

IV. The Potential of the North-east as a Livestock Producing Region

The North-east Economic Development Planning Advisory Group suggests that the Livestock Department must place increased emphasis upon pasture development.(1) It may be necessary to develop a disease-free corridor from the north-east through Sattahip with processing facilities in the north-east. There should be elimination of unofficial taxes and fees, which the Advisory Group thinks would enable both raising of the price paid to the producer and cut the price paid by the consumer. They also claim that the regulations prohibiting the movement of processed meat across provincial lines should be dropped. In addition, private capital should be encouraged to establish large-scale operations

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(1) Comparisons have been made between the environments of north-east Thailand and the *sertão* of north-east Brazil and in fact a group of Thai officials have visited Brazil on a tour of inspection. In north-east Brazil in the late 19th century a variety of palma, a spineless cactus (*Optuntia ficus indica* Mill. and *Nopalea cochennillefera* S.D.) were introduced and provided a basis for livestock development. However, the livestock industry of north-east Brazil is based upon large open-range ranches, many of which are held in common by a group of people, based on a sparse population, living almost entirely on meat and having only occasional contacts with the few scattered agricultural regions of the *sertão* or the agricultural coastal belt.
Sources: Furtado, C., *Diagnosis of the Brazilian Crisis*, Univ. of California Press, 1965.
Julião, F., *Cambão - the Yoke*, Pelican Books, 1972.
However, it seems to the writer that socially and economically the north-east of Thailand cannot be compared with the north-east of Brazil. It is impossible to envisage the replacement of the present settled agricultural economy of the north-east by open range grazing of cattle without enormous social, economic and demographic changes. Nor is this desirable. Moreover, although the spineless cactus provides a nutritious "natural" vegetation, livestock of higher quality could probably be raised on smaller landholdings in conjunction with field crops and/or paddy cultivation and based upon improved pastures, supplemented by mixed feed concentrates produced from such north-eastern crops as cassava and sorghum.

such as Chokchai ranch.(1)

The Board of Investment has, accordingly, stipulated among many other requirements that for future livestock ventures seeking promotion the main line must be beef cattle, the breeding, raising and importation of stock must comply with Ministry of Agriculture requirements, the project must start with not less than 30 pure-bred bulls and 100 cows and those receiving promotional privileges must make the services of their bulls available to other farmers in the neighbourhood. For water buffaloes all the rules are the same except that the farm must be 3,000 rai and the opening stock at least 200 cows and 10 males of an age and height specified by the Ministry of Agriculture.

In all instances attempts are being made to improve breeds or animals and poultry. The Livestock Improvement Programme, launched in 1954, introduced several hundred head of breeding stock, including Santa Gertrudis, American Brahmin, Pakistan Red Beef and Brown Swiss dairy cattle imported and kept at about fifteen livestock stations throughout

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(1) The Chokchai Ranch Co. Ltd. was set up in 1968 in the Pak Chong area of Nakhon Ratchasima by Khun Chokchai Bulakul with a registered capital of 2 million Baht, 99% of which was subscribed by Thai and 1% by Taiwan. A prize Santa Gertrudis bull was imported from the U.S.A. at a cost of 1 million Baht, together with 372 Santa Gertrudis and 35 Brahmin calves, each prized at 30,000 Baht. Pstures were sown mainly with Mauritius grass and Guinea grass, both of which do well in Thailand, whilst Napier grass was sown for silage. (Napier grass, yielding 6 tons per rai per year, yields more than any other grass grown in Thailand). Maize stems, leaves and sorghum stalks are also used as silage material. The operations on the ranch fit in with the surrounding agricultural cycles: the majority of the calves are weaned between August and November, when the maize is harvested and the price lowest. Breeding continues from April to July, so that the calves are born between February and May the next year - just before the rainy season and the onset of grass growth. Source: "A Ranch in Korat", Investor, Jan. 1971.

the country and cross-bred with native animals.(1) The three established breeds of pig, the Red from the north-east, the Kwai from the north and the Hainan from the Central Plain, are being supplemented by imported Hampshires, Berkshires, Landrace, Duroc-Jersey and Large White, although it appears that indiscriminate cross-breeding is diluting the characteristics of the indigenous breeds. The small native chicken (averaging 0.8 kg. in weight) is a low producer of meat and eggs. Since World War II various breeds have been introduced such as the White Leghorn, Rhode Island Red, Barred Plymouth Rock, New Hampshire and Australop. Some have been distributed to rural areas under various government programmes for cross-breeding with local ducks.(2) Ducks are mainly of the Khaki Campbell breed, although there are a lesser number

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(1) Two such specialized livestock stations are the Thai-Danish dairy farm at Muak Lek, changwat Saraburi and the Thai-German dairy farm at Chiang Mai. However, at present the cost of processing from local milk is higher than that from imported powdered milk. Source: Seminar on "Industrial Plant" held by the Agricultural Services Associations, Thai Industry Association and ASRCT in 1970.

(2) There is evidence that large scale commercial enterprises may effectively price the smaller producer out of the poultry business. These enterprises, mostly in the Central Plain, may have flocks of several thousand chickens, one enterprise near Bangkok having over one million birds. These birds are often bred under "battery" conditions. Private American capital is invested in poultry raising and processing in Thailand.
Source: The Agricultural Economy of Thailand, U.S. Dept. of Agricultural Economic Research Service 1972.
For example, Arbor Acres (Thailand) Ltd., a branch of the worldwide American company, supply chicks to poultry farmers in Thailand (as well as other countries in south-east Asia). The company purchases eggs and broiler chickens back from the farmers at a guaranteed price. The broilers are sold in a pre-packed form on the Thai and Far Eastern market, the eggs are exported, especially to Hong Kong. However, Arbor Acres have had to reduce their activities in Thailand, following government pressure, arising out of popular xenophobia. They intend to expand their activities in Malaysia.
Source: Personal Communication from Khun Napaporn Lim, Advance Pharma Co. Ltd. (Bangkok), importers of poultry supplement.

of Peking Ducks. Little effort has, however, been expended in improving water buffalo breeds in Thailand or indeed in the world as a whole. Although water buffaloes produce meat acceptable to both Thai and European in high-class restaurants and hotels in Bangkok, the scope for improvement is limited. Cattle-rearing is obviously a more promising enterprise. In Thailand there are several strains of water buffalo, including chiefly the black Kwai Tui and the grey Kwai Kham, although a few belong to the Murrah (Indian) breed, which are good milk producers.(1) Fig. 6.4 and Fig. 6.5 illustrate the relative neglect of the north-east in these developments.

Concurrent with improvements in breeding is the development of artificial insemination of cattle and pigs. This is still relatively insignificant, however. In 1970 only 1,900 calves and 30,517 piglets were born as a result of this practice. Of these a mere 4.5% of the calves and 16.6% of the piglets were born in the north-east.(2) This practice could clearly have tremendous impact upon the livestock of the north-east.

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(1) Buranamans, P., A Survey of Buffalo in Thailand, Kasetsart Univ.,1963.

(2) "Statistics of Artificial Insemination of Cattle and Pigs", Livestock Report 1970 (in Thai).

FIG. 6.4 ANIMAL BREEDING STATIONS: NE & WHOLE KINGDOM

SOURCE: LIVESTOCK REPORT 1970

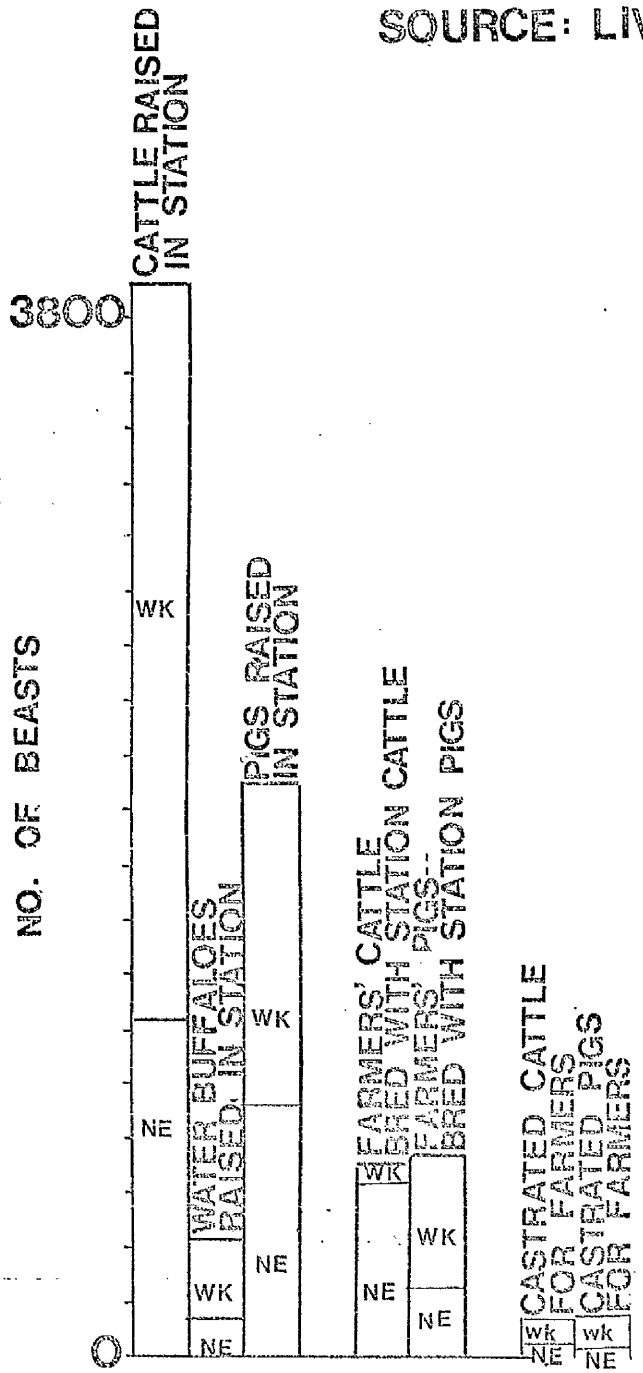
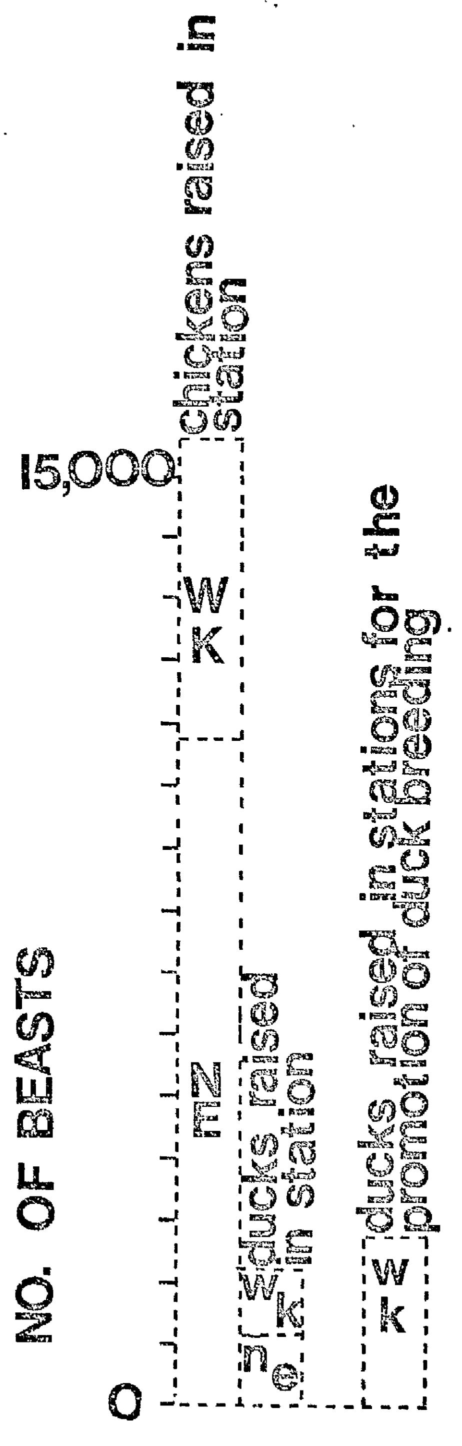


FIG. 6.5 EXPERIMENTAL POULTRY BREEDING: NE & WHOLE KINGDOM
Source: Livestock Report 1970



V. Conclusion

It is apparent that as yet unrealized potential exists in north-east Thailand for cattle-raising and with it associated poultry- and pig-raising. The problem is to develop this enterprise effectively without undue dislocation of the present rural economy. The large ranch has an important rôle in breeding and improving standards, but it is to be hoped that an increasing rôle in and benefit from livestock enterprises will be taken by the small farmer, whose stock should ideally be purchased from and constantly replenished by the ranch and livestock station.

Cattle on the farm can be combined with the existing paddy and field crop cultivation. In addition to natural forage, some upland fields could be sown with improved pasture, perhaps on a rotation system or with fodder crops. Likewise the stalks and residues from such crops as sorghum, maize, tapioca and rice could be fed to cattle(1) and pigs,(2) whilst, as Lee suggests, the nation should develop a compound feed industry, based upon tapioca, maize, rice bran, fish and other basic materials.(3) This would have the advantage of reducing Thailand's

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(1) At present cassava leaves are thrown away when the roots are harvested. However, a food-testing laboratory in the Philippines found that hydrated and ground cassava leaves are superior in carotene and protein content to alfalfa leaf meal. Source: Butler, E.T., *et al.*, *op.cit.*

(2) It is considered that tapioca is useful only for finisher pigs and reproductive sows, but of less value to piglets, where the protein for body building is more important than forming fat. Source: *Journal Min. of Commerce and Industry*, Malaysia, *op.cit.*

(3) Lee, S.Y., "Thailand's Tapioca", *Far Eastern Economic Review*, 41(4),1963. However, Johnson considers that in developing countries as a whole the feed industry is to a large extent owned and directed by multi-national corporations, which prefer to rely on known technology rather than invest in the development of new technologies, appropriate to the typical developing country situation. Johnson, H.G., "Multinational Corporation as a Development Agent", *Columbia J. Wld Busin.*, May/June, 1970.

dependence upon foreign markets for its field crops. It might reduce income from overseas to a certain extent, but this could be made up by the export of livestock products. At least it would provide greater security for the farmer of the north-east.

Of the other animals, pigs should be raised as a lesser supplement to cattle. It would seem, however, that, despite temporary success by individual farmers, the scope for large scale poultry and duck-raising in north-east Thailand is limited.

CHAPTER SEVEN

THE IMPACT OF TECHNICAL INNOVATIONS WITHIN THE LAM PAO SAMPLE

I. Fertilizer

i. The place of fertilizer in Thailand

The use of chemical fertilizer in Thailand was nil until World War II, whilst the use of animal manure and night soil has never been very significant.(1) In 1963 only 9% of farmers in the Kingdom applied any chemical fertilizer, whereas an additional 35% used only organic fertilizer.(2) In 1968 60% to 70% of all fertilizer was used on rice and most of the rest on sugar-cane, rubber, tobacco, fruits, vegetables and corn.(3) Consumption of fertilizer has increased rapidly, as Table 7.1 illustrates, but, nevertheless, Thailand remains one of the lowest users in the region, as Table 7.2 shows. The total requirements of nutrients (NPK) were estimated at 272,050 metric tons in 1969 against an actual estimated consumption of only 108,700 metric tons.(4) This is not

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(1) This lack of use of animal manure and night soil is probably related to the traditional presence of new land for pioneer settlement in Thailand and the absence of any chronic population pressure on agricultural resources. It thus contrasts sharply with the traditional intensive use of organic waste made by Chinese farmers, both in the Middle Kingdom and throughout south-east Asia, including Thailand.

(2) Bond, B.J., Kelso, M.T. and Woodward, O.R., A Report on the Thailand Fertilizer Situation and Potential, TVA, Muscle Shoals, Ala., U.S.A., Mimeo AID, 1966.

(3) FAO/UNDP Survey Mission for the Chao Phraya Delta, Thailand, Report to the UNDP, 1968.

(4) Quoted in an article in the Investor, May 1972, entitled "Thailand Not Growing Enough".

Table 7.1 Consumption of Commercial Fertilizers, Thailand, average 1951/'52-1965/'66, annual 1961/'62-1968/'69

Period or year (1)	Nitrogen (N)	Phosphate (P_2O_5) (2)	Potash (K_2O)
Average			
1951/'52-1955/'56	2.4	0.9	1.6
1956/'57-1960/'61	7.5	2.9	1.7
1961/'62-1965/'66	15.2	8.7	3.8
1961/'62	11.1	4.7	2.1
1962/'63	12.3	6.5	3.0
1963/'64	18.4	11.1	4.3
1964/'65	16.2	9.9	4.7
1965/'66	17.9	11.3	4.6
1966/'67	34.8	24.3	7.9
1967/'68 (3)	52.2	35.7	12.7
1968/'69 (3)	50.0	40.0	15.0

(1) Year beginning July 1st.

(2) Plant Nutrient Content.

(3) Preliminary.

Source: The Agricultural Economy of Thailand, U.S. Dept. of Agriculture, Economic Research Service, 1972.

Table 7.2 Chemical Fertilizer Used per Hectare of Cultivated Land in kg. 1965/'66

Country	N	P_2O_5	K_2O
Indonesia	3.4	2.6	0.3
Malaysia	9.1	1.3	4.8
Philippines	6.3	3.8	4.0
Thailand	1.6	0.9	0.4
Republic of Vietnam	0.0	18.9	3.8
Taiwan	162.9	41.9	51.0

Source: Far Eastern Economic Review Yearbook, 1969.

surprising, since fertilizer has long been considerably more expensive in Thailand than elsewhere in the region. Table 7.3 illustrates this strikingly for 1964. This table brings together figures derived from two independent writers, H.R. von Uexbuell and R.L. Sansom. Admittedly, von Uexbuell's figures are for 1964 and Sansom's for 1964/65, but, nevertheless, although their ranking of countries tallies, there are large discrepancies between some of the figures for consumption rates of nutrients. Such a discrepancy serves to underline the comparative roughness of such mean figures of nutrient consumption: even in advanced nations such figures would have to be treated with caution.

From his figures von Uexbuell came to the conclusion that "for every unit of rice spent on fertilizer in Thailand, the farmer can count on a return of 1.72 units of rice, compared with a ratio of 6 to 5 in Japan".(1)

Table 7.4 cannot be directly compared with Table 7.3, owing to the different mode of expression of the data. It nevertheless serves to indicate that in 1970 the cost of fertilizer in Thailand was still comparatively high even when compared with the "closed" and inward-looking nation of Burma.

Indeed, the only producer at present in Thailand is the Chemical Fertilizer Co. Ltd. (Chemferco) at Mae Mo in the north,(2)

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(1) Von Uexbuell, H.R., "Obstacles to using fertilizers for rice in south-east Asia", Wld Crops, March 1964, pp.70-75.

(2) This plant, owned 49.9% by the Thai government, came into production in 1966 and has a capacity of 60,000 tons of ammonium sulphate and 30,000 tons of urea annually and uses lignite as a raw material. The licensing of imports was introduced at the end of 1968, because the Mae Mo plant was not competitive with imported fertilizer. However, imports of ammonium sulphate and urea fertilizer require prior government approval and are virtually prohibited, whilst imports of certain other nitrogenous fertilizers, but not ammonium phosphates, also require prior government approval, which has not been given.
Source: Fertilizer: a Description of the Industrial Sector in Thailand, ASRCT, 1968.

Table 7.3 Fertilizer Costs and Consumption Rates in Selected Countries.

Country	von Uexbuell's Figures			Sansom's Figures	
	Relative Fertilizer Cost (1)	Recommended NPK kg./ha.	Actual NPK kg./ha.	1964/'65 Price Ratio kg.N_2/kg. paddy.	Consumption 1964/'65 kg.nutrient (N, P_2O_5, K_2O)
Japan	1	196	204	1.4	304.4
South Korea	2.46	206	117	2.3	167.5
Taiwan	3.75	170	144	4.4	237.0
Malaysia	5.37	88	23	n.d.p.	n.d.p.
Hong Kong	5.42	102	21	n.d.p.	n.d.p.
Philippines	8.45	155	11	4.3	8.1
Republic of Vietnam	8.85	60	13.2	1.16	181.8 (2)
Indonesia	9.50	90	5	n.d.p.	n.d.p.
Thailand	18.00	76	0.012	5.9	3.2
Sri Lanka	n.d.p.	n.d.p.	n.d.p.	2.1	35.5
India	n.d.p.	n.d.p.	n.d.p.	4.6	4.4
Pakistan	n.d.p.	n.d.p.	n.d.p.	1.6	3.7

n.d.p. = no data provided

Sources: H.R. von Uexbuell, "Obstacles to Using Fertilizer for Rice in south -east Asia", Wld Crops, March 1964, pp.70-75.
Sansom, Robert L., The Economics of Insurgency in the Mekong Delta of Vietnam, MIT Press, 1970.

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(1) Von Uexbuell derived the "Relative Fertilizer Cost" as follows:

$$\text{Relative Fertilizer Cost} = \frac{\text{Yield in Japan x Cost of 1 kg. of NPK in respective country in terms of rice}}{\text{Yield in respective country x cost of 1 kg. of NPK in Japan.}}$$

(2) Sansom's field work was carried out in the Republic of Vietnam. Accordingly, he gives two consumption figures for nutrients for that country, one from each of the two villages he studies (the one a traditional rice village in the Upper Mekong Delta, the other a "rice and vegetable" village in the same region) rather than an average for the Republic as a whole. The writer has averaged these two figures.

Table 7.4 Cost per 100 kg. of nutrients in U.S. dollars for 1970 in selected countries

Country	Ammonium sulphate	Urea
Bangladesh	17.1	13.8
Sri Lanka	21.2	15.8
Pakistan	21.7	21.9
South Korea	23.1	18.9
Japan	25.6	22.5
India	27.1	20.9
Burma	31.8	34.2
Thailand	33.8	29.2

Source: Dr. Wolf Donner and Banlu Puthigorn in "The Marketing of Fertilizer in Thailand", FAO 1972, quoted in "Thailand Not Growing Enough", Investor, May 1972.

although the Bangkok City Council has a plant which produced about 20,000 cubic metres of organic compost-like fertilizer from municipal rubbish in 1965, whilst some fertilizer-mixing is also carried out by the Yip-in-Tsoi Co. Ltd., which annually produces about 2,000 tons of nitrogen phosphate mixture for local consumption, whilst organic fertilizers such as oilcake, fishmeal, bonemeal, duck manure and barnyard manure are also produced and used. In addition, two United States concerns are reported to be interested in expanding into the fertilizer industry of Thailand.(1)

The Mae Mo plant is demonstrably uneconomical.(2) Accordingly, most of the chemical fertilizer used in Thailand at present is imported.(3) Table 7.5 illustrates how these imports of fertilizer have risen considerably from 1950 to 1969.

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(1) These are the Allied Chemical International Corporation (ACI) which was forming a joint venture with Chemferco on a 50-50 basis to build a 400 million Baht factory at Si Racha, changwat Chon Buri, to produce 120,000 tons of NP and NPK compound fertilizer per year, and the Thai Agricultural Chemical Industries (TACI) which also planned to build a factory at Si Racha to produce NPK compound fertilizer. Source: Fertilizer: A Description of the Industrial Sector in Thailand, op.cit.

(2) The cheapest and simplest method of producing pure hydrogen for the ammonia synthesis is by reforming natural gas by catalytic reaction with steam. Since natural gas occurs in enormous quantities in Indonesia, H.P.A. Groll, the Adviser for the Chemical Industry for ASRCT, thinks that production of all fertilizer for south-east Asia should be in Indonesia.
Quoted in Thailand Not Growing Enough, op.cit.
Such possibly sound economic advice would seem to ignore political realities.

(3) The main suppliers are Japan and the German Federal Republic, whilst the U.S.A. supplies 5% to 10% of imports, consisting primarily of ammonium phosphates.
Source: A Description of the Industrial Sector in Thailand, op.cit.

Table 7.5 Imports of Fertilizer into Thailand in selected years

Year	Imports (metric tons)
1950	9,400
1955	24,300
1957	
1958	
1959	
1960	52,200
1961	
1962	
1963	
1964	
1965	88,900
1966	141,400
1967	218,000
1968	265,500
1969	265,300

Sources: For 1950-'64, Bond, B. *et al.*, *op.cit.*
For other years "Annual Statement of Foreign Trade". Quoted in Ingram, James C., *Economic Change in Thailand, 1850-1970*, Stanford, 1971.

Fertilizer is clearly relatively unimportant in Thailand at present and markedly expensive. The question then arises as to its relative beneficiality. The results of research are often conflicting. Sansom found a very high response to low-usage levels of fertilizer application in his study villages in the upper Mekong Delta of the Republic of Vietnam.(1) Work carried out in Thailand by Montrakum and Suwanawong demonstrated that N and P are the most important fertilizer elements for increasing rice yields.(2) Table 7.6 presents some typical results that they obtained from large pilot demonstrations in three regions of Thailand in 1968.

Obviously, rice does respond to fertilizer inputs. Mahapatra, however, considers that nitrogen is the crucial constituent in determining rice yields and that response to phosphate is not as great and response to potassium low.(3) He further considers that the soil organic matter is dominant in determining the higher yields of rice and the response of rice to chemical fertilizer: thus, soils low in organic content would be

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(1) Sansom's responses ranged from 3 to 4 kg. of paddy per kg. of fertilizer to 10 kg. of paddy per kg. of fertilizer. At higher use levels he found that the returns to additional kilograms of fertilizer began to decline, but even at the 150 kg. level an additional kilogram of fertilizer yielded 4.4 kg. of paddy. It would appear that a 6.1 response is a realistic statement, according to Sansom, of the prevailing relationship for usage levels below 150 kg., whilst above this level a 6.1 response is seldom obtained. Source: Sansom, R.L., The Economics of Insurgency in the Mekong Delta of Vietnam, MIT Press, Cambridge, Mass., 1970.

(2) Montrakum, S. and Suwanawong, S., "Integrated Techniques of Rice Cultivation in Thailand", in Some Aspects of Rice Production in the ASPAC countries of south-east Asia, Extension Bulletin No.5, Part 1, Food and Fertilizer Technology Centre, Taipei City, Taiwan, June 1971.

(3) Mahapatra, I.C., "Fertilizer Needs of Rice", Ind. Fmg., Vol.XVIII, No.12, March 1969.
He states that the Central Rice Research Institute at Cuttack demonstrated the efficiency of such deep placement of nitrogenous fertilizer under puddled conditions by use of a simple bullock-drawn fertilizer drill.

Table 7.6 Experimental Data to Illustrate Benefits of Fertilizer Application for Rice in Thailand

	Northern Region (1)	North-eastern Region (1)	Central Plain
Highest yield for average fertilizer input kg./ha.	5,337.50	3,581.25	4,118.75
Average yield of fertilized plots kg./ha.	3,956.25	1,918.75	2,962.25
Average yield of unfertilized plots kg./ha.	2,931.25	1,243.75	1,612.50
Average increase kg./ha.	1,025	675	1,349.75
% increase in yield as a result of fertilizer application	39	57	88

(Source: Montrakum and Suwanawong, op.cit.)

(1) Whether the demonstration plots in northern and north-eastern regions consist of glutinous and/or non-glutinous rice is not specified.

expected to react less favourably to chemical fertilizer application. He concluded that it is uneconomical to use fertilizer without thoroughly evaluating the soil fertility beforehand and considers that desirable results can only be obtained from very careful fertilizer application (such as few farmers in the developing countries have the expertise to practise at present). Thus high-yielding varieties of rice will give a negative response beyond a critical level of phosphate application and, similarly, according to experiments throughout the world, optimum results can be obtained by applying ammonium fertilizers in the reduced instead of the surface zone of the paddy soil, producing increases in yields of from 10% to 15%.

Von Uexbuell makes several cogent points on this subject.(1) The lack of proper irrigation he considers to be instrumental in many regions of south-east Asia in preventing optimum paddy response to fertilizers, whilst he further claims that fertilizer trials in Thailand have shown that only with a proper adjustment of quantity and ration of NPK would application be profitable, and that experiments in Japan have revealed that, depending upon the time and method of application of fertilizer, the response of rice to the same amount of nitrogen could range between 13% and 49.8%. He also considers that the response depends upon the age of the seedlings: if the seedlings are too old, fertilizer application might be harmful. Moreover, von Uexbuell points out that most of the common traditional varieties of rice cultivated in south-east Asia have been selected over several hundred years for their ability to produce a modest crop under low soil fertility conditions and with a minimum of care. Therefore, when fertilizer is applied, such varieties

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(1) von Uexbuell, op.cit.

respond with an over-abundance of foliage and a comparatively low increase in grain yield. New varieties of rice do not, however, solve this problem: Thai farmers have found that increased fertilizer application on IR8 encourages the growth of weeds, whilst the so-called "miracle rice" requires so much fertilizer that predictions were being made of a world "fertilizer famine".(1)

Because of the predominant position of rice as a food crop, far more research has been carried out on its response to fertilizer application than on the response of individual field crops. Thus it is difficult to come to any conclusion on the subject of field crop response to fertilizer application in Thailand. It is certain that under favourable conditions all field crops and vegetables at present grown in the country will respond to fertilizer application. This is particularly important in the case of cassava, which tends to exhaust the soil very quickly, but experiments on control plots of cassava in the Serdang Experimental Station, West Malaysia, demonstrated that cattle manure gave better results than either a complete mixture of chemical manure or green manure supplemented with basic slag.(2)

From the plethora of results, some contradictory, on fertilizer application in rice cultivation in developing countries, it can be stated without reservation that the benefits of fertilizer application are so far neither ubiquitous nor automatic: the nature of the soil, the exact composition of the chemical fertilizer and the time and amount of application, traditional agricultural practices and the development of adequate irrigation - all are constraining factors. Doubtless many

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(1) Far Eastern Economic Review Year Book, 1969.

(2) Lambourne, J., "Experiments on the economic maintenance of soil fertility under conditions of continuous cropping with tapioca", Malay. Agric. J., 25 (4), pp.134-145, 1937.

farmers have built up a psychological mistrust of fertilizer after disappointing or even harmful results through application without awareness of these constraining factors. In the case of Thailand the high cost of fertilizer and the general absence of a tradition of intensive farming are additional constraints. Thus it is hardly surprising that fertilizer has so far made little ground in Thailand.

One would expect its impact on north-eastern Thailand to be even more markedly slight. This is borne out by the 1963 Census of Agriculture figures. Table 7.7 illustrates the small impact of chemical fertilizer in north-east Thailand, whilst Table 7.8 indicates that changwat Kalasin is marginally above the mean for the north-east in the utilization of chemical fertilizers.

ii. Fertilizer in the Lam Pao Sample

Within the Lam Pao Sample 140 farmers use fertilizer on glutinous rice (58% of total farmers); a mere four farmers use fertilizer on kenaf (2.8% of total kenaf growers). In three of the cases of fertilizer application on kenaf plots the application is high, viz. 16-20 kg./rai, but in the other case only 0.40 kg./rai. Five farmers use fertilizer on vegetables (83.3% of total vegetable growers), four of whom use moderate amounts, viz. 2-4 kg./rai, whilst the fifth uses 23.0 kg./rai.

Fig. 7.1 shows the relationship between knowledge and use of chemical fertilizer. Knowledge of the innovation is widespread, only 5% of the total farmers never having heard of chemical

Table 7.7 Utilization of Fertilizer in north-east Thailand, 1963

All tenures	% of total using chemical fertilizer	% of total using other fertilizer
All holdings	0.4	60.0
2 - 5.9 rai	0.5	47.7
6 - 14.9 rai	0.4	58.2
15 - 29.9 rai	0.4	62.9
30 - 44.9 rai	0.4	64.3
45 - 59.9 rai	0.5	63.5
60 - 139.9 rai	0.5	65.0
over 140 rai	1.8	54.3

Total holdings equals 1,177,241 holdings.

(Source: 1963 Census of Agriculture)

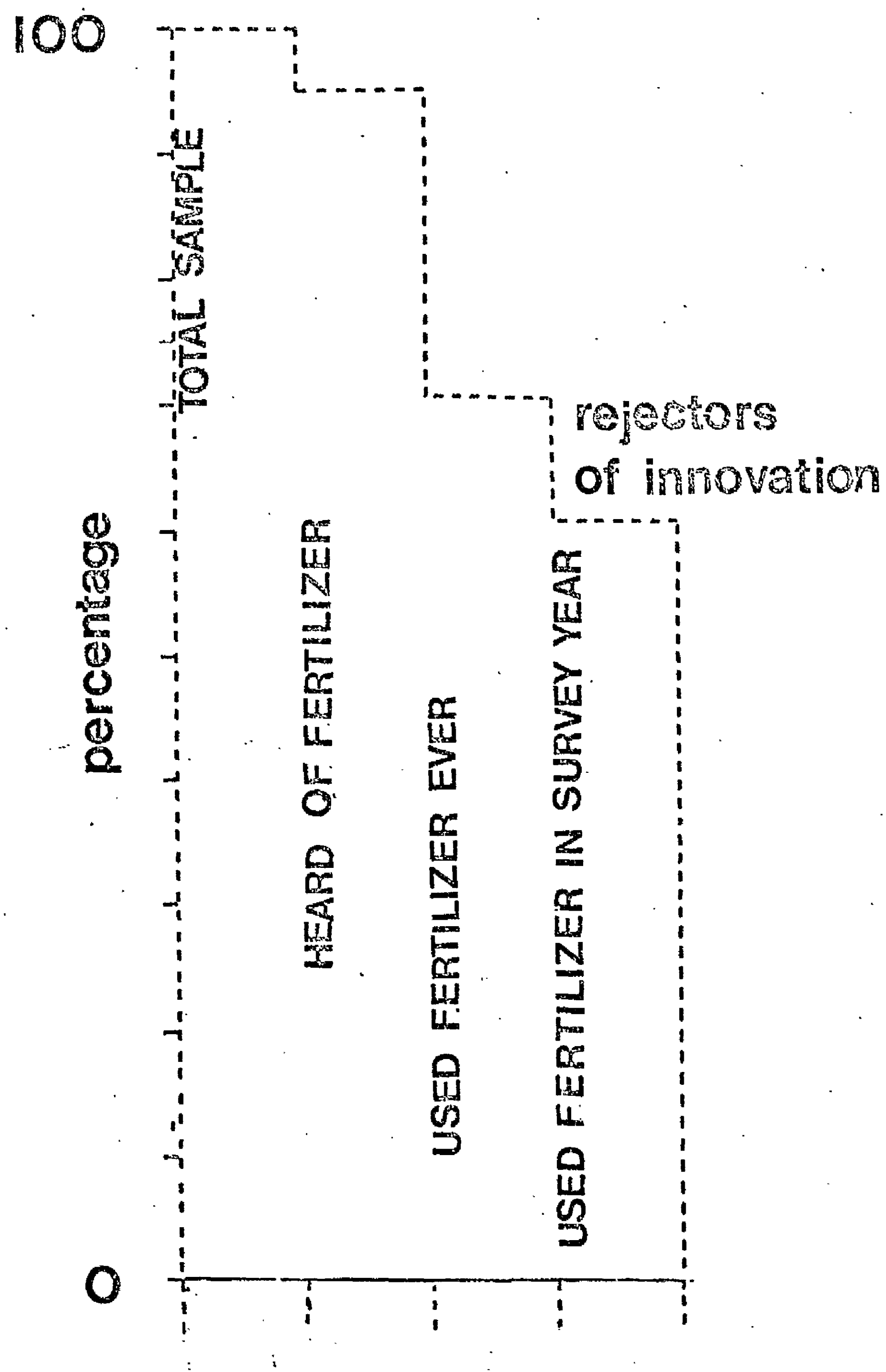
Table 7.8 Utilization of Fertilizer in changwat Kalasin, 1963

All tenures	% of total using chemical fertilizer	% of total using other fertilizer
All holdings sizes	0.6	48.9
2 - 5.9 rai	0.5	40.1
6 - 14.9 rai	0.6	46.5
15 - 29.9 rai	0.5	51.0
30 - 44.9 rai	0.6	53.4
45 - 59.9 rai	0.7	53.3
60 - 139.9 rai	0.7	56.9
140 and over rai	1.0	54.1

Total holdings equals 58,363 holdings.

(Source: 1963 Census of Agriculture).

FIG. 7.1 KNOWLEDGE & USE OF FERTILIZER IN LAM PAO SAMPLE



fertilizer.[1] Of those who have knowledge of the innovation, 74% have used fertilizer in the past and 64% have used it in the year of study. Thus, of those who have used chemical fertilizer in the past, 86% of them used it also in the year of study. This implies a rejection rate of 14%.[2]

Initially, it is necessary to examine whether yields of glutinous rice are in fact affected by fertilizer inputs within the Lam Pao Sample. The Coefficient of Correlation between fertilizer input and yield of glutinous rice is 0.45, significant at 0.1%. The mean fertilizer input is 11.11 kg./rai (standard deviation 8.77); the mean yield of glutinous rice is 303.45 kg./rai (standard deviation 121.36).

It was next decided to determine whether this relationship differs for high and low yields and high and low fertilizer applications. Accordingly, the yields of glutinous rice were divided into three discrete categories, viz. high, medium and low yields. The low yield

(1) The question asked of the farmers in Thai is exactly translatable into English as "Have you ever heard of chemical fertilizer?" The grammatical structure of the Thai language makes it necessary that this question be either answered with a word signifying "never" or "ever". This was in fact the way the question was answered in the field. Thus there can be no question of the farmers' answers having been misinterpreted. However, it is possible that the farmers misconstrued the question. Thus, answers could either imply that they had never heard of the words "chemical fertilizer" and did not know what they mean, or that they had never heard of chemical fertilizer being applied in their area. The writer would take the latter interpretation as more likely, even though it suggests, on the one hand, a lack of observation on the farmers' part of the merchandise which is available in Kalasin town, and, on the other hand, a marked lack of communication between the large proportion of villagers who have used the innovation and their neighbours who have never heard of it.

(2) Time did not permit a more detailed study of the reasons for rejection of this and other innovations. The writer feels that the study of the rejection of innovations and the diffusion of such rejections should be pursued as more than an after-thought to the study of innovation and diffusion as a whole. It by no means follows that it is merely the reverse of adoption and that the "laws" formulated for the adoption and diffusion of innovations will apply to rejection and diffusion.

category consisted of 65 cases with a maximum value of 275 kg./rai; the medium yield category consisted of 41 cases with a maximum yield of 384.6 kg./rai; the high yield category consisted of 30 cases with a maximum value of 666.7 kg./rai.

Similarly, the whole range of fertilizer inputs was subdivided into three discrete categories, viz. low fertilizer inputs, medium fertilizer inputs and high fertilizer inputs. The low fertilizer input category consisted of 77 cases with a maximum input of 9.6 kg./rai; the medium fertilizer input category consisted of 41 cases with a maximum value of 18.8 kg./rai; the high fertilizer input category consisted of 18 cases with a maximum input value of 50 kg./rai.

For each of these six discrete categories, fertilizer inputs per rai was correlated with yield of glutinous rice per rai. Tables 7.9 and 7.10 show the results.

Thus it can be seen that for none of the discrete categories is a higher correlation obtained than for the sample as a whole. Only in the case of the low fertilizer application category does the Coefficient of Correlation approach that for the whole sample. Thus, at low levels of fertilizer input returns in the form of increased yields appear to be more marked than at higher levels of fertilizer application. Similarly, the returns from medium fertilizer inputs are substantially relatively greater than for high fertilizer inputs. Thus fertilizer input appears to produce diminishing returns. At present this does not pose a serious problem in the Lam Pao Sample, since applications of fertilizer are generally low. The results obtained are, however, suggestive rather than conclusive.

In the case of the yield categories, a correlation, not very significant, is only obtained for the medium yield categories. The

Table 7.9 Correlation of Fertilizer Inputs (kg./rai) on glutinous rice with yields of glutinous rice (kg./rai) for Lam Pao Sample according to Yield Categories

	Low yields	Medium yields	High yields	All
N	65	41	30	136
Mean yield	206.79	323.44	485.56	303.45
Mean fertilizer input	9.04	11.98	16.84	11.11
Coefficient of correlation	0.06	0.25	0.17	0.45
Level of significance	ns	10%	ns	0.1%

Table 7.10 Correlation of Fertilizer Inputs (kg./rai) on glutinous rice with yield of glutinous rice (kg./rai) for the Lam Pao Sample according to Fertilizer Input Categories

	Low fertilizer inputs	Medium fertilizer inputs	High fertilizer inputs	All
N	77	41	18	136
Mean yield	258.64	346.39	397.35	303.45
Mean fertilizer input	5.67	13.47	29.04	11.11
Coefficient of correlation	0.26	0.21	0.20	0.45
Level of significance	0.2%	10%	25%	0.1%

correlations for the low yield and high yield categories are not significant. It is not possible to come to any conclusion from these results.

The Student's 't' test was carried out on a number of variables to determine whether there is any significant difference between users of fertilizer and non-users. It was found that there was no significant difference in the size of the cultivated holding between the two groups. Similarly, fertilizer users did not have a significantly greater area under commercial field crops than non-users. The only land-use variable that was rather significant related to glutinous rice cultivation. Fertilizer users sold on average 7.9% of their glutinous rice, compared with 5.5% for non-users of fertilizer. This gives a value of 1.24 for 't', significant at the .20 level. This might suggest a two-way causality: since it has been demonstrated in the Sample that glutinous rice responds quite markedly to chemical fertilizer inputs, farmers who use chemical fertilizer would, *ceteris paribus*, have a larger glutinous rice surplus for sale; alternatively, farmers who produced a large rice surplus anyway for reasons unrelated to fertilizer input would have more income from the sale of this rice to invest in fertilizer. Probably, both of these factors play a part.

It became clear from the analysis, however, that income plays a large part in determining whether the individual farmer uses fertilizer or not. Thus the total income of fertilizer users is 6718.6 Baht, compared with 5282.3 Baht for non-users. This gives a value of 1.94 for 't', significant at the .05 level. Of the various sources of income the income from crops seems most important, although not as significant as total income. Thus fertilizer users acquired on average 3053.4 Baht from their crops, compared with 2647.5 Baht for non-users. ('t' = 1.63, significant at the .10 level). There is no significant difference between fertilizer users and non-users with respect to income from remittances. This is not to deny that for an individual farmer his income from remittances may be a valuable source of income, which may largely determine his innovativeness: conversations with individual farmers bear this out. However, in the Sample as a whole, the number of farmers who receive remittances is not sufficiently large to make this variable significant.

However, one monetary variable emerges as even more significant than income from crops, viz. the amount of money that a farmer borrows. Users of fertilizer have borrowed on average 605.5 Baht, compared with 223.5 Baht for non-users. ('t' = 2.70, significant at the .01 level). This money may have been borrowed from relatives, neighbours, the Bank for Agriculture and Agricultural Co-operatives or from a co-operative of farmers' association.

Within the Lam Pao Sample non-institutional borrowing is far more important than institutional borrowing. Sixty farmers (25%) borrowed money from the former source. The mean amount borrowed was 780 Baht. Of these, six farmers borrowed to buy animals, eight to buy fertilizer or use as working capital, one to buy land and one to improve his land. One more borrowed for trade. However, by far the bulk of the cases of non-institutional borrowing were for non-agricultural uses. Whilst only three farmers borrowed for house construction or house maintenance, forty-three farmers borrowed for expenditure within the household, of which one borrowed in order to pay his children's school fees, four borrowed to buy medicine and fully seven borrowed in order to buy food. This serves to underline the semi-subsistent nature of the Lam Pao economy and the fact that borrowing for some farmers at certain times appears not to be an innovative enterprise but a grave necessity. In addition, other miscellaneous reasons for borrowing included payment of farm tax and purchase of fish traps. Twenty farmers borrowed from institutional sources, their average loan being 2742 Baht. Unfortunately, information was not obtained on the purpose of this borrowing.

Even though the term "land improvement" might include the purchase of fertilizer and many institutional loans might have been used for purchase of fertilizer, the breakdown of the statistics according to purpose of borrowing does not support the high correlation between fertilizer use and borrowing, already derived. There is no satisfactory explanation for this anomaly, but a number of factors may be partially responsible. It is possible, for instance, that borrowing individual sums may have been for a variety of reasons of which only the major one was stated. Secondly, from conversations with farmers it would appear that in some cases at least subsistence borrowing was made necessary by developmental expenditure. In other words, the farmer is persuaded to purchase fertilizer, but in so doing he inadvertently over-spends; this in turn leaves him without money for everyday expenditure and for such items as school fees; in addition, it may leave him without sufficient funds to cope with unforeseen circumstances, such as a bad harvest, which necessitates the purchase of rice, or illness, necessitating expenditure on medicine. This is a point which could be investigated in more detail. However, information supplied by the Manager of the Bank for Agriculture and Agricultural Co-operatives in Kalasin town suggests that in changwat Kalasin as a whole borrowing for the purchase of fertilizer is relatively unimportant.(1)

Despite the significantly greater degree of borrowing by fertilizer users, compared with non-users, in the Lam Pao Sample, there is no significant difference in the degree of indebtedness between the two groups. However, neither is there any significant difference in the amount of credit possessed by the two groups.

Apart from economic factors, the demographic factor seems to be important. The mean number of persons per holding for fertilizer users was 7.4, compared with 6.8 for non-users. ('t' = 1.66, significant at the .10 level). Similarly, fertilizer users expended on average 121.8 mandays on their glutinous rice plots, compared with the 96.6 mandays of non-users. ('t' = 2.59, significant at the .05 level). The total mandays expended is directly related to the size of the labour force and, since fertilizer users do not have a significantly greater size of holding than non-users, it follows that fertilizer users must utilize their labour more intensively. Fertilizer application implies, because of its high cost in Thailand, capital-intensive cultivation par excellence, albeit relative to the north-eastern scale of operations. Thus it would

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(1) The activities of the Bank at the time of the conversation with the Manager did not extend throughout the whole changwat, since amphoe Tha Khantho was excluded. The Bank categorized borrowing in a two-fold manner, viz. according to the land-use purpose for which the loan was intended, which might include but not specify the purchase of fertilizer, insecticide and machines for each particular land-use, and, secondly, according to general use. In 1970 borrowing for specific land-use accounted for 75% of all borrowing, whilst borrowing according to general use accounted for 25% of all borrowing. Borrowing according to land-use was subdivided in the following manner: rice cultivation 83.9%, pig rearing 7.8%, kenaf cultivation 7.3%, water melon cultivation 7.3%, poultry rearing 0.36%, fishing 0.18%, yam cultivation 0.06%, mung bean cultivation 0.04%, cassava 0.01%. The borrowing according to general use was subdivided as follows: buying buffalo and cattle 50%, clearing land 17.5%, buying land 16.6%, cattle rearing 8.6%, land development 4.0%, buying carts 0.9%, fish pond construction 0.9%, buying water pumps 0.41%, repaying old debts 0.3%, poultry raising 0.2%, house building 0.1%. In 1970 4,500 families and over 20 co-operatives borrowed from this bank. The total amount borrowed was 10,000,000 Baht.

appear that in the case of the Lam Pao Sample capital-intensive and labour-intensive cultivation are not mutually exclusive alternatives. On the contrary, they coincide, since both bespeak an attempt to optimize production and an awareness that production can be improved, even though this attempt might not be optimal in a "rational" sense, i.e. the optimization of production that could be derived by a scholar with all the relevant facts available and the help of a powerful computer. By comparison, the Lam Pao farmer's rationalisations seem myopic: he can rationalise only from his own or his neighbours' past successes and failures (which may have been just as much a result of vagaries of weather or price fluctuations as of the farmer's techniques of cultivation and decisions).

There is no significant difference in the age of users and non-users of fertilizer. However, users have received on average 4 years of education, compared with 3.6 years for non-users. ('t' = 1.75, significant at the .10 level).

Having defined fertilizer users as a group, it was next decided to examine the amount of fertilizer used by each user. There was found to be no significant correlation between the total fertilizer applied and the percentage of glutinous rice sold nor between total fertilizer applied and income from remittances or the age of the household head. Similarly, the intensity of fertilizer application could not be correlated with any of these aforementioned socio-economic variables.

Whilst total fertilizer used could be significantly correlated with the number of people on the holding at the 5% level of significance and with the amount of loan at 2%, input intensity was correlated with the amount of debt at the 25% level of significance. Interestingly, although the size of the cultivated holding was correlated with the total fertilizer purchased at the 1% level of significance, it could be correlated with the intensity of fertilizer application only at the 5% level of significance. This might suggest that fertilizer is used more effectively on the smaller holdings. Total fertilizer used and intensity of fertilizer application are both correlated with the area of commercial field crop cultivation, the former at the 25%, the latter at the 5% level of significance. However, the former is a positive correlation, the latter a negative one. Thus it might be that the larger the commercial field crop area a farmer has, the more fertilizer he is likely to buy (for use on his paddy land in the main,rather than on his field crops), since his income from commercial field crops enables him to do so, but since large commercial field crop areas are associated with large paddy areas, the less intensively is he likely to apply this fertilizer on his paddy land.

Similarly, it is interesting to note that total fertilizer is positively correlated with the amount of loan, but intensity of fertilizer input is negatively correlated with the amount of loan, the former at the 2% level of significance, the latter at the 25% level. This apparent anomaly could be explained, if one postulates that, whereas the smaller farmer is likely to be in need of a loan more often, which would be likely to be a small loan for contingency purposes, the larger farmer, however, would not usually <u>need</u> a loan, but would be more likely to rationalize to acquire a loan for innovation and investment. Owing to the larger farmer's greater personal security, his loan would be likely to be much larger.

Both intensity of fertilizer input and total fertilizer use are positively correlated with total income, the former at the 25% level of significance, the latter at the 5%. Whilst total fertilizer used is correlated with total mandays expended at the 1% level of significance, mandays and fertilizer input intensity are unrelated. The years of education of the household head are not too important: they are correlated with total fertilizer use at the 10% level of significance and fertilizer input intensity at 5%. Total fertilizer increases as the amount of credit the farmer has increases (25% significance level) and decreases as the farmer's indebtedness increases (25% significance level).

The amount of fertilizer applied per rai of glutinous rice is very closely correlated with the number of mandays spent weeding each rai of glutinous rice (0.1% significance level). This variable was included to assess whether fertilizer inputs in the Sample had produced more weeds, as evidence from other areas suggests. From the available data on the Lam Pao Sample this could be assessed only by the amount of time spent weeding per unit of area. Surprisingly, however, this close correlation is negative. Thus, the more fertilizer that is applied per rai, the fewer the mandays spent in weeding that rai of glutinous rice. Since fertilizer is applied more intensively on the smaller holdings, this might suggest that weeding is more associated with the larger holdings. Another partial explanation is that weeding is carried out most assiduously in a situation where fertilizer inputs are small or absent as an alternative labour-intensive means of optimizing yields - this does not contradict the previous assertion that overall labour-intensive methods and capital-intensive methods coincide in the Sample. However, this does tie in with the anomalous conclusion in Chapter 4 that farmers who weeded their glutinous rice plots achieved a lower mean yield than those who did not weed. Neither of these explanations is entirely satisfactory. Table 7.11 indicates, however, that the size of the cultivated holding and the overall labour expenditure are the chief

Table 7.11 Stepwise Regression of Weeding in Mandays per rai of Glutinous Rice with selected variables in the Lam Pao Sample

Variable	Value of R Square
Size of cultivated holding	0.20112
Total Mandays on glutinous rice	0.41564
Number of people on holding	0.44946
Percentage of glutinous rice sold	0.46099
Commercial field crop area	0.46573
Fertilizer application per rai of glutinous rice	0.47168
Age of household head	0.47303
Years of education of household head	0.47323

Table 7.12 Stepwise Regression of Fertilizer Application per rai of glutinous rice in the Lam Pao Sample with selected variables

Variable	Value of R Square
Size of cultivated holding	0.12485
Commercial field crop area	0.18511
Years of education of household head	0.22411
Age of household head	0.24768
Income from crops	0.25780
Number of people on holding	0.26798
Percentage of glutinous rice sold	0.27666
Credit/Debit	0.27955
Total income	0.28008

determinants of the amount of mandays expended in weeding each rai of glutinous rice, being responsible for about 42% of the variation in this variable. Fertilizer input per rai of glutinous rice is clearly here of small influence. It must be stressed that this analysis of weeding has not in fact confirmed or refuted the evidence from elsewhere that fertilizer inputs increase weeds in the paddy fields. It has indicated that the intensity of weeding cannot be used as a direct indicator of the weediness of the plot; other factors are here involved.(1)

The analysis of fertilizer inputs in the Sample yields ideas and directives for further research. However, Table 7.12 illustrates that the significant variables studied are responsible for only 28% of the variation in fertilizer input per rai. Of these, the size of the cultivated holding is responsible for about 13% of the variation; this variable together with the area under commercial field crops is responsible for 19% of the variation; these two variables combined with the age of the household head account for 22% of the variation.

(1) A different approach would have been used to solve this interesting and important problem, if time had allowed. This would have involved weed counts of various randomly selected paddy plots, the numerical scales of plant cover and plant sociability being used. At the same time the owners of the plots would have been closely questioned about their application of fertilizer over a number of years and the varieties of rice grown.

II. Pesticides

i. Pesticides in general

The use of pesticides in Thailand is more recent than that of fertilizer. The local manufacture is limited to some blending of imported active ingredients. Table 7.13 indicates a steady rise in the import of insecticides; imports of fungicides, rodenticides and disinfectants have been more static; imports of herbicides more fluctuating. At present the U.S.A. is the main supplier of insecticides, whilst the German Federal Republic leads in fungicides, herbicides and rodenticides and is second in insecticides. Japan is rapidly gaining a share of the Thai market.(1)

It is clear that insect pests and diseases are an important problem in Thailand, particularly in the case of rice cultivation. Petersen considers that by 1958 Thailand had lost on average 480,000 hectares of rice each season through disease and pests.(2) Table 7.14 indicates the percentage of rice area damaged by insects and pests for certain years.

Insect and animal pests, diseases and viruses are responsible for this damage. The principal insect rice pests are the seedling cutworm, Spodoptera mauritia (a leaf eater) and the white borer, Tryporyza incertulas and Sesamia inferens (a stem borer).(3) In addition, there are two serious animal pests - crabs and rats.(4) Birds, especially

(1) The Agricultural Economy of Thailand, U.S. Dept. of Agriculture, Economic Research Service, 1972.

(2) Petersen, R.O., Annual Report of International Rice Research Institute, Los Baños, Quezon City, Philippines, 1966.

(3) Chakratong Tongyai, M.R., former Entomology Specialist, Min. of Agr., Review of Pests of Rice in the Field in Thailand, Min. of Agr. Mimeo.

(4) Both crab and rat can form part of the north-easterner's diet. The writer recalls an incident which convinced him of the need for the research student to divest himself of all traces of ethnocentricity before studying an exotic culture. The writer found a farmer in Ban Um Mao who kept a large rat in a bamboo bird-cage in his house. When asked the reason for this, he replied, literally, that he liked to look at it.

Table 7.13 Imports of Pesticides into Thailand

	1961	1963	1966	1967	1968	1969
			(metric tons)			
Fungicides	6	132	404	501	838	535
Insecticides	1,604	4,125	6,371	10,387	10,700	12,997
Disinfectants	276	113	1,304	230	570	410
Herbicides	304	321	385	566	1,852	1,659
Rodenticides	8	16	22	23	37	33

(Source: The Agricultural Economy of Thailand, op.cit.)

Table 7.14 Percentage of Area damaged by Insects and Diseases in Thailand

1954	10
1955	11.2
1956	9.8
1957	2.1
1958 (incomplete)	13.0
Mean	9.2

(Source: H.R. Chakratong Tongyai, former Entomology Specialist, Ministry of Agriculture, Review of Pests of Rice in the Field in Thailand, Min. of Agriculture, Mimeo.)

the rice sparrow, take their toll of the growing rice.[1] The list of diseases which affect rice in Thailand is large and all but two of these diseases are found in north-east Thailand, viz. bacterial leaf stripe and bacterial leaf blight.[2] For four diseases, viz. bacterial leaf stripe, bacterial leaf blight, leaf smut and kernel smut there is no known control measure. Only three of these diseases can be controlled by chemical spraying, viz. false smut, rice blast and collar rot, whilst brown leaf spot and foot rot require a different chemical treatment. However, the other diseases can be largely controlled by purely mechanical means, such as flooding the paddy land or alternate flooding and draining (which requires efficient irrigation to be effective) or by burning of the rice stubble. It is salutary to observe that both rice blast and stem rot can be caused by an unbalanced fertilizer application, the former by excess nitrogen.

In addition, there are four principal virus diseases, all but one of which affect the rice in the north-east of Thailand.[3]

All field crops suffer from pests and diseases to a certain extent, but cotton probably most of all. For certain varieties that lack

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(1) Hunting these birds provides a useful, and, apparently, pleasurable activity for the young boys of the village. These birds also form part of the local diet. The writer recalls seeing the headman of Ban Na Chuak Nuea breakfast on five rice sparrow fledgelings with chillies and glutinous rice.

(2) The diseases listed by Worawisithumrong et al. are as follow: Piricularia oryzae (rice blast); Sclerotium oryzae (stem rot); Helminthosporium oryzae (brown leaf spot); Oriental sheaf and leaf spot; foot rot; collar rot; bacterial leaf stripe; bacterial leaf blight; Enyloma oryzae (leaf smut); Neovessia horrida (kernel smut); false smut, root knot nematode and rice stem nematode.
Source: Worawisithumrong, A. and Sithchai, T. Rice Diseases in Thailand and Control Measures, Technical Division, Rice Dept., Min. of Agr. Mimeo, 1964.

(3) These virus diseases are the yellow-orange leaf virus disease, the orange leaf, the yellow dwarf and the grassy stunt.
Source: Wathanakul, L., Rice Virus Diseases in Thailand, Rice Protection Research Centre, Technical Division, Rice Dept., Min. of Agr. Mimeo.

resistance to the leaf-sucking jassid (Empoasce devastans), cultivation is virtually impossible without a complete spray programme. Corn is affected from time to time by locusts and grasshoppers, pests which were not reported in Thailand until the mid 1950's.(1)

In view of the gravity of this problem the government has been active in promoting pest control. The Rice Protection Research Centre has been set up and Rice Pest Suppression Centres established in various provinces. They provide individual farmers with free help in the form of chemical and spraying services, chiefly for rice and corn. In the 1969/'70 crop year these pest control services provided for some 1.2 million hectares of riceland. In addition, the Rice Department owns a small fleet of aeroplanes for aerial spraying.(2)

Despite the short-term beneficial effects of insecticide, it is generally recognized that the use of this innovation may have deleterious effects, both short- and long-term. The personal hazard to the inexperienced user should not be minimized.(3) Moreover, chemical pest control may result in the absorption of poisonous substances by plants, animals and man. Thirdly, there is the danger of "drift", whereby insecticides miss their target area and contaminate the surrounding countryside; this is most serious in large scale operations, especially aerial operations. Through the "food chain" poisons may affect a wide variety of insects and plants, possibly leading to an impoverishment of the flora and fauna, at least an aesthetic loss, at worst a serious ecological imbalance. Moreover, it is noted that by natural selection

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(1) The Agricultural Economy of Thailand, op.cit.

(2) Ibid.

(3) The headman of Ban Lao Yai permanently damaged his larynx through contact with insecticide. He informed the writer of this incident, which occurred prior to the study period.

insects develop resistance to insecticides. This problem is not solved by increasing the dosage. The phenomenon of "cross-resistance" has also been observed: thus an insect that has developed resistance to a particular compound has usually also "acquired" resistance to closely related compounds.

The biological approach should be considered as an alternative to the use of insecticide. In Thailand this approach is best exemplified by the control of rice stem borers through the introduction of sterile male insects. Often predators and parasites may be set upon the pest.[1] The ecological approach can occasionally backfire - it is a delicate and skilled operation. Moreover, it implies large scale nationwide planning to be effective. The British entomologist, R.C. Reay, considering the world situation, has written that, applying the criteria of practicability and economic success, "regrettable as it might be, biological control still lags far behind chemical control in these respects".[2] Both biological and chemical control introduce unknown factors into an environment, which the farmer, rightly or wrongly, perceives as known.[3]

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(1) 14th Session of FAO Conference, Rome, 1967.

(2) Reay, R.C., Insects and Insecticides, Oliver and Boyd Ltd.,Edinburgh, 1969.

(3) The traditional north-eastern Thai farmer is certainly not a master of his environment, but just as surely is he not its slave. From his own personal experience and the collective experience of the village over time, the farmer has developed an intuitive but real knowledge of environmental probabilities. Thus none of his agricultural practices are rash or without an underlying reason. His cultivation of rice, for example, is such as to ensure some produce whatever the environmental conditions chance to be. To this end he traditionally cultivates rice of different varieties together, e.g. drought-resistant varieties with quick-maturing and slow-maturing varieties. If for some reason the farmer migrates to a different area of the country, where the nature of the environment is slightly different and the environmental probabilities different, then the farmer will continue to react to the environmental probabilities of his former area, perhaps with disastrous results. If a new crop is introduced into his traditional environment, the farmer is gauche and unsure in its cultivation. In general, however, psychologists are not in agreement on this point. Feller stresses the importance of intuitions. Feller, W., An Introduction to Probability Theory and its Applications, Vol.1, Wiley, 1966.
However, Cohen and Christensen consider that the existence of intuitions merely confuses the psychological study of probability.
Cohen, J. and Christensen, I., Information and Choice, Oliver & Boyd, 1970.

Research is also under way throughout the world on so-called "integrated systems" of insect control, in which, to quote Reay, "only compounds of formulations which will affect the pest more than the rest of the fauna can be used, and their timing and placement must be related to the biology of any beneficial species".(1)

Integrated systems and chemical control require a degree of planning co-ordination which is not at present feasible in a developing country like Thailand under normal circumstances. For this reason and also because the short-term benefits of insecticide use are almost immediately perceived, as well as the psychological satisfaction the farmer obtains from feeling directly in control of the eradication, it is likely that fungicides, pesticides, and insecticides, either on sale in the village shop, sold by a travelling merchant, or provided by co-operative or agricultural associations, will continue to be the Thai farmer's way of combatting the conspicuously real problem of disease and pests in agriculture, although, as in the case of fertilizer, the ratio of the cost of substances to the cash return from rice is a major constraint.

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(1) The control of apple pests in Nova Scotia, of the alfalfa caterpillar in California and the diamond-back moth in South Africa are encouraging examples of success in integrated system of control. Reay, op.cit.

ii. Insecticide in the Lam Pao Sample

In the Lam Pao Sample there are 53 users of insecticide (22% of the total Sample). Fig. 7.2 indicates that, whilst a majority of farmers are aware of the innovation, only 36% have ever used it, whilst 10% have rejected the innovation. This low rate of adoption is confirmed by another study in the general area.(1)

Although most insecticide is used on glutinous rice, there is some evidence that some is also used on commercial field crops.(2)

The Student's 't' test was applied to determine salient differences between users and non-users of insecticide. There is no significant difference between the two in relation to whether they use fertilizer or not, or to the total amount of fertilizer used or the intensity of fertilizer use. Both the size of the cultivated holding and the population per holding are insignificant variables. There is no significant difference between users and non-users of insecticide with respect to total mandays expended on glutinous rice, percentage of glutinous rice sold, income from remittances, total income and amount of credit possessed. Similarly, there is no significant age difference between the two groups.

However, insecticide users acquired on average 2,294 Baht from their crops, whereas non-users acquired 3,051 Baht ('t' = 2.59, significant

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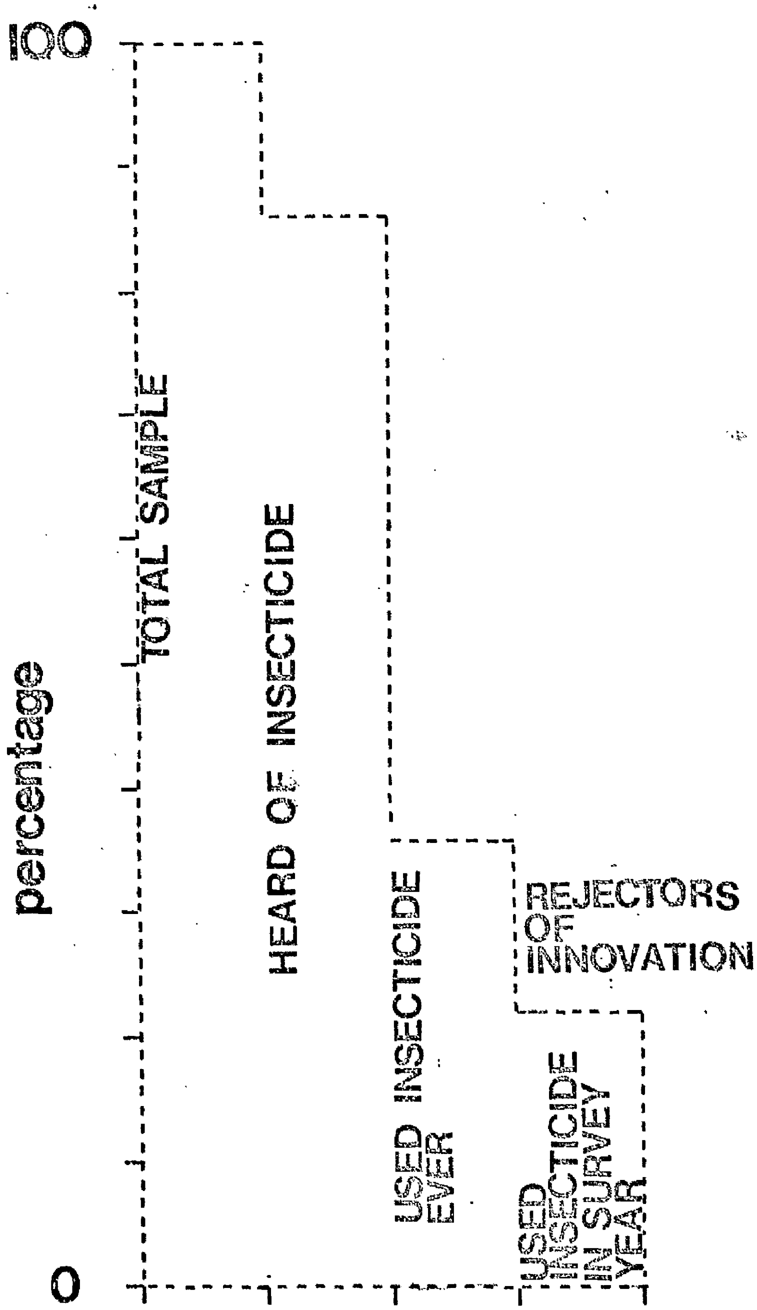
(1) Narkswasdi reported that in his study in changwat Kalasin and Maha Sarakham out of 377 farmers (51% of the total sample) who knew about insecticide, only 183 farmers used it, notwithstanding that out of a total of 97 farmers in Kalasin and 70 in Maha Sarakham 76 and 41 farmers respectively cited pests and plant diseases as major cultivation problems.
Source: Narkswasdi, U., A Study of the Socio-economic conditions of People living in the Development Areas of the north-east, Kasetsart Univ., Bangkok, undated.

(2) The village shop in Ban Na Chuak Nuea sells "slug-killer" for watermelons and vegetables. In that village, according to the headman, there are 100 rai under vegetables.

FIG. 7.2 KNOWLEDGE & USE OF INSECTICIDE IN LAM PAO SAMPLE



at the .01 level). Similarly, users have a mean commercial field crop area of 2.46 rai, compared with 3.71 rai for non-users ('t' = 1.91, significant at the .10 level). This might suggest that it is the more marginal cultivator, for whom loss of crops through disease or pests would be more serious, who are more likely to adopt the innovation. Users borrow less money on average than non-users, i.e. 234 Baht as opposed to 505 Baht ('t' = 1.60, significant at the .10 level), and are significantly less indebted. Thus users on average are 1,221 Baht in debt, compared with 1,569 Baht for non-users ('t' = 1.34, significant at the .20 level). Users are also significantly more educated than non-users: they have had on average 4.3 years of education, compared with 3.7 years for non-users ('t' = 1.95, significant at the .05 level).

III. Mechanization

i. Assessment of the impact and feasibility of mechanization in Thai farming

The impact of mechanization on Thai agriculture is quite recent. However, at least at present and in the immediate past, the farmer is not and has not been self-sufficient with regard to traditional rural technology. The hoe, the spade, the sickle and "machete-type" knife he buys in the hardware store, whilst he must pay for materials and labour for the manufacture of ploughs, harrows, carts and water wheels. (Plate 7.1 shows a traditional harrow).

In 1963 out of a total of 3,087,141 landholdings in the Kingdom only 3.3% used mechanical power exclusively, whilst 11.6% used both mechanical and animal power and 85% depended entirely upon human and animal power.(1)

The country is dependent upon imports, there being no domestic manufacture of tractors. The tractors are imported in a "knocked-down" condition for assembly in Thailand. There are, however, two significant domestic manufacturers of tractor drawn disc ploughs and harrows in Thailand(2), but, despite this, imports of ploughs and harrows are still important.

Fig. 7.3 illustrates the increasing importance of tractor imports into Thailand.(3) It is considered, however, that there is a

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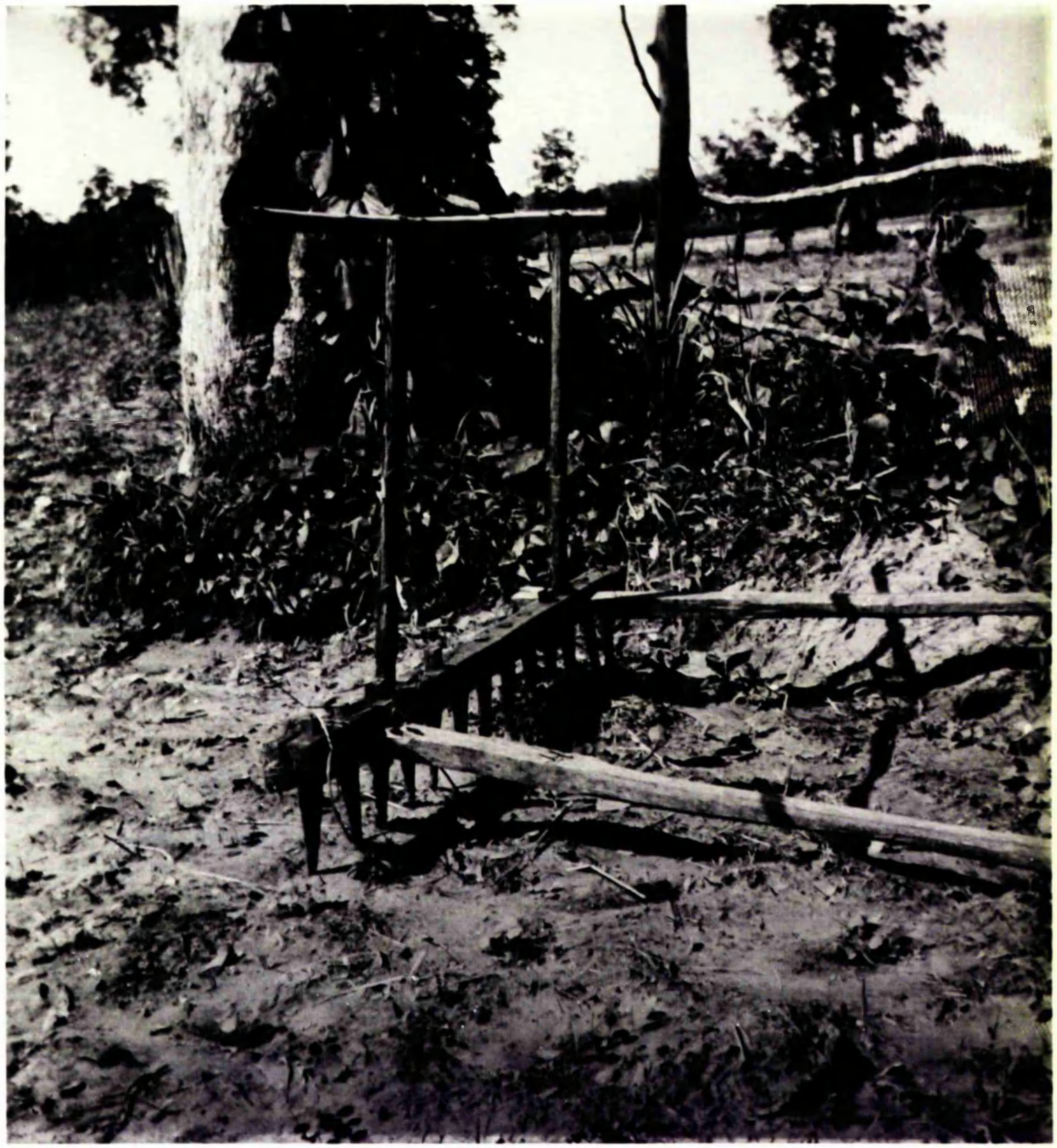
(1) 1963 Census of Agriculture.

(2) These are the Chon Buri Muang Thong Co. Ltd. of changwat Chon Buri and the Kai Heng Lee Factory of amphoe Ban Pong, changwat Ratchaburi.

(3) Tractor imports are classified by the Customs Department either as "tractors other than steam" or "track tractors other than steam". There is no segregation of farm tractors from industrial wheeled tractors nor of two-wheeled and four-wheeled tractors.

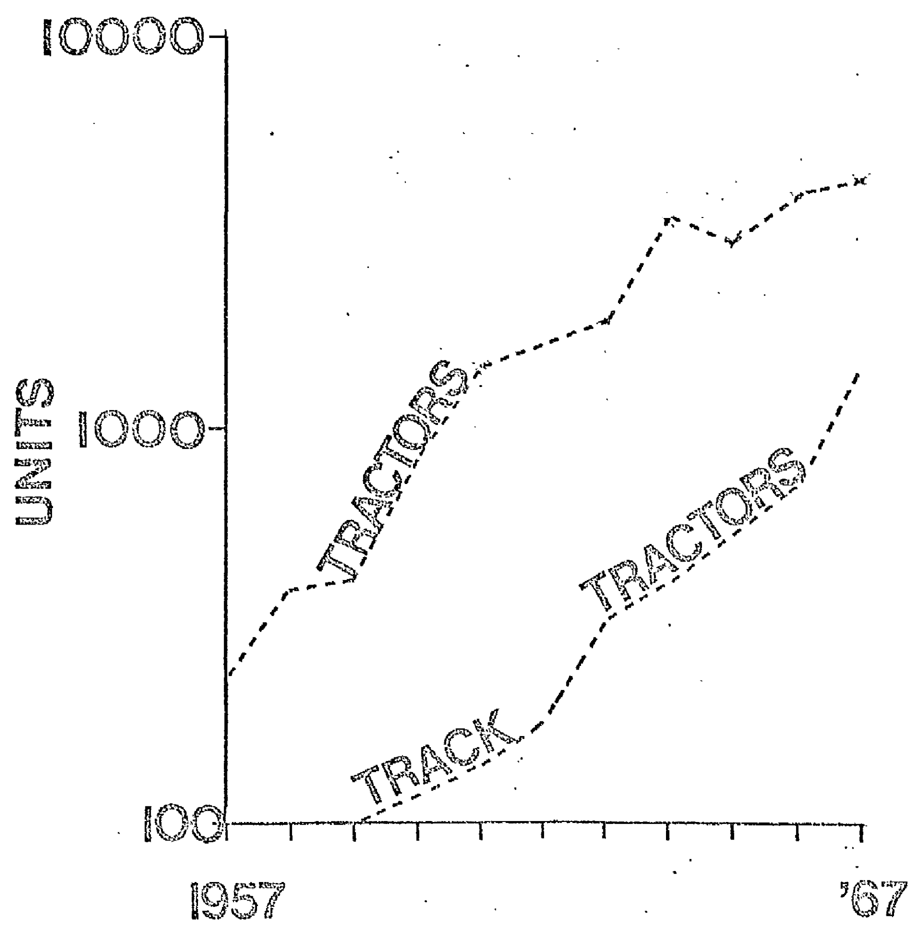


Source: O'Reilly, dry season, 1971.

Plate 7.1. A traditional harrow (*khrat*) in Ban Tum

All the parts of this instrument are made by wood or bamboo. It might be pulled by human beings as well as cattle or water buffaloes.

FIG. 7.3 IMPORTS OF TRACTORS OTHER THAN STEAM INTO THAILAND
SOURCE: THAILAND CUSTOMS DEPT.
SEMI-LOG



vast potential still to be realized. For example, a co-ordinated industry study project in 1969 conservatively estimated Thailand's potential as a farm tractor population of 80,000 to 120,000 units based upon the 74.9 million rai under cultivation in 1967. The actual population of four-wheeled farm tractors in 1967 is estimated as 17,500 units or 15% to 22% of potential.(1) A later estimate in 1972 suggested the market for agricultural machinery in Thailand to be of the value of 200 million U.S. dollars per year and expected to grow by about 15% to 20% over the subsequent three years.(2)

Tractor imports in 1967 included twenty-seven different brands of tractor, imported from twenty-two countries. However, the major supplier was the United Kingdom, which provided 2,038 units, whilst Japan followed with 1,233 units and Finland was third with only 210 units. It would appear, however, that all the British tractors are four-wheeled, whereas the Japanese tractors are predominantly two-wheeled and estimated to account for virtually all two-wheeled tractor imports.(3) The two types of tractor are in the main not functionally inter-changeable. The former is suited to comparatively large paddy plots and field crop plots; the latter, developed in the context of the tiny Japanese paddy holdings, is manoeuvrable in the smaller paddy plots with their obstructive bunds. The exclusive applicability of one or the other to the individual farmer is not clear-cut, since, for example, the north-eastern farmer may combine

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(1) Thailand Farm Mechanization and Farm Machinery Market, A Co-ordinated Study Project by the Ministry of Industry, Board of Investment, Ministry of National Development and Min. of Agr., RTG, and Kasetsart Univ., Bangkok, together with the Industrial Finance Corporation of Thailand and USOM, 1969.

(2) Developing Countries Trade Promotion Staff, U.S. Dept. of Commerce.

(3) Thailand Farm Mechanization and Farm Machinery Market, op.cit.

in the same holding small, scattered paddy plots and continuous upland plots, cleared from the forest en bloc. It will be interesting to compare the relative successes of the two types in the future. Chancellor considers that two-wheeled tractors, because of their limited mobility, would not be able to engender such a rapid spread of their use as four-wheeled tractors.(1) On the other hand, tractor imports like any other import are as much a result of trade agreements between countries, determined by general political and economic considerations, as of theoretical agricultural economics. On the other hand, if four-wheeled tractors are in the long run more successful, they may result in, through private enterprise and/or government pressure, fundamental changes in the type of agricultural holding with land consolidation, the dissolution of small, unviable holdings and the emergence of a new type of farmer. It must be stressed that this is all at the moment mere conjecture, since mechanization is still in its infancy in Thailand at present.

A free economy has resulted in the proliferation of tractor brands in Thailand and perusal of recent Thai newspapers and periodicals gives the impression that the number of brands is increasing.(2) In the writer's opinion this results in certain inefficiencies in tractor use: a greater number of trained mechanics is required, none of whom can be familiar with every brand on the market; similarly, a greater number of

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(1) Chancellor, W.J., Survey of Tractor Contractor Operations in Thailand and Malaysia, Agricultural Engineering Dept., Univ. of California at Davis, 1968.

(2) One such new machine is the John Deere combine harvester from the German Federal Republic. This four ton machine, costing 400,000 Baht, can work 7.5 rai of paddy per hour. Such a machine can obviously only be of interest to very large and prosperous farmers or to government farms.
Source: "Machines in the Paddies : Rice Harvester from West Germany", Investor, March 1971.

spare parts must be kept in stock throughout the country, since each brand requires its own spare parts - this lessens the rapidity with which the farmer may have his tractor repaired, following a breakdown; also it involves competition in the field between agents of different companies in a market where the customer may have little discernment about the merits and demerits of individual machines. If, on the other hand, there were merely one brand of tractor on the market, then farmers throughout the region would become familiar with that machine, and it is possible that as the innovation of tractor use spread throughout a region it would be accompanied by the basic knowledge of how to look after and maintain the machine and effect minor repairs. The wider dangers of monopoly, however, hardly need reiterating in this context.

Fig. 7.4 indicates the predominance of ploughs among major tractor implements imported; ploughing is in fact the most common use of tractors in Thailand.(1) However, as Fig. 7.5 indicates there is a wide variety of other farm equipment imported, although only the agricultural and horticultural machines for soil preparation are numerically important. "Others" here includes harvesting machines, threshing machines, hullers and shellers, and straw and fodder presses. In addition the import of water pumps into Thailand is not insignificant: they increased from 20,000 units annually in 1957 to about 82,000 units annually in 1967.

When the innovation was first introduced into Thailand, a government tractor service was provided. Government operated tractor stations operated since 1950, but were discontinued for financial reasons.

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(1) Figures of ploughs and harrows are acknowledged in recent years to represent the import of discs either in a plough or harrow-frame or separately.
Source: Thailand Customs Dept.

FIG. 7.4 IMPORTS OF PLOUGHS, HARROWS AND CULTIVATORS INTO THAILAND

SOURCE: THAILAND CUSTOMS DEPT.

SEMI-LOG

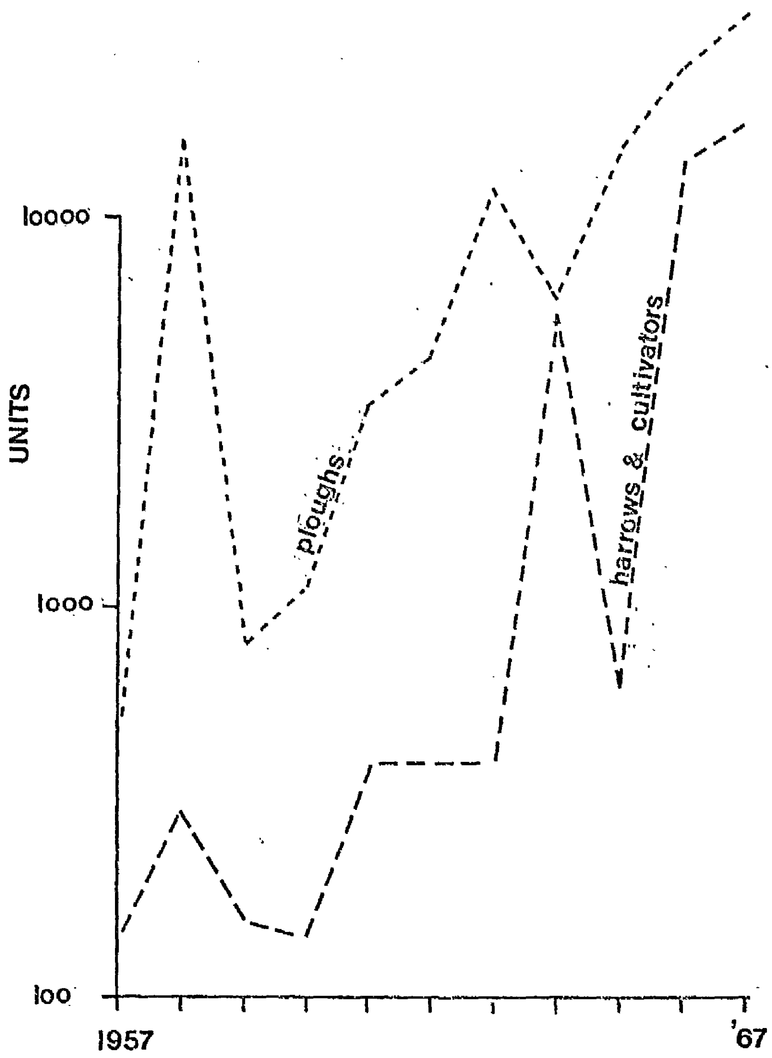
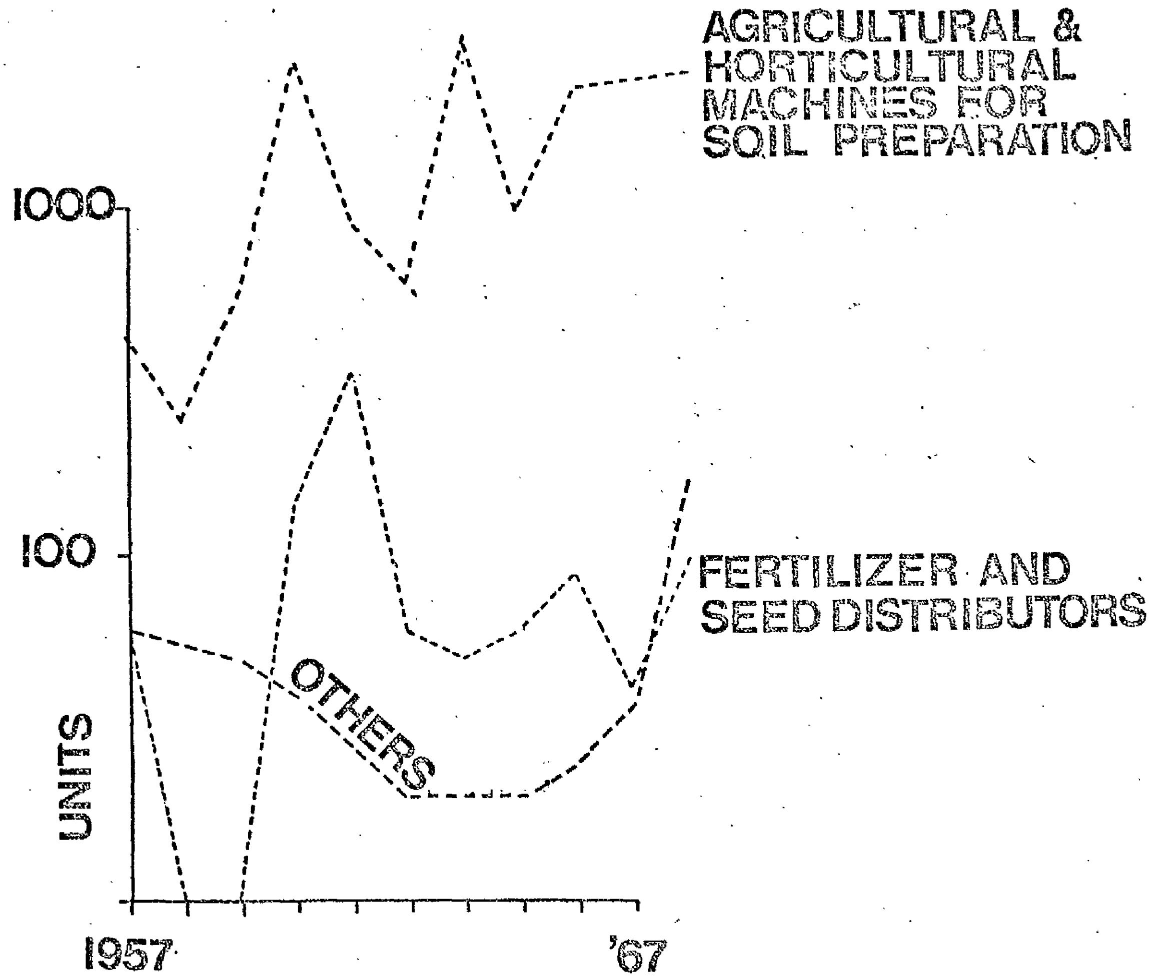


FIG. 7.5 IMPORTS OF OTHER FARM EQUIPMENT INTO THAILAND

SOURCE: THAILAND CUSTOMS DEPT.
SEMI-LOG



The fees the farmers paid were not sufficient. Moreover, the farmers felt that the service should be free or at a partially subsidized cost.

Thus at present most farmers who use a tractor hire it. They may be hired from private entrepreneurs or farmers' associations. In 1969 90% of the farm tractors were owned by such so-called custom service operators, who usually possessed one to five tractors and one or two implements per tractor.[1] 80% to 90% of them were farmers, albeit of above average prosperity. Individuals are helped to purchase tractors by government sponsored loans.[2] The farmers' associations are also eligible for loans, although some gain funds through selling shares among members. Evidence supplied by Chancellor seems to indicate that the farmers' associations are far less efficient than the private entrepreneur in providing the tractor user with a reliable service.[3] Apart from technical inexperience,[4] the main problems he cites are that members are served on a "first-come, first-served" basis, thus involving extensive travel for the tractor and that members' fields are all grouped in a given area and thus all require the service at approximately the same time.

The service has to be made available to non-members to earn extra income, but, in some cases, non-members were served before members, so great was the need for cash. These failings are largely failings

(1) Thailand Farm Mechanization and Farm Machinery Market, op.cit.

(2) The Farmers' Aid Programme, sponsored by the National Farmers' Aid Committee, made funds available through various government agencies. One such agency was the Rice Dept. of the Min. of Agr. However, it appears that the administration of the fund felt that loans for tractor use were less beneficial to the farmer than loans for fertilizer and water pumps.

(3) Chancellor, op.cit.

(4) A training programme is provided by the Rice Dept., involving a six-week and twelve-week course for members of farmers' associations and their sons.

of the weakly established farmers' associations; they are not in themselves insuperable failings. However, it is possible that, whilst the farmers' associations are maturing, the private entrepreneur will be able to consolidate his dominance in the tractor market.

Chancellor's findings on the effects of tractor use in his sample contrast with those of the government co-ordinated study. Chancellor found "a definite relationship between tractor use and the initiation of new farm enterprises". The co-ordinated study, on the other hand, concluded that "the availability of equipment for farm tasks has not significantly affected farming cycles or the extent of multiple cropping as yet. Farmers principally use the tractors' considerably higher productivity over draught animals to enable greater land preparation". The one year which separates these two studies is no explanation for their discrepant conclusions.

It is clear, however, that tractor use provides the farmer with more free time and thus the opportunity to earn more income, either in agricultural or non-agricultural pursuits. The system also presents some farmers, the tractor owners, with the potential to increase their income more markedly,(1) as well as providing ready cash for the tractor drivers, young, inexperienced men.(2) Tractor use thus injects new

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(1) However, less than 50% of Chancellor's sample of tractor owners thought that they were making a profit.
Source: Chancellor, op.cit.

(2) Mr. Donald Slack of the University of Kentucky team at Tha Phra Agricultural Station, Khon Kaen, N.E. Thailand, considers that in his experience the Thai plough very badly; they merely steer the tractor. Moreover, he states that instruction must always be by word not by example, since the latter method involves, in the Thai view, "loss of face" (sia na in Thai). If his observation is correct, then it is of more than passing interest. On the one hand, bad driving aggravates wear and tear on the machine; on the other hand, and more seriously, it may have deleterious effects on poorer soils, if the tractor ploughs too deeply.

capital into the agricultural system. Socially, it may also lead to greater co-operation between farmers, either through the owner-hirer relationship or within farmers' associations.

In the short term, however, the system has produced many problems. The restriction of communication to local areas has allowed regional variations in practices and prices to develop and maintain themselves. Although in Chancellor's sample only 4% to 6% of the farmers failed to pay for their service, it is probable that in a bad year in north-eastern provinces this rate would be higher. The machines are utilized fully for a relatively short period of time and then left idle - this could be remedied by providing off-season work for the tractors in such activities as road maintenance and canal digging.(1)

Tractor breakdown is a serious problem: Chancellor estimated that in his sample 26% of the potential work time was thus wasted.(2) Obsolescence, although not a problem at present, will become increasingly severe.(3)

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(1) Donald Slack also observed that the Thai word for "tractor" is rot thai, which literally means "a vehicle for ploughing". Because of this semantic curiosity, he considers, the Thai have difficulty in thinking of using a tractor for any purpose other than ploughing. If this observation is correct, it provides a good example of what the American anthropologist, Loren Eiseley, means by the power of words to "imprison" man.
Eiseley, L., The Unexpected Universe, Victor Gollancz, 1970.

(2) Chancellor, op.cit.

(3) Data from the U.S.A. indicates that the economic life of a farm tractor in that country ranges from six to fifteen years, depending upon the hours of annual use.
Source: Multifarm Use of Agricultural Machinery, FAO, 1967, quoting the Agricultural Engineers' Handbook 1965, American Society of Agricultural Engineers.
American farmers are usually competent in driving and maintaining their machines. At present this is not true of Thai farmers. Thus machines in Thailand would be likely to become obsolescent more quickly, aggravated by the problem of rust in a humid tropical climate. Conversely, however, it is likely that the Thai tractor owner would use his obsolescent machine much longer and be more reluctant to replace it than his American counterpart.

Tractor use and other forms of mechanization in agriculture inevitably, though slowly, produce a decline in crafts connected with the manufacture of traditional agricultural implements. Incidentally, it also terminates certain rural crafts which use unlacerated straw (tractor harvesting lacerates the straw), e.g. the manufacture of straw mats, baskets and headgear. Possibly these disadvantages are more lamented by the anthropologist than the economist.

Tractor use could have an irreversibly damaging effect upon many soils of north-eastern Thailand. If such soils are ploughed too deep, the soils will harden through concretions of mottled clay (which harden on exposure to the air); this soil, turned to rock, would have to be abandoned.[1]

The subject of whether traditional agriculture should be mechanized is controversial. Even divested of political overtones,[2]

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(1) Dudal, R., Soil Correlator, FAO, quoted in Mechanization and the World's Rice, a conference held during September 1966, organized by Massey-Ferguson Ltd. at the Massey-Ferguson School of Farm Mechanization, Warwickshire, U.K. and Vercelli, Italy.

(2) Political considerations need not necessarily be concerned with the economic efficiency of mechanized agriculture. Indeed, inefficiencies, perhaps, rightly or wrongly, considered temporary, may be accepted as means to an end, which may be development in other sectors, industrialization or Rostowian take-off.
Moreover, politicians are judged at home and abroad by what they achieve and, *ceteris paribus*, the more dynamic the changes they effect, the more favourably they are assessed.
In addition, in this age of mass-communication even the isolated farmer is vaguely aware of conditions in advanced countries. The intelligentsia of the developing countries are painfully aware of such conditions in advanced countries. Developing countries as a whole vie with one another and emulate more advanced countries to earn the epithet "modern". The surest signs of modernity are the material signs, conspicuous to the world, e.g. steel plants, modern highways and mechanized agriculture. The educated Thai, for example, tend to self-consciously disparage what is traditional. One such told the writer, "What is in museums in the West is reality in Thailand". Such an attitude makes it difficult for a fair comparison - social and economic - to be made between mechanized and non-mechanized agriculture.

there remain marked discrepancies in the findings and opinions of economists. The topic is vast and complicated and the writer can here no more than delineate the nature of the controversy. The crucial issues seem to be whether mechanized agriculture is more "efficient" (variously defined) than traditional agriculture, whether mechanized agriculture is economically feasible for the traditional farmer and whether mechanized agriculture produces or aggravates rural under- or unemployment. An additional issue is whether it produces desirable or harmful social and psychological spin-offs.

As regards the efficiency of mechanized agriculture, the conclusions of the Massey-Ferguson conference were that, although mechanization is a proven method of increasing output per man, the fact that high rice yields are often associated with full mechanization does not mean that machines always increase unit yields.(1) A decade earlier, Dr. Sen of the Indian Ministry of Food and Agriculture had, somewhat unfashionably for the time, stated, "While mechanization of farming operations improves considerably the yield per unit of labour, it does not necessarily increase the yield per unit of land".(2)

The Netherlands Development Corporation (NEDECO) found tractor farming to be more labour-efficient than buffalo farming in their assessment of labour requirements per unit of land for four different types of farming techniques in its land consolidation project in changwat

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(1) Mechanization and the World's Rice, op.cit.

(2) Quoted in The Meaning of Technical Change in the Context of the Agricultural Economy of Different Environment - Asia, Proceedings of the 9th International Conference of Agricultural Economists, pp.49-59, Oxford Univ. Press, 1956.

Sing Buri, Thailand.[1]

That tractors are more labour-efficient than animals is, however, by no means univerally accepted. Thus Gill concluded from experiments he carried out comparing different tractors and bullocks in Lyallpur, Pakistan in 1952 - '54 that "direct mechanized farming" used the maximum amount of manual labour per year.[2]

The controversy is greater as regards the relative yields per unit of land of mechanized and non-mechanized agriculture. Kaneda thinks that, apart from the possibility of increasing the intensity of cropping and therefore the yield per unit of land per year, it is not obvious that tractor mechanization per se has much effect upon yield per unit of land per crop as compared with animal draught power.[3]

Fisk, however, argues that mechanization increases the productivity of the land by making possible the cultivation of land that would not otherwise be cultivated.[4] He seems to overlook the fact that mechanization also may make other areas of land "uncultivable", areas which are not accessible to machines, such as the elaborate and highly productive rice terraces of Kandy, Sri Lanka or of the Ifugao in northern Luzon, Philippines.

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(1) For all operations transplanting with water buffalo-farming required 14.0 mandays/rai, transplanting with tractor farming 10.5 mandays/rai, broadcasting with buffalo-farming 8.75 mandays/rai, broadcasting with tractor farming 5.5 mandays/rai.
Quoted in Inukai, I., "Farm Mechanization, Output and Labour Input: A Case Study in Thailand"., Int. Lab. R., Vol.101, No. 5, May 1970.

(2) Gill, M.S., "Economics of Farm Mechanization", W. Pak. J. Agric.Res., Vol.1, 1, Dec. 1962.

(3) Kaneda, H., "Economic Implications of the "Green Revolution" and the Strategy of Agricultural Development in West Pakistan", in Growth and Inequality in Pakistan, ed. Griffin, K. and Khan, A.R., McMillan, 1972.

(4) Fisk, E.K., "The Mechanization of Agricultural Smallholdings in Under-developed Areas," MER, Oct. 1961.

In contrast to Kaneda's and Fisk's conclusions the International Rice Research Institute of Los Baños found, following trials in 1967 on four adjacent plots, animal and machine ploughing to be "equally productive".(1)

Apart from comparative productivity, comparative cost is an important issue. Beckett states that mechanized farming in India requires three to five times as much capital as farming with draught beasts.(2)

In contrast to Beckett's findings, the United States Bureau of Reclamation conducted detailed studies of farming practices and costs in north-east Thailand in 1968 and found the use of water buffalo to be more expensive than the use of tractors in various operations.(3)

Inukai also thinks that water buffaloes are not necessarily cheaper than tractors and are subject to diminishing efficiency.(4) The writer considers that for reasons of obsolescence and breakdown, mentioned earlier, tractors are subject to diminishing efficiency as well

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(1) Quoted in Johnson, S., Quintana, E.U. and Johnson, L., "The Mechanization of Rice Production", PhEJ, No.14, 1968, Vol.VII, No.2.

(2) Beckett, W.H., "Status and Future of the Small Scale Cultivator in World Rice Production", in Mechanization and the World's Rice, op.cit.

(3) They found that ploughing with water buffalo cost on average 46 Baht/rai, whilst ploughing with a tractor cost 25 Baht/rai. Similarly, harrowing with a water buffalo cost 21 Baht/rai, contrasting with 15 Baht/rai for tractor use, whilst for rice threshing using the buffalo cost 0.042 Baht/kg. and the tractor 0.030 Baht/kg.
Source: Cost and Return Study for Several Crops in Pa Mong Project Area, U.S. Bureau of Reclamation Internal Memo dated April 30th 1969.

(4) He compares an average tractor hire cost for the Central Plain of Thailand of 13 Baht/rai for first ploughing and 12 Baht/rai for second ploughing with a water buffalo which he claims cost on average 1,000 Baht in 1957 and required maintenance costs of 100 Baht per annum.
Source: Inukai, op.cit.

(as are overworked drivers). Water buffaloes, on the other hand, are seldom incapacitated and, because ubiquitous, readily replaceable.(1)

The comparative cheapness of mechanized farming was confirmed by an experiment carried out at the Central Agricultural Experiment Station of Japan in 1963. They found that the direct cost of production per hectare in mechanized farming was less than that of the customary method.(2)

The underlying premise for much of this work is that animal power is a constant rather than a variable factor. However, Kaneda makes the valuable point that it is possible to make animals more efficient by improving the equipment they power, e.g. mouldboard ploughs, harrows, seed-cum-fertilizer drills.(3) This is but one case for an "intermediate technology".(4)

With regard to the effects of mechanization on the labour situation, Inukai states, "In a dynamic setting, mechanization creates more jobs than it eliminates".(5)

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(1) Moreover, whilst the water buffalo receives its sustenance from the landholding, the tractor is dependent in many cases upon imported oil, the price of which varies according to the prevailing political climate. There is little doubt that the "fuel crisis", following the Arab-Israeli conflict of October 1973 hit certain developing countries hardest, i.e. those without indigenous fuel supplies of note and the economies of which are closely linked with the U.S.A. and Japan. Such a country is Thailand, as also are South Korea and South Vietnam.

(2) Kaneda, op.cit.

(3) Kaneda, op.cit.

(4) The case for an "intermediate technology" is cogently and comprehensively argued by Schumacher. It adds another dimension to the controversy and has not been analyzed in this thesis both because it is too vast, complex and controversial a topic to merely constitute a small part of a larger research topic and because, rightly or wrongly, it is not at present significant in Thailand and the Lam Pao area. Schumacher, E.F., Small is Beautiful: A Study of Economics as if People Really Mattered, Blond and Briggs, 1973.

(5) Inukai, op.cit.

Fisk considers that, in a situation where mechanization extends the area of cultivable land, it will lead to an increase in the demand for labour. However, when it increases the intensity of cultivation of a given area (by multiple cropping), the effects on labour are partly positive and partly negative: positively, it increases the requirements for planting, weeding, harvesting and processing of the crop; negatively, it decreases the demand for labour in the tilling of the soil.[1]

Beckett takes a contradictory view. He thinks that in a situation where labour is abundant mechanization may only be justifiable where an increase in absolute produce is obtained or through breaking of a labour bottle neck or performing work beyond the capacity of the animal.[2]

Once adopted, however, mechanization has far reaching effects. Kaneda thinks that tractor mechanization diverts capital away from other needy areas and creates social and political problems,[3] and John stresses the cumulative effect of mechanization, bringing about obsolescence in other products and processes, demanding a re-organization of related production processes and requiring basic social and psychological change.[4]

This latter view is not shared by Brewster, who concludes that "the machine in agriculture is mechanically progressive but socially conservative, since it increases the power of the hand without disturbing beliefs fostered by the older economy of family units.[5]

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(1) Fisk, <u>op.cit.</u>

(2) Beckett, <u>op.cit.</u>

(3) Kaneda, <u>op.cit.</u>

(4) John, M.E., "The Impact of Technology on Rural Values", <u>JFE</u>, Vol.40, 1958.

(5) Brewster, J.M., "The Machine Process in Agriculture and Industry" in <u>Readings in the Economics of Agriculture</u>, 1969.

Inukai thinks that the machine in agriculture can have a great value psychologically, because it takes away a great deal of the drudgery and uncertainty of farming,[1] but the psychological effect may not always be the most obvious one, for Tempany and Grist noted in Guyana that the farm machine was more of a social asset than an economic factor in production.[2]

It is impossible to be categorical about the justification of mechanized agriculture per se. It is equally difficult to assess its applicability to any given area. What is certain, however, is that ideally such an assessment should be made prior to the introduction of farm machines.[3] In fact, however, detailed prior evaluation is usually considered impractical and, at least in a free economy, the process of mechanization is likely to be haphazard, involving considerable personal hardship as well as some financial success.

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(1) Inukai, op.cit.

(2) Tempany, H. and Grist, D.H., Introduction to Tropical Agriculture, Longmans, Green and Co., 1958.

(3) Toussaint, W.D. and Stone, P.S., "Evaluating a Farm Machine Prior to its Introduction", JFE, August 1960, No.42.

ii. Mechanization in north-east Thailand

Within north-east Thailand mechanization of agriculture is as yet slight. Table 7.15 illustrates the findings of the 1963 Census. The relative backwardness is even more marked in the case of changwat Kalasin, as Table 7.16 illustrates. Table 7.17 presents the figures given to the writer by the provincial office in 1971.

Map 7.1 indicates the unequal distribution of tractors registered throughout north-east Thailand in 1967.(1) Nakhon Ratchasima emerges as the entry point of this, as of most innovations, into the north-east, whilst central north-eastern changwat, including Kalasin, and the southern north-eastern changwat (Surin, Si Sa Ket and Buri Ram) are characteristically underdeveloped.

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(1) The co-ordinated study, mentioned previously, considers that outside Bangkok-Thon Buri registration records are found to represent only a small part of the actual tractor population. The co-ordinated study estimates that in 1967 there were 2,100 units in north-east Thailand out of a total of 19,540 in the whole Kingdom. Thailand Farm Mechanization and Farm Machinery Market, op.cit.
Chancellor makes the same point. He thinks that the reason for this is that all tractors, while still on credit contract, are registered in Bangkok and few people register them locally once the contract is completed to avoid the cost.
(Chancellor, personal communication).
The map of tractor registration, Map 7.1, thus gives a better idea of the distribution of tractors than of the total numbers involved.

Table 7.15 Use of selected agricultural equipment in north-east Thailand, 1963.

Size of holding	Number of holdings	Electric or petrol motor	Tractor	Sprayer	Thresher	Windmill and water wheel
				percentage		
2-5.9	137,071	0.5	0.3	0.5	0.1	0.2
6-14.9	363,656	0.9	0.3	0.5	0.1	0.2
15-29.9	380,339	1.4	0.4	0.8	0.2	0.1
30-44.9	169,359	1.8	0.6	0.9	0.4	0.1
45-59.9	71,234	2.0	0.9	1.0	0.6	0.1
60-139.9	52,606	2.3	1.5	1.2	1.1	0.2
over 140	2,970	4.1	10.3	2.6	6.3	0.5

(Source: Census of Agriculture 1963)

Table 7.16 Use of selected agricultural equipment in Kalasin province 1963

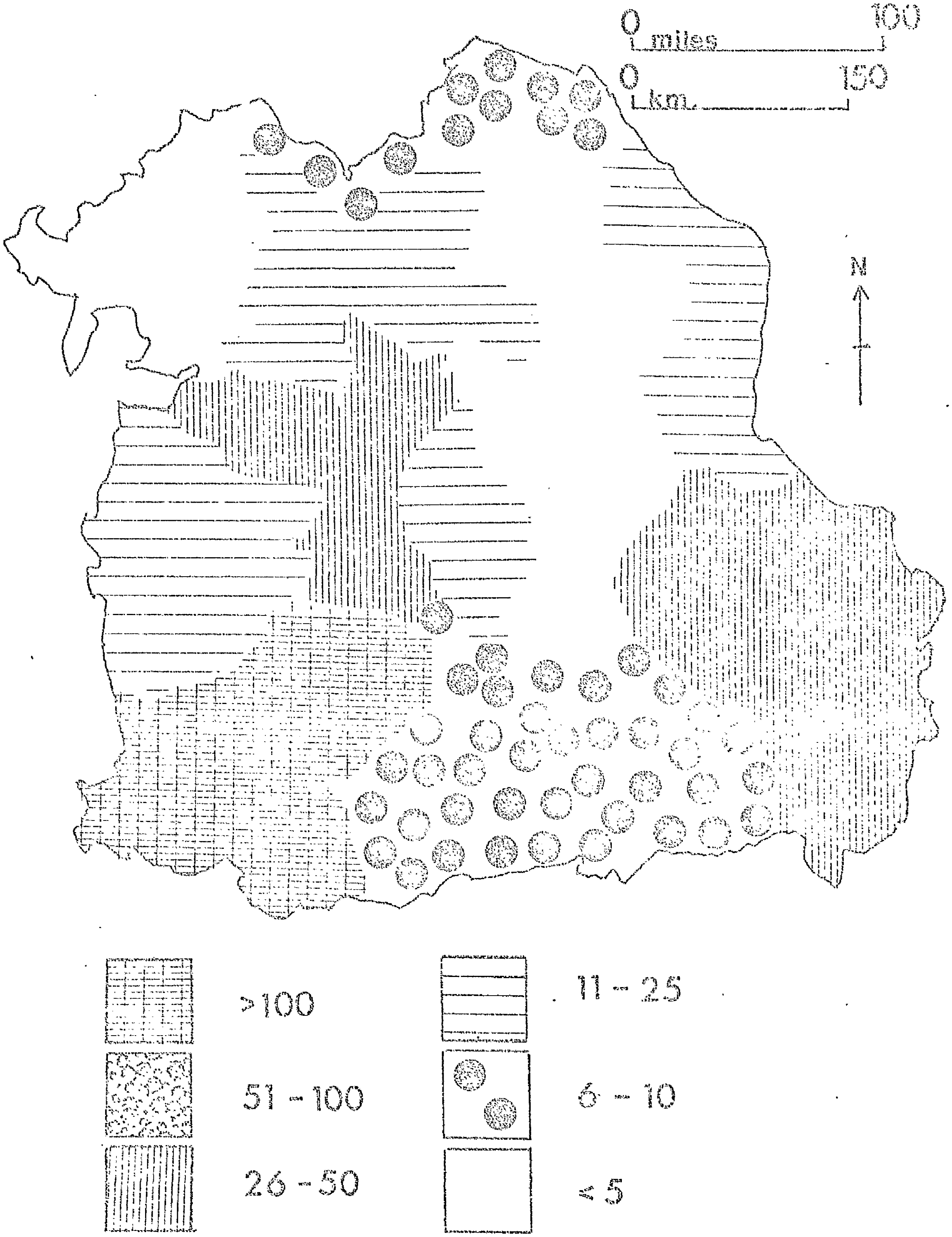
Size of holding	Number of holdings	Electric or petrol motor	Tractor	Sprayer	Thresher	Windmill and water wheel
2-5.9	7,488	-	-	-	-	-
6-14.9	18,690	-	0.1	-	-	-
15-29.9	18,457	0.1	-	-	-	-
30-44.9	8,181	-	0.1	-	-	-
45-59.9	3,258	0.1	0.1	-	-	-
60-139.9	2,191	0.2	0.6	-	-	-
over 140	98	2.0	4.1	-	-	-

(Source: 1963 Census of Agriculture)

Table 7.17 Agricultural Equipment in Kalasin Province 1971

amphoe	water pump	fertilizer spray	tractor
Muang	10	2	-
Yang Talat	-	-	1
Kamalasai	6	10	-
Sahatsakhan	-	-	-
Somdet	8	2	-
Kuchinarai	4	5	-
Tha Khantho	-	-	-

(Source: Changwat Office, Kalasin)



Map 7.1 Number of tractors registered in NE Thailand 1967

Source: Police Dept.

iii. Mechanization in the Lam Pao Sample

Within the Lam Pao Sample, although a high proportion of farmers (77%) have heard of tractor hire, only 4% have ever used it in the past or in the year of study. Fig. 7.6 and Fig. 7.7 show the impact of the water pump and tractor hire as innovations in the Lam Pao Sample.

Because of the insignificance of mechanization in the Lam Pao Sample, detailed statistical analysis is precluded. However, use of the Chi-square test reveals a relationship between tractor use and the farmer's mean income from crops (Chi-square = 4.89) and his cultivation of new field crops (Chi-square = 6.41). Similarly, the use of water pumps seems to be related to the cultivation of new field crops (Chi-square = 4.57). These three results are all significant at the 5% level.

FIG. 7.6 KNOWLEDGE & USE OF WATER PUMP IN LAM PAO SAMPLE

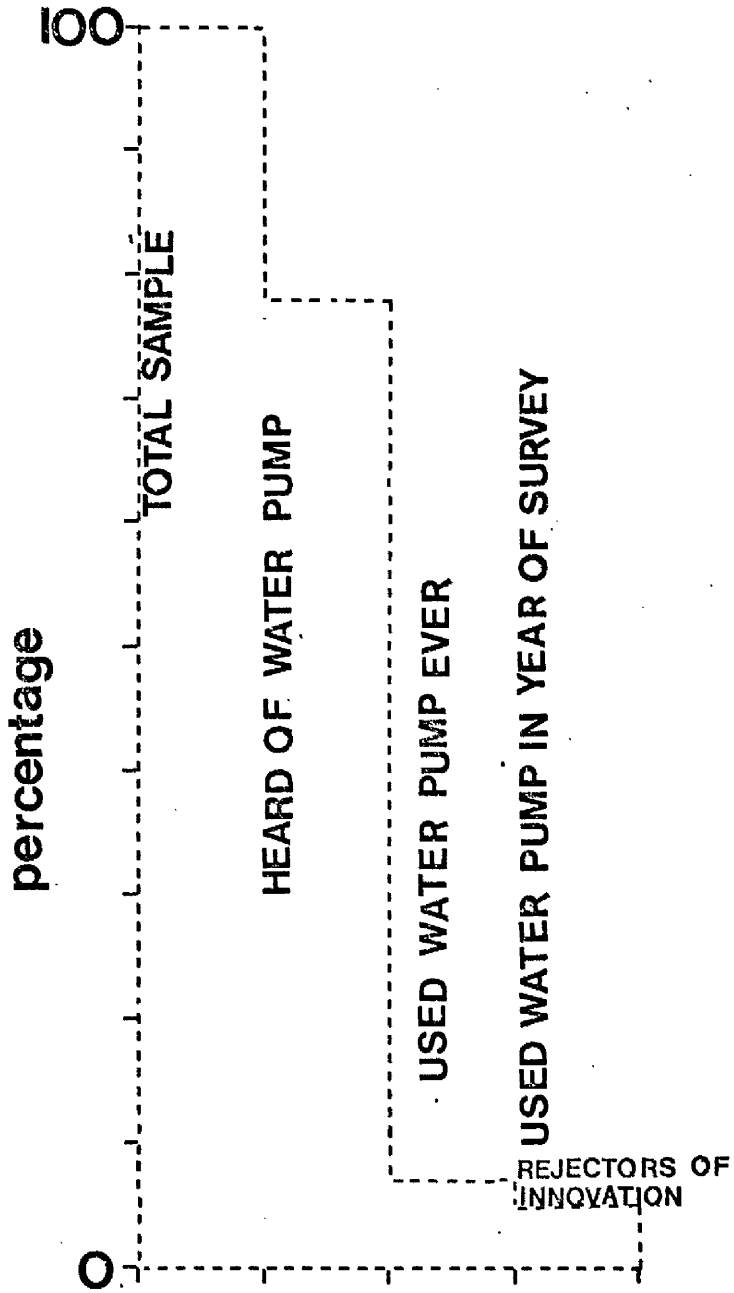
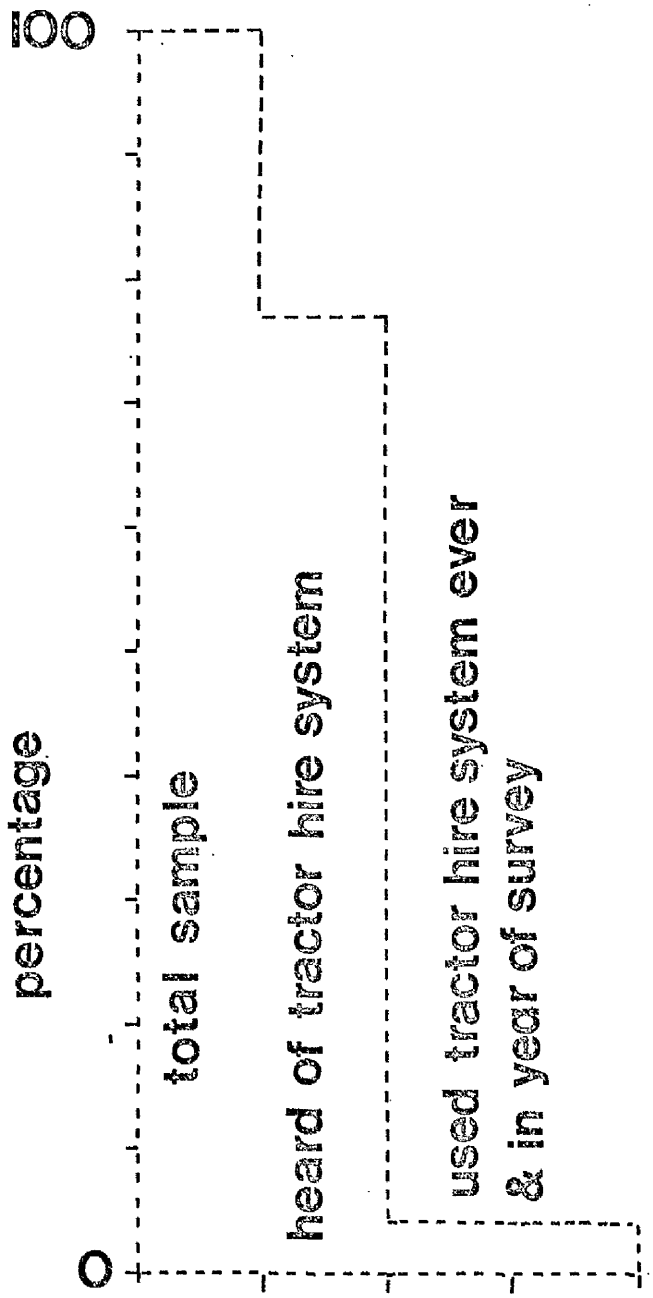


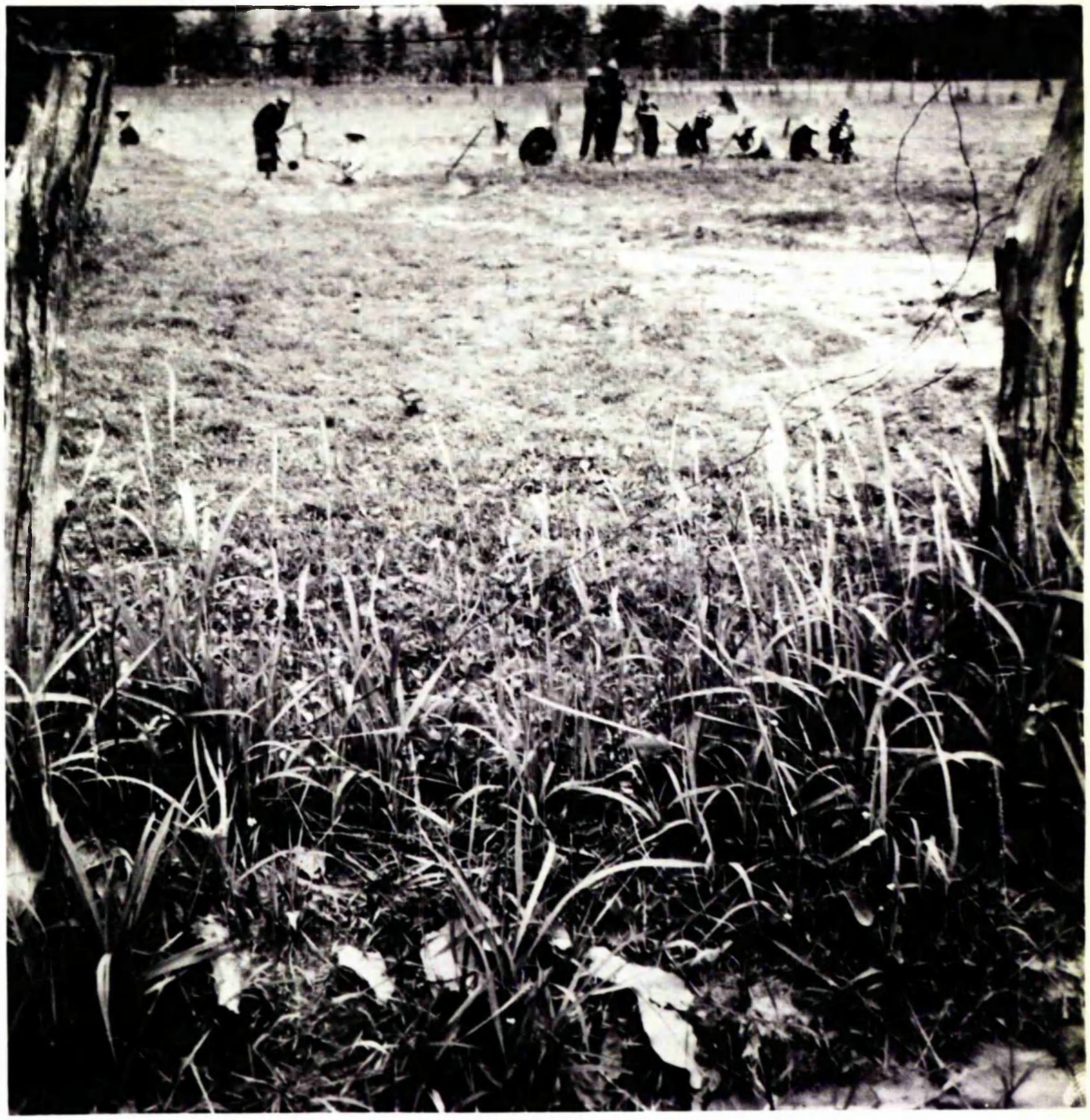
FIG. 7.7 KNOWLEDGE & USE OF TRACTOR HIRE SYSTEM IN LAM PAO SAMPLE



Source: O'Reilly, dry season, 1971.

Plate 7.2 Sowing Kenaf in Ban Tum

Sowing, like other agricultural techniques, is not as yet in the main mechanized in the Lam Pao area. Note the use of the branches as a makeshift field boundary. In the middle distance is a field house, used by the farmer when working his upland plots, since they are quite distant from the village.



Source: O'Reilly, dry season, 1971.

Plate 7.3 Weeding upland plots in Ban Tum

This plate indicates the labour-intensive nature of weeding and gives an impression of the slow and laborious nature of this work. Note here the poor state of the field boundary. Here barbed wire is used. In this plate all but two of the persons are women, the men standing in the supervisory rôle.

IV. Assessment

The interrelationships between innovations will be discussed in Chapter 8. An attempt to assess innovations is difficult. It is clear that at the government level the decision must be made whether to promote one innovation or group of innovations most vigorously, possibly at the expense of another innovation or group of innovations, or to promote all equally simultaneously, perhaps in the form of a "package deal".[1] The latter method is more costly and requires more trained personnel. Moreover, it is clear that very few Thai farmers would be able to afford all innovations at once. Thus at both the administrative level and the farm level innovations tend to be ranked according to their importance: these two ranking systems may not always coincide.

Kaneda makes the distinction between "biological-chemical technology" which is "more divisible, quicker in pay-off and primarily yield-increasing" and "mechanical-engineering technology", which is in general "'lumpy', slow in pay-off and primarily labour-displacing".[2]

This Japanese view owes much to Japanese experience, since Ohkawa considers the rapid increase in fertilizer input to have had the greatest rôle in raising output in Japanese agriculture. In fact, this innovation became significant there in 1919, whilst mechanization only

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(1) The term "package deal" implies a situation in which farmers are encouraged to adopt a group of innovations simultaneously. They are given precise quantitative information about the way each of these innovations should be used. This system was carried to its logical conclusion in the Rice Campaign in the Philippines in 1966. Then the farmer was given one plastic container, which held the entire requirements for sowing one acre with "miracle rice" (IRRI-8), viz. the seed, the proper amounts of fertilizer for each application, the correct pesticide and written instructions.
Kulp, E.M., Rural Development Planning, Praeger Special Studies in International Economics and Development, 1970.
Such a method might be useful for initial demonstration effects, but would be too costly for general use.

(2) Kaneda, op.cit.

became important after 1954.(1) According to Beckett, all the other main innovations preceded mechanization in Japan.(2)

There is a point of view that the success of chemical and mechanical innovations has largely not been the result of either research or promotion. Griliches, taking a wide view, thinks it is possible to explain almost all variations in fertilizer consumption on the basis of changing relative prices,(3) whilst Tsuchiya thinks that mechanization in Japan resulted mainly from a structural change in the labour market and the fact that near perfect conditions existed in the market for labour.(4) Neither of these observations are encouraging in the Thai context.

There is considerable opinion within Thailand that neither "biological-chemical technology" nor "mechanical-engineering technology" can hope to be successful, unless there is adequate investment in irrigation.(5) Kaneda in fact states that, where water is the limiting factor, "the strategy that maximizes output per unit of water or per unit of irrigated acreage is the most economical".(6) Clearly, however, the provision of adequate irrigation facilities takes years to implement.

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(1) Ohkawa, K., Phases of Agricultural Development and Economic Growth, International Conference on Agriculture and Agricultural Development, Tokyo, 1967.

(2) Beckett, op.cit.

(3) Griliches, Z., "The Demand for Fertilizer: an Economic Interpretation of Technical Change", JFE, 40, 1958.

(4) Tsuchiya, K., Economics of Mechanization in Small-scale Agriculture, International Conference on Agriculture and Agricultural Development, Tokyo, 1967.

(5) Ruttan, V.W., Soothipan, A. and Venegas, E.C., "Changes in Rice Growing in the Philippines and Thailand", Wld.Crops, pp.1-16, 1966.

(6) Kaneda, op.cit.

In the interim period the agricultural sector cannot be left in abeyance. The authorities have to promote and be seen to promote agricultural development as a preparation of the farmers for the benefits of irrigation and, among other reasons, as a means of alleviating regional hardship and stilling regional discontent. Unfortunately, it must be admitted that there are no clear guidelines as to the form this promotion should take. Moreover, the agricultural sector cannot be considered in isolation, but must be related to the demographic structure and industrial needs. The Japanese case confirms this, since, as Ohkawa states, each phase of agricultural growth was associated with the pattern of non-agricultural growth.(1)

At the farm level, however, the individual is presented with a confusing array of innovations. He cannot adopt all, at least simultaneously; one innovation alone may indeed prove a calculated financial risk. In the Lam Pao Sample at this stage it is difficult to ascertain how farmers rank innovations: when questioned about specific innovation, they expressed interest, but their motivation may have been desire to please the questioner. Chancellor, however, thinks that a farmer's decisions to adopt an innovation is based not on potential benefits alone, but upon "the perceived value of the product of the benefit and the probability of its occurrence to him." Thus he thinks that the tractor contractor service has more saleability than chemical innovations.(2) This may not of course be desirable.

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(1) Ohkawa, op.cit.

(2) Chancellor, personal communication.

CHAPTER EIGHT

THE GUTTMAN SCALE APPLIED TO INNOVATIONS IN THE LAM PAO SAMPLE

In previous chapters the acceptance of innovations in the Lam Pao Sample has been examined in the context of the socio-economic framework of the study villages. It is equally important to know what relationship exists between the individual innovations: whether the adoption and rejection of one innovation or one group of innovations is in any way linked to the adoption of one or more other innovations or groups of innovations.

Other studies are neither in agreement nor conclusive. Thus Sansom in the Mekong Delta of South Vietnam did not find the adoption of innovations to be linked in any way; his observations were in fact different for each individual innovation.(1) On the other hand, the Cornell Cross-Cultural Methodology Project in the village of Bang Chan in the Central Plain of Thailand found a partial linkage. Thus, although they found no evidence of "innovation mindedness", they did conclude that a farmer who was willing to try out a major capital innovation like a small motor would be more likely to try out other agricultural innovations.(2)

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(1) Sansom, R.L., The Economics of Insurgency in the Mekong Delta of Vietnam, M.I.T. Press, Cambridge, Mass., 1970.

(2) Factors Related to the Acceptance of Innovations in Bang Chan, Analysis of Survey conducted by the Cornell Cross-Cultural Methodology Project, May 1955.

To examine the precise linkage between innovations in the Lam Pao Sample the writer decided to use the Guttman scale. This is a unidimensional scale in that the component items must all measure movement away from the single underlying object and it is a cumulative scale in that the component items are ordered according to difficulty. It is used particularly in sociology and political science, but less frequently in geography. It was used effectively by Nakahara and Witton to measure the rate of structural change in Thai provinces.(1) Its utilization in the Lam Pao Sample rests upon the premise that, when the farmer is presented with an array of innovations, his choice of an innovation or group of innovations is not haphazard: he is unlikely to adopt a 'complex' innovation before he has adopted a 'simple' one. The complexity of an innovation, which may be actual or perceived complexity, may reside in the alien nature of the innovation, its indivisibility, the difficulty involved in comprehending the function, operation or maintenance of the innovation or in the nature and magnitude of socio-economic spin-offs from the innovation. The cost of an innovation is clearly an important factor, but not, except in extreme cases, the sole determinant of whether a particular innovation is adopted or rejected. Cost is merely another factor which contributes to the complexity of the innovation. In an ideal Guttman scale then all innovations could be ranked according to their complexity, as here defined. In that situation implied by the ideal scale no farmer would have adopted a particular innovation without having adopted all the other simpler innovations first.

Fig. 8.1 shows the best scale obtained by scaling all innovations. Innovations connected with cattle, chickens and water

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(1) Nakahara, J. and Witton, R.A., Development and Conflict in Thailand, Data Paper: No.80, S.E. Asia Programme, Cornell, June 1971.

Abbreviations for Innovations used in the Guttman scale

FE	Fertilizer
KE	Kenaf
NR	New varieties of rice
GR	Commercial cultivation of glutinous rice
IN	Insecticide
DU	Duck raising
PI	Pig raising
FC	Other field crops
NGR	Cultivation of non-glutinous rice
WP	Water pump use
TR	Tractor hire
CA	Cattle raising
WB	More than one water buffalo
CH	More than twenty chickens.

FIG. 8.1 AGRICULTURAL INNOVATIONS

ITEM..	TR		WR		NGR		FC		PI		DU		IN		GR		NR		KE		FF		
RESP..	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	TOTAL
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	9	2	8	3	9	2	8	3	6	5	5	6	2	9	5	6	2	9	0	11	1	10	11
5	18	4	18	4	15	7	16	6	16	6	17	5	6	16	10	12	10	12	4	18	2	20	22
4	37	3	39	1	35	5	33	7	30	10	22	18	29	11	24	16	18	22	11	29	2	38	40
3	55	0	52	3	51	4	50	5	45	9	40	15	49	6	40	15	21	34	19	36	17	38	55
2	52	1	51	2	51	2	50	3	48	5	48	5	44	9	46	7	37	16	25	28	25	28	53
1	45	0	45	0	45	0	44	1	44	1	43	2	43	2	43	2	40	5	26	19	32	13	45
	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12
SUMS	223	10	225	13	218	20	213	25	202	36	187	51	185	53	180	58	140	98	97	141	91	147	238
PCTS	96	4	95	5	92	8	89	11	85	15	79	21	78	22	76	24	59	41	41	59	38	62	
ERRORS	0	10	0	13	0	20	0	25	0	34	5	45	8	28	39	24	51	21	59	19	79	0	482

234 CASES WERE PROCESSED
0 (OR 0.0 PCT) WERE MISSING

STATISTICS..

COEFFICIENT OF REPRODUCIBILITY = 0.8159
MINIMUM MARGINAL REPRODUCIBILITY = 0.7892
PERCENT IMPROVEMENT = 0.0267
COEFFICIENT OF SCALABILITY = 0.1268

buffaloes were suppressed, since they caused too much distortion. In this table fertilizer appears as the most common innovation, followed by cultivation of kenaf and then cultivation of new varieties of rice. Then follow in ascending order of complexity the sale of glutinous rice, the use of insecticide, duck and pig raising, the cultivation of new field crops and the cultivation of non-glutinous rice. Least common of all are the use of water pump and tractor. Tha validity of the scale can be assessed by the Coefficient of Reproducibility. This is a measure of the extent to which an individual's scale score is a predictor of his response pattern. It varies from 0 to 1. It is considered in statistical literature that the Coefficient of Reproducibility should be higher than .9 to indicate a valid scale. In the case of Fig. 8.1 the Coefficient of Reproducibility is 0.8159. With such a heterogenous group of innovations this is not unexpected.

Next it was decided to split the innovations up into separate categories. Fig. 8.2 shows that the scale is less valid for animal innovations than for general innovations. The Coefficient of Reproducibility for animal innovations is 0.7815. The scale is only slightly more valid for crop innovations than for animal or general innovations, as Fig. 8.3 shows. For crop innovations the Coefficient of Reproducibility is 0.8370.

Fig. 8.4 shows the Guttman scale applied to technical innovations, viz. the use of fertilizer, insecticide, water pump and tractor. The Coefficient of Reproducibility here is 0.9454 which indicates a valid scale.

Thus it can be concluded that there is no clear evidence that animal innovations are linked. Thus the farmer does not necessarily have to have innovated with respect to water buffalo, i.e. by rearing

FIG. 8.2 ANIMAL INNOVATIONS

SCALE	ITEM..	PI 0	PI 1	DU 0	DU 1	CH 0	CH 1	CA 0	CA 1	WB 0	WB 1	TOTAL
	RESP..	0	1	0	1	0	1	0	1	0	1	
		ERR		ERR		ERR		ERR		ERR		
	5	0	1	0	1	0	1	0	1	0	1	1
			ERR									
	4	7	4	0	11	3	8	1	10	0	11	11
					ERR							
	3	25	11	16	20	17	19	8	28	6	30	36
							ERR					
	2	52	13	52	13	44	21	33	32	14	51	65
									ERR			
	1	86	7	87	6	75	18	76	17	48	45	93
											ERR	
	0	32	0	32	0	32	0	32	0	32	0	32
SUMS		202	36	187	51	171	67	150	88	100	138	238
PCTS		85	15	79	21	72	28	63	37	42	58	
ERRORS		0	35	0	39	20	39	42	17	68	0	260

238 CASES WERE PROCESSED
0 (OR 0.0 PCT) WERE MISSING

STATISTICS..

COEFFICIENT OF REPRODUCIBILITY = 0.7815
MINIMUM MARGINAL REPRODUCIBILITY = 0.7126
PERCENT IMPROVEMENT = 0.0689
COEFFICIENT OF SCALABILITY = 0.2398

FIG. 8.3 CROP INNOVATIONS

ITEM..	NGR 0	NGR 1	FC 0	FC 1	SGP 0	SGP 1	NR 0	NR 1	KE 0	KE 1	TOTAL
SCALE 5	0	0	0	0	0	0	0	0	0	0	0
4	1	1	1	1	0	2	0	2	0	2	2
3	23	10	22	11	9	24	9	24	3	30	33
2	65	7	62	10	50	22	21	51	18	54	72
1	89	2	88	3	81	10	70	21	36	55	91
0	40	0	40	0	40	0	40	0	40	0	40
SUMS	218	20	213	25	180	58	140	98	97	141	238
PCTS	92	8	89	11	76	24	59	41	41	59	
ERRORS	0	20	1	24	9	32	30	21	57	0	194

238 CASES WERE PROCESSED
0 (OR 0.0 PCT) WERE MISSING

STATISTICS..

COEFFICIENT OF REPRODUCIBILITY = 0.8370
MINIMUM MARGINAL REPRODUCIBILITY = 0.7496
PERCENT IMPROVEMENT = 0.0874
COEFFICIENT OF SCALABILITY = 0.3490

FIGURE 8.4 TECHNICAL INNOVATIONS

```
ITEM.. TR           WP           IN           FE

RESP..  0      1 I   0      1 I   0      1 I   0      1 I  TOTAL
-----I-ERR-----I-ERR-----I-ERR-----I-ERR-----I
S    I          I          I          I          I
C. 4 I   0     1I   0     1I   0     1I   0     1I      1
A    I------ERRI          I          I          I
L    I          I          I          I          I
E  3 I   2     3I   2     3I   1     4I   0     5I      5
     I          I------ERRI          I          I
     I          I          I          I          I
   2 I  43    5I  42     6I   8    40I   3    45I     48
     I          I          I------ERRI          I
     I          I          I          I          I
   1 I 107     1I 105     3I 100     8I  12    96I    108
     I          I          I          I------ERRI
     I          I          I          I          I
   0 I  76     0I  76     0I  76     0I  76     0I     76
     I----------I----------I----------I----------I
SUMS    228    10  225    13  185    53   91  147       238
PCTS     96     4   95     5   78    22   38   62
ERRORS    0     9    2     9    9     8   15    0        52


   238 CASES WERE PROCESSED
     0 (OR  0.0 PCT) WERE MISSING


STATISTICS..

COEFFICIENT OF REPRODUCIBILITY = 0.9454
MINIMUM MARGINAL REPRODUCIBILITY = 0.8246
PERCENT IMPROVEMENT = 0.1208
COEFFICIENT OF SCALABILITY = 0.6886
```

more than he needs for his work force, the excess being reared for sale, before he may branch out into cattle rearing. Indeed, in the case of farmers who have a small number of both water buffaloes and cattle, these two species serve as complementary work beasts, the cattle working the upland areas, which may be too dry for the water buffalo. The large scale raising of cattle and water buffaloes are not linked. There is similarly no evidence that a farmer will undertake large scale raising of either or both of the two bovine work beasts before he undertakes large scale raising of chickens, ducks or pigs. Of these latter three creatures ducks and pigs are statistically so uncommon as to be considered innovations in their own right. (This of course only refers to the Lam Pao Sample, since duck and pig raising are very common in certain other parts of Thailand). Chickens are however a traditional part of the farm economy. Thus it was arbitrarily decided that, if a farmer has over twenty chickens, this is an indication that chicken raising is for him a commercial rather than a subsistence activity. It is probable, however,that farmers with less than twenty chickens are in some instances commercial chicken raisers.

Similarly, it is not necessary for farmers to have innovated in adopting the crops, which, though once comparatively rare, are now common through the area (in particular kenaf) before they adopt less common or new crops. However, farmers are unlikely to venture to use the technological innovations of water pump or tractor, if they have not first used the chemical innovations of fertilizer and insecticide. In the same way, they are unlikely to use insecticide, if they have not first used fertilizer. There is, however, no apparent relationship between the adoption of technical, animal and crop innovations.

The preceding evidence should be regarded as suggestive rather than conclusive. It awaits corroboration by testing in similar socio-economic settings.

Finally, it was decided to examine the rejection of innovations. Information was available on the rejection rates of fertilizer, insecticide, water pump, new field crops, new rice and tractor hire. Fig. 8.5 shows the resulting Guttman scale. The Coefficient of Reproducibility is 0.9776, which is the most valid scale obtained. Thus farmers who reject one innovation are likely to reject one or more other innovations that they have already adopted and possibly all other innovations that they have already adopted. This may be because their adoption of innovations in the first place was rash and ill-considered and they are therefore dissatisfied with all the innovations they thus adopted. Alternatively, it may be that they are only dissatisfied with one innovation, but that this fact has induced them to reject more or all. Further questionnaire work would be necessary to determine which of these two viewpoints is correct. Moreover, the Guttman scale has indicated that, even though the adoption of technical and crop innovations are not linked, their rejection is linked. There is no information about the rejection of animal innovations. However, animal innovations are by their very nature less easy to reject. At any rate the overall evidence suggests that the rejection of innovations has a more marked "snowball" effect than their adoption. Presumably, this only applies in a situation where the investment involved in adopting an innovation has not been so great as to make rejection a costly and rash step.

Certain concluding qualificatory remarks must be made. In the first place some of the innovations are very new in the area, e.g. tractor hire. As farmers become more used to such very new innovations,

FIG. 8.5 REJECTION OF INNOVATIONS

```
ITEM.. TR        NR        FC        WP        FE        IN

RESP..   0    1 I  0    1 I  0    1 I  0    1 I  0    1 I  0    1 I TOTAL
-----I-ERR-----I-ERR-----I-ERR-----I-ERR-----I-ERR-----I-ERR-----I
S    I         I         I         I         I         I         I
C  6 I   0    0I   0    0I   0    0I   0    0I   0    0I   0    0I     0
A    I-------ERRI        I         I         I         I         I
L    I         I         I         I         I         I         I
E  5 I   0    0I   0    0I   0    0I   0    0I   0    0I   0    0I     0
     I         I-------ERRI        I         I         I         I
     I         I         I         I         I         I         I
   4 I   0    0I   0    0I   0    0I   0    0I   0    0I   0    0I     0
     I         I         I-------ERRI        I         I         I
     I         I         I         I         I         I         I
   3 I   3    0I   3    0I   3    0I   0    3I   0    3I   0    3I     3
     I         I         I         I-------ERRI        I         I
     I         I         I         I         I         I         I
   2 I  13    1I  14    0I  14    0I  12    2I   2   12I   1   13I    14
     I         I         I         I         I-------ERRI        I
     I         I         I         I         I         I         I
   1 I  31    0I  30    1I  29    2I  29    2I  23    8I  13   18I    31
     I         I         I         I         I         I-------ERRI
     I         I         I         I         I         I         I
   0 I 190    0I 190    0I 190    0I 190    0I 190    0I 190    0I   190
     I---------I---------I---------I---------I---------I---------I
SUMS   237    1  237    1  236    2  231    7  215   23  204   34     238
PCTS   100    0  100    0   99    1   97    3   90   10   86   14
ERRORS   0    1    0    1    0    2    0    4    2    8   14    0      32

   238 CASES WERE PROCESSED
     0 (OR   0.0 PCT) WERE MISSING

STATISTICS..

COEFFICIENT OF REPRODUCIBILITY = 0.9776
MINIMUM MARGINAL REPRODUCIBILITY = 0.9524
PERCENT IMPROVEMENT = 0.0252
COEFFICIENT OF SCALABILITY = 0.5294
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the resulting Guttman scale might be very different. Secondly, the total number of rejectors is much smaller than the total number of adopters. If the rate of rejection of innovations were to increase, this might also considerably modify the Guttman scale.

CHAPTER 9

THE RÔLE OF EDUCATION, ORGANIZATION AND EXPERIMENTATION IN AGRICULTURAL DEVELOPMENT

It is questionable whether innovation, change and development can occur spontaneously in agriculture without the influence of outside forces. In the developing world it is assumed that outside forces should play a large part in developing traditional agriculture, both by providing a favourable infrastructure within which change can take place and by actually stimulating change. Such outside forces include education, organization and experimentation. Education refers not only to the dissemination of agricultural knowledge to cultivators but also to the transformation of their outlooks and expectations. It also includes the building up of a corps of indigenous specialists in all branches of agriculture. Organization refers at the highest level to the organization of government departments relevant to agriculture or of private commercial groups which may influence the agricultural sector. At the lowest level, the village level, it refers to the banding together of individual farmers for their mutual benefit and protection, either spontaneously or through government pressure or encouragement. Experimentation refers to research in all branches of science, both physical and social, the aim of which is the improvement and rationalization of the agricultural sector.

I. Education

It seems a truism that education is necessary for development in agriculture and in the economy as a whole and that investment in education is prudent. This assertion, however, needs qualification. In the first place it is possible for an educational system to maintain the socio-economic status quo rather than induce change. In fact perusal of history leads one to the conclusion that this has been the primary purpose of education in most of the great civilizations. At the present time, according to Beeby, the least developed countries have the most conservative educational systems.[(1)] In such instances it is unlikely that the 'need for achievement' will be fostered which McClelland considers one of education's most fruitful consequences.[(2)] Whether the need for achievement and the allied competitive instinct are inherent in man, but capable of being submerged by socio-cultural pressures, or whether they are entirely a result of such socio-cultural pressures is difficult to ascertain. What is clear is that these so-called instincts are by no means universal in human societies; in fact they are far from ubiquitous even in those advanced industrial societies in which they are considered normal. Steggerda's work among the Maya Indians of Yucatan provides but one example of a society deficient in such instincts.[(3)]

That education is necessary for economic development is far from obvious. Certainly, the rôle of education in the British Industrial Revolution was not of great significance. In fact, Curle and Cerych consider that economic development precedes increased expenditure on education rather than vice versa.[(4)] [(5)]

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(1) Beeby, C.E., The Quality of Education in Developing Countries, Harvard Univ. Press, 1966.

(2) McClelland, D.C., The Achieving Society, D. Van Nostrand Co.Inc.,1961.

(3) Steggerda, M., Maya Indians of Yucatan, Carnegie Institution of Washington, 1941.

(4) Curle, A., Educational Problems of Developing Societies, Praeger Special Studies on International Economics and Development, 1969.

(5) Cerych, L., Problems of Aid to Education in Developing Countries, Praeger Special Studies in International Economics and Development,1965.

Education may be subdivided into general education, higher education and vocational education, being aimed at schoolchildren, scholars and workers respectively. General education usually imparts literacy and a superficial acquaintanceship with academic subjects, as well as inculcating the values of the state and society. Whatever value literacy may have per se, it is often assumed that it is a prerequisite for agricultural and economic development. Arnaud argues that agricultural development cannot proceed beyond a low level of technology if farmers are illiterate.(1) On the other hand, Wharton found no correlation between literacy and agricultural development,(2) and Sansom found no correlation between literacy and innovativeness.(3) Pilgrim has shown in Kalasin that even though most youths are literate, there is an aversion to reading,(4) whilst Castro has demonstrated that literacy may be lost, if unused.(5)

Rural primary schools in developing countries very rarely have syllabi which are tied in with the agriculture of the surrounding area. Balogh considers that the primary school should be an important driving-force behind agricultural development. He writes:

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(1) Arnaud, A., La Mise en valeur des ressources humaines dans le Bassin du Mekong., IV, L'alphabetisation fonctionelle au Laos, ECAFE Mekong Paper, Laos -ESE-5/PM, 1970. (in French)

(2) Quoted in Bowman, M.J. and Anderson, C.A. (ed.), Education and Economic Development, London, 1965.

(3) Sansom, op.cit.

(4) Pilgrim, J.W., Social Planning for Rural Development, Draft, Bangkok, 1972.

(5) According to a survey made in a rural district of Uruguay, 82% of adults who had spent five years at school lapsed back into illiteracy or so-called 'semi-illiteracy'.
Castro, J., Illiteracy in Latin America, Santiago Conference, March 1962.

> "The rural elementary school must be made the centre of the rural renaissance... elementary biology, soil chemistry and knowledge of implements and their use and of crop management must be given an increasingly important place...the schools could, to some extent, be self-supporting". (1)

Balogh's ideas would involve fundamental social changes. Griffiths thinks, however, that, only if economic development is taking place, can the school be expected to play a part, albeit a subsidiary one.[2] The education of children can be expected to produce development in two, not mutually exclusive, ways, viz. through the children 'educating' their parents and through the children becoming progressive farmers when they are adults. The first method seems unlikely. Even in advanced societies the old are reluctant to pay heed to the wisdom of youth; in traditional societies youth would not presume to air its wisdom. The second method, although more feasible, is not straightforward. In the first place young men in traditional societies may have to wait a long time before they acquire their own land and thus have the opportunity of putting their new progressive ideas into practice. During this waiting period what was learned in school is likely to be submerged by the traditional agricultural 're-education' provided by father and kinsmen. Moreover, Bennett claims that there is little objective evidence that the directional motivation of a child helps the directional motivation of the same person when an adult,[3] whilst Griffiths claims that the agricultural rôle of the school clashes with

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(1) Balogh, T., Land Tenure, Education and Development, Report prepared for the seminar of the International Institute for Educational Planning, Paris, 1964.

(2) Griffiths, V.L., The Problems of Rural Education, UNESCO, 1968.

(3) Bennett, N., "Primary Education in Rural Communities: an investment in ignorance," JDS, Vol.6, July 1970.

farm parents' ideas of what a rural school should be, viz. a means by which their offspring may escape from the drudgery and low status of farming.(1)

In addition, for rural schools to be able to impart progressive agricultural knowledge implies a situation where rural schoolteachers are more advanced in their agricultural knowledge than the average local farmer. In the main this situation seems improbable. The training of rural schoolteachers is usually mainly academic and, owing to desperate teacher shortages in developing countries, this academic training may leave room for improvement. In some cases, for example north-east Thailand, the rural schoolteacher may own and farm land. In such cases his school duties may hinder him from becoming one of the more progressive farmers or even make him a relatively indifferent farmer.

If schoolchildren should not be the main target of agricultural education, the alternative is to provide the farmers with vocational education. However, Shipman points out that Japanese agriculture developed without vocational education,(2) whilst Johnson and Mellor claim that even an extension service was lacking.(3)

Such education may be imparted by extension agents or local figures of authority or may necessitate farmers attending courses in vocational schools, either day schools or residential. Over a wide area knowledge may be more conveniently, if less effectively, spread by the mass media. Lerner considers these to be very important.(4)

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(1) Griffiths, op.cit.

(2) Shipman, M.D., Education and Modernization, Faber & Faber, 1971.

(3) Johnson, B.F. and Mellor, J.W., "The Rôle of Agriculture in Economic Development", AER, Vol.51, No.4, September 1961, pp.566-93.

(4) Lerner, D., The Passing of Traditional Society, Free Press of Glencoe, 1958.

Shapiro[1] and Rogers and Herzog[2] have demonstrated the value of the radio and the newspaper respectively in this context. Finally, for an educational programme to be successful it must be under the direction of men competent in all subjects relevant to agriculture and must, at a lower level, be manned by able field workers. This demands an increasing emphasis upon agriculture in colleges and universities. However, agriculture does not seem an attractive proposition to the gifted student. Those who do study it often aim for an administrative rather than a field or even research position.

II. Education in Thailand

Elementary education was made compulsory in Thailand in 1921. Virtually all rural children enter low elementary schools and complete four grades, leaving school at about eleven years of age.[3] Upper elementary schools where they can proceed beyond the fourth grade are but thinly spread throughout the rural areas. Fuhs and Vingerhoets state that for the country as a whole, excluding the metropolitan area of Bangkok-Thon Buri, the ratio of lower elementary schools to upper elementary schools was 13.5 to 1 in 1965 and in the period from 1966 to 1967 only 14% of north-eastern pupils passed from fourth to fifth grades, compared with 30% to 40% for the Central Plain (excluding Bangkok-Thon

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(1) Shapiro found in Turkey that villages distant from roads with radios were more developed than villages near roads but lacking radios. Quoted in Haefele, E.T. (ed.), Transport and National Goals, Brookings Institution, Transport Research Programme, 1969.

(2) Rogers, E.M. and Herzog, W., "Functional Literacy amongst Colombian peasants", EDCC, Vol.XIV, No.2, January 1966.

(3) Saihoo, P., Review of Present Economic and Social Circumstances of Children and Youth in Thailand, National Seminar on Planning for Children and Youth in Thailand, Nov. 1970.

Buri) and the south and 22% in the north.(1)

Effective co-ordination of the education system may be hampered by the fact that, whilst rural elementary schools are the responsibility of the Ministry of the Interior, secondary schools are administered by the Ministry of Education. Within the Lam Pao Sample 51 adults (7.25% of total adults) have received no education and, hence, are presumably illiterate. Of these 82% are women and 18% men. They are generally old, the mean age of the uneducated men being 44 years and of the uneducated women 55 years. All children of school age are at school by the age of nine years in the Sample. Only 3% of eight year olds but fully 46% of seven year olds are not at school.

According to Pilgrim's study of an area which overlapped the Lam Pao Sample, most youths are literate but do not use their literacy.(2) At present the curriculum in Pilgrim's sample is not geared to agriculture.

In 1969/70 there were twenty-six agricultural education institutions in Thailand, of which seven were in the north-east.(3) The Lam Pao Area is served by the Vocational School for Agriculture in Kalasin.

Advanced agricultural education is provided by Kasetsart University in Bangkok, the main purpose of which is to train students for government service. There are agricultural colleges in the Universities of Chiang Mai in the north and Khon Kaen in the north-east and one is

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(1) Fuhs, F.W. and Vingerhoets, J., Rural Manpower, Rural Institutions and Rural Employment in Thailand, Manpower Planning Division, NEDB, Bangkok, 1972.

(2) Pilgrim, op.cit.

(3) The Second National Economic and Social Development Plan, (1967-1971) NEDB, Bangkok.

planned for the University of the South in Pattani. Chulalongkorn University in Bangkok has a veterinary school. The University of Khon Kaen, established in 1964, is intended to stimulate agricultural progress throughout the north-east. It has a University farm with an area of 2,000 rai. However, there is evidence that many of the students are from a non-farming background. Moreover, of the 115 students who had graduated by 1970, only 17 went into teaching positions, including college teaching and extension, 10 combined research and extension, whilst fully 60 plumbed for research and 14 took up careers unconnected with agriculture.[1] To consider that the bias should rather be in favour of teaching and extension activities is not to denigrate the value of research.

Fuhs, moreover, considers that on the farms cultivated by institutes for higher and advanced agricultural education the management practices may be inferior to those of neighbouring farms,[2] a viewpoint confirmed by the writer's own observations. This situation would tend to diminish the teaching value of such an institution.

None of the aforementioned places teach farmers. Although Pilgrim favours farmers taking short training courses at special institutions,[3] in the main farmers receive their education through the extension service, either directly or by way of influential men in the village, whilst the mass media play a subsidiary rôle.

The Department of Agricultural Extension was created in 1968

(1) This information is taken from a booklet entitled Faculty of Agriculture, Khon Kaen University, which was provided by the University of Khon Kaen.

(2) Fuhs, op.cit.

(3) Pilgrim, op.cit.

by merging the extension services of the Department of Rice and the Department of Agriculture. At present, however, the service functions through two separate channels: there are about sixteen extension regions, each comprising four to six provinces and receiving their instruction from the Department of Agricultural Extension; at the provincial and district level extension agents receive their instructions mainly from the governor or the nai amphoe. Lack of co-ordination is thus possible. In 1970 there were 1,725 officials working at the provincial level.(1) Beal suggests a target of one extension worker per 1,000 farm families,(2) which accords with FAO recommendations.(3) Fuhs makes the point that, since the extension service was originally developed on a commodity basis, beginning with the rice extension campaign of 1937, most agents are at present either 'rice men' or 'field crop men'. It is rare to find a 'generalist', who can assess the farm as a unit.(4) Louis Berger Inc. concluded that the extension service should concentrate on assisting farmers to utilize fully irrigation systems.(5)

The extension service may facilitate its work by working through persons of authority within the village. There are three such candidates, viz. the headman, the headmaster and the abbot. Weed,

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(1) Fuhs, op.cit.

(2) Beal, D.W., "Agricultural Education and Training in Developing Countries", BBMR, Jan. 1969.

(3) Provisional Indicative World Plan for Agricultural Development, FAO, Vol.2, p.427, undated.

(4) Fuhs, op.cit.

(5) Louis Berger Inc., op.cit.

however, considers the police an important modernizing force.[1] Between headman, headmaster and abbot there exists, according to Mulder, considerable latent tension.[2] Niehoff stresses the monk's role as a disseminator of agricultural knowledge[3] and Mulder points out elsewhere that the government, members of the ranking Sangha and the Buddhist Association often interpret the Buddhist concept of 'merit' as also conducive to modernization.[4] [5] However, Mulder thinks that, although the abbot is more powerful than the headman or headmaster, upcountry people do not put their trust in him *per se*.

The village headmaster is a civil servant and usually not a native of the village. Although it is possible for him to wield influence, he has so far been inactive, according to Fuhs.[6]

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(1) Weed, A.C.II., Police and the Modernization Process: Thailand, Woodrow Wilson Association Monograph Series in Public Affairs, No. 3, Woodrow Wilson School of Public and International Affairs, Princeton, 1970.

(2) Mulder, J.A.N., Monks, Merit and Motivation, Special Report Series No.1, Centre for South-East Asian Studies, Northern Illinois University, 1969.

(3) Niehoff, A., "Therevada Buddhism: a Vehicle for Technical Change", Hum. Org. Vol.23, No.2, Summer 1964, pp.108-12.

(4) Mulder, J.A.N., An Investigation of the Motivational Qualities of the Buddhist Concept of Merit in Thailand, Centre for South-East Asian Studies, Northern Illinois University, 1968.

(5) The Buddhists believe that an individual is responsible only for his own spiritual destiny. By good deeds he stores up 'merit', which will enable him to be re-incarnated at a higher level. The individual's sins are likewise recorded and weighed in the balance. Merit-making activities include acts of charity, pilgrimages, giving alms to the monks, entering the monkhood or constructing temples. It is suggested that agricultural innovation, development and co-operative activities could also be considered merit-making. The writer recalls the abbot of the temple in Ban Tum thus extolling the virtues of irrigation in his sermon.
The mingling of the secular and the religious is fraught with perils.

(6) Fuhs, op.cit.

The headman is in fact the usual harbinger of news for the village. He is called to the district office once a month by the _nai amphoe_. He is the liaison between the villagers and the government officials or foreign research personnel. He is selected by the villagers as _primus inter pares_, this selection being approved by the _nai amphoe_. His authority is thus circumscribed, although a strong personality can wield influence. Usually he is advanced in years. Mulder considers his rôle as a medium of communication to be strictly one way: he cannot feed the wishes of the villagers back into the higher bureaucratic officialdom.(1) Thus in effect to the villagers the _nai amphoe_ and not the headman, headmaster or abbot represents the government. The developmental rôle of the headman, headmaster and abbot could, however, be considerably expanded.

The other main channel of communication for the extension service is the mass media, i.e. literature, the radio and the television. Fuhs considers these at present to be mere stimulators in Thailand.(2) According to a survey of four villages in north-east Thailand in 1964, 18% to 42% of villagers received news from the radio. Although 84% to 100% had listened to a radio, only 26% to 40% were daily listeners. A mere 1% to 16% received news from a newspaper.(3) A study of north-east Thailand as a whole in 1965 found 31.58% of farmers listened to the radio for news about the market for crops.(4)

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(1) Mulder, J.A.N., _Monks, Merit and Motivation_, _op.cit._

(2) Fuhs, _op.cit._

(3) _Village Channels of Communication in north-east Thailand, a pilot study_, USOM, 1964.

(4) _Report of the Study on Market News System in the north-east_, Division of Agricultural Economics, Office of the Under-Secretary of the State, Ministry of Agriculture, Bangkok, 1965.

Within the Lam Pao Sample no questions were asked about newspaper readership. However, as Chapter 3 shows, radios are found in all the study villages. Television sets may be viewed in the cafés at the Lam Pao dam site, whilst a number of workers' homes also posses television sets. At present, however, in the writer's opinion, their entertainment value is more important than their educational value. Coincidentally, they are destroying the art of the local raconteur and musician. Pilgrim in his survey found that 51 out of a sample of 60 youths were interested in viewing educational television.(1) In the writer's opinion there are two other possible media, viz. the travelling film show and the travelling theatre.(2)

Apart from education and extension there are a number of other miscellaneous bodies whose aim is the education of the farmer. These include the Mobile Development Unit Programme under the supervision of the Ministry of Defence, which concentrates on politically sensitive areas (including Kalasin), the Accelerated Rural Development Programme (ARD), launched in 1964, and the Potable Water Project, originally confined to the sensitive areas of the north-east. In addition the government set up the North-east Economic Development Board (NEDB) to

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(1) Pilgrim, _op.cit_.

(2) During the writer's field work period visits to the area by travelling film companies were not uncommon. They showed simple Thai romances to large audiences in an open space in the village, often the temple courtyard. It is possible that short-length films of agricultural instruction could be shown before the main feature film.
Travelling folk theatres are also quite popular. In the main, however, rural theatre is mainly satirical, even cynical, about the state of the world. This particularly applies to the peculiarly north-eastern _mo lam_ theatre. It would be difficult to imagine such actors, who are people of low status and lead a generally hard life, becoming government mouthpieces, although there are instances of north-eastern politicians having hired the _mo lam_ theatre for electioneering purposes. It is possible, however, that the government could organise its own itinerant drama groups, which might combine an educational with an entertainment rôle.

co-ordinate development in the region. In 1960 the Bureau of Community Development was established with the aim of creating "stable and self-reliant communities with an assured sense of social political responsibility".[1] This Bureau set up an academy to train nai amphoe. In 1970 75% of all nai amphoe in Thailand were "graduates" from this academy.[2]

Youth clubs and 4H clubs in the villages are a means of combining instruction and leisure time activities, whilst the Thai Volunteer Programme provides several thousand young people (mainly University students) with an opportunity to serve in remote rural villages.

Fuhs thinks that the influence of commercial persons and firms on agricultural development has been small.[3] One exception to this generalisation is the successful experiment of rural development conducted by the Shell Company of Thailand in Saraphi, changwat Nakhon Ratchasima.[4]

III. Organization

The organization of farmers into groups for their mutual

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(1) Platenius, H., The north-east of Thailand: its Problems and Potentialities, 1963, Bangkok.

(2) American Assistance to Thailand: 1950-1970. Thailand Development Report, No.5, April-June 1970.

(3) Fuhs, op.cit.

(4) This experiment, conducted in conjunction with the Department of Community Development of RTG was modelled on a similar Shell success in Borgo a Mozzano in Italy.
Saraphi - a developing village, Thailand Development Report, Vol. IV, No.8, May 1969.
However, according to information supplied to the writer by British personnel of Shell, the success of the Saraphi scheme tended to lure farmers into the area from adjacent districts with consequent neglect of the abandoned areas and excessive strain on the development area. The writer is of the opinion that 'pockets of development' can have as many unfavourable as beneficial repercussions.

co-operation is demonstrably not necessary for agricultural progress to take place. In the developed world, the United Kingdom and the United States and, in the developing world, Mexico demonstrate this. Such progress is likely to have been the result of the rationalization of the agricultural sector with the consolidation of landholdings into large viable units in the hands of the few. The opposite form of rationalization is the collectivization of agriculture, which has been attempted with varying success in the Soviet Union, Cuba, the People's Republic of China and North Korea. In between these two extremes both socialist and capitalist countries which have important rural sectors and are or were unindustrialized or but partially industrialized have attempted to achieve an evenly spread agricultural development through some form of co-operation between farmers. In Europe, Denmark, Ireland and Poland, all traditionally agricultural economies, provide examples. The co-operative ideal has been widely adopted in Asia, as Singh's compendious study illustrates.(1)

That this model is appropriate to Asian conditions is said to be illustrated by the successes of Japan and Taiwan, both of which maintained the co-operative system after agricultural progress had been achieved.(2)

The first agricultural co-operative in Thailand was set up in 1916 in changwat Phitsanulok among a group of farmers to eliminate

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(1) Singh, M., Co-operatives in Asia, Praeger Special Studies in International Economics and Development, 1970.

(2) Spaeth, D.H., "Quasi-co-operative arrangements: the Japanese and Taiwanese experience" in Agricultural co-operatives and markets in developing countries, Praeger Special Studies in International Economics and Development, 1969.

indebtedness.[1][2] Until 1938 only unlimited liability co-operatives were set up; after this date the movement embraced land co-operatives, marketing co-operatives, savings and credit co-operatives, production credit co-operatives, land settlement co-operatives,[3] land hire-purchase co-operatives[4] and land improvement co-operatives[5] as well as consumers' co-operatives and industrial co-operatives. These co-operatives were based upon the Raiffeisen model.[6]

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(1) Ladyinsky, W., "Thailand's Agricultural Economy", Foreign Agric., May 6th, 1942, pp.165-184.

(2) It is curious to note that by 1969 this province was one of only five provinces in the whole Kingdom in which there were no co-operative societies. It was furthermore the only province outside areas of insurgent activity without a co-operative society. This is anomalous and merits further study. (Source: Dept. of Land Co-operatives).

(3) These were set up to enable farmers to acquire more economically sized farms. By 1967 there were 273 of these.

(4) These acquired land with government financial aid to sell to members on an instalment basis. By the end of 1966 there were 55 of these.

(5) These were set up to encourage more scientific farming. There were 155 such by the end of 1966.

(Source for footnotes 3 to 5: Fifty Years of Co-operative Movement in Thailand, Thailand Development Report, Vol.II, No.1, April 1967.)

(6) This model is based upon the credit unions developed by Friedrich Wilhelm Raiffeisen in the Prussian Rhine province, the first being developed in Weyerbusch in 1847. The salient features of this model, which, based upon Christian socialism, was moralistic and all-embracing from the start, are as follow :
i. The liability of all members is unlimited. They are jointly and severally liable for all the debts of the village. ii. There is no share capital. iii. Membership and activities are limited to a village or other area, where each member will be known personally. iv. The surplus is used to form an indivisible reserve fund. No dividends are paid on capital or trade. v. The management are unpaid.
He considered that state help was acceptable, provided that it did not infringe upon the co-operative's independence.
At about the same time Hermann Schulze-Delitzsch developed a rival form of co-operative in Germany, henceforth known as the Schulze-Delitzsch model. It is the Raiffeisen model which has provided the basis for most agricultural co-operatives throughout Asia. However, in many cases they depart from the original aims of the founder.
The founder's original work is: Raiffeisen, F.W., Die Darlehnskassen=Vereine als Mittel zur Abhilfe der Noth der ländlichen Bevölkerung sowie auch der städtischen Handwerker und Arbeiter, 1866. (in German)
The most recent version in English is:
Raiffeisen, F.W., The Credit Unions (translated by Konrad Engelmann), Raiffeisen Printing and Publishing Co., 1966.

Each co-operative serves a closely restricted area and rests on the mutual acquaintanceship of all members and their joint and unlimited liability. However, in 1969 the first limited liability production credit co-operative was established, financed by the Bank for Agriculture and Agricultural Co-operatives.(1)

By 1969 there were about 9,600 village credit co-operatives, which, although they represented the largest institutional source of loan for farmers, accounted for only 7% or 8% of the credit received by farmers. The mean village membership was only 17 men, whereas 150 to 300 members has been suggested as optimum.(2) Village credit co-operatives accounted for 93% of all co-operatives in Thailand.(3) Fig. 9.1 shows the growth of co-operatives in Thailand.

So far agricultural co-operatives have not achieved the anticipated success. In this context Ayal contrasted the Thai value system which centres around personal values and does not require commitment to other individuals or groups with the Japanese emphasis upon political values.(4)

Oury has suggested that a crop yield insurance system should be adopted in Thailand. This would be an organization for the protection

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(1) This bank, founded in 1966, lends money to individual farmers as well as to co-operatives, whilst the Bangkok Bank provides supervised credit to small landholders.
Johnson, V.W., Agricultural Development of Thailand with special reference to rural institutions, Division of Land Policy, Department of Land Development, Jan. 1969.

(2) Johnson, V.W., op.cit.

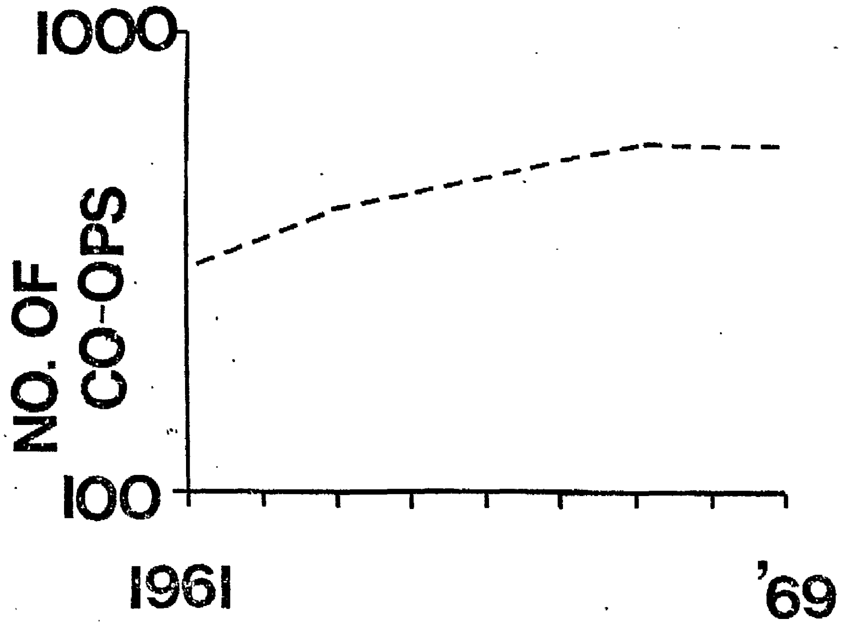
(3) Singh, op.cit.

(4) Ayal, E.B., "Value systems and Economic Development in Japan and Thailand", J. soc. Issues, Jan. 1963, XIX, No.1.

FIG.9.1 GROWTH OF AGRICULTURAL CO-OPS IN THAILAND

SOURCE: DEPT. OF LAND CO-OPS

SEMI-LOG



of farmers which operated on a national level.[1]

In 1969 north-east Thailand had 45% of all land co-operatives but only 28% of all members and 26% of the total area under co-operatives in the whole Kingdom.[2] Map 9.1 illustrates the concentration of the movement in changwat Khon Kaen, Chaiyaphum and Nakhon Ratchasima and its ill development in politically sensitive provinces. The movement is not, as yet, prominent in changwat Kalasin.

Within the Lam Pao Sample the organization of farmers has so far made little progress. Thirty-nine (16%) of farmers are members of agricultural associations. Of these, fourteen are members of co-operatives, twelve of land co-operatives and two of agricultural credit co-operatives. In addition, ten farmers are members of the Bank for Agriculture and Agricultural Co-operatives; none of these ten are members of co-operatives. The Farmers' Group and the People's Irrigation Association each have one member. The Water Users' Association has fourteen members, of which only one is also a member of a co-operative. There thus appear to be too many competing associations within the area. If this results in associations having very small memberships, it clearly impedes their proper functioning. Since the Lam Pao Sample is in a designated irrigation project area, it is possible that in the future associations connected with water use will compete with co-operatives. There is no reason why a farmer may not be a member of both types of

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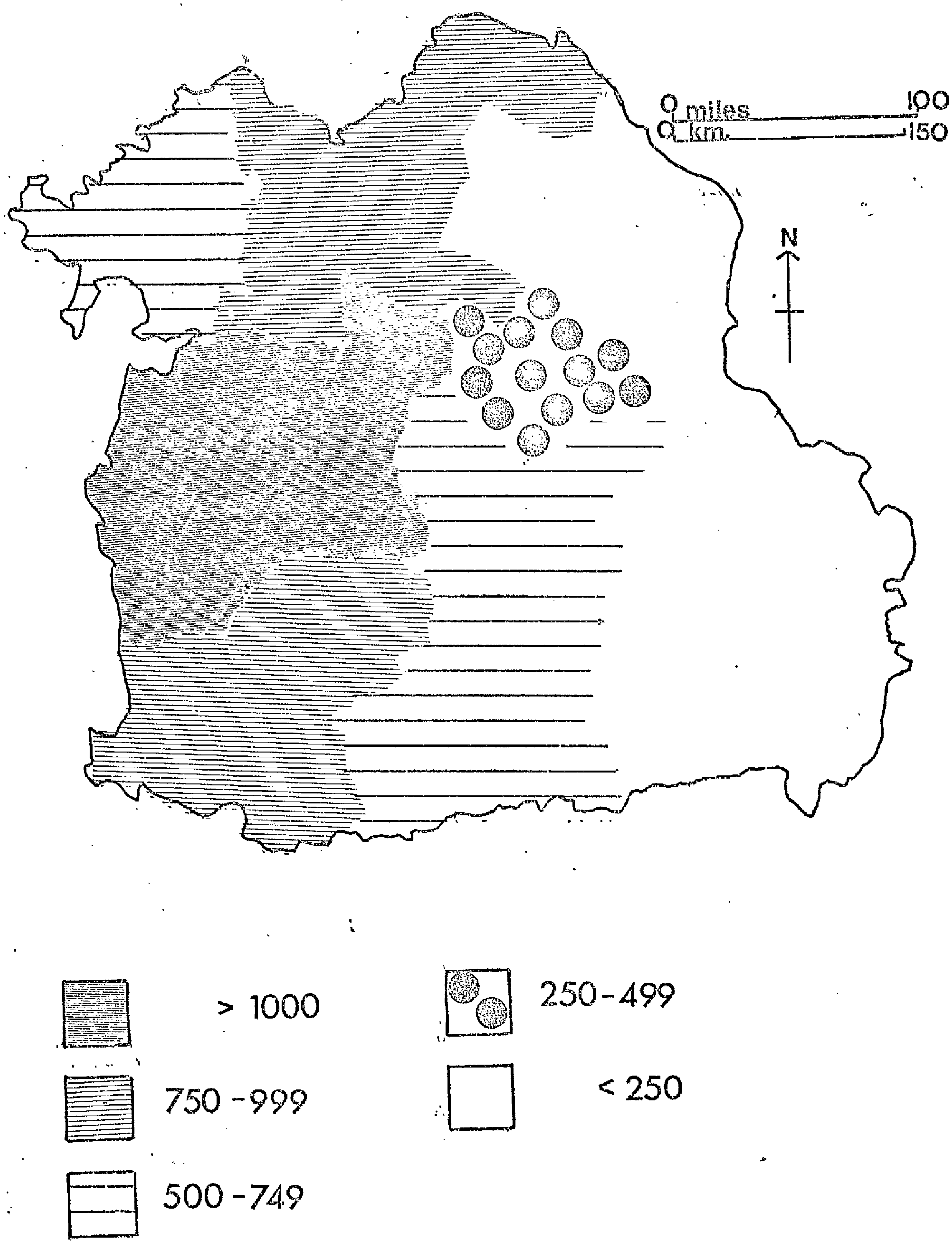
(1) This system, which works on the premise that the evaluation of risk can be established on a probability basis, is practised in Sri Lanka, India and Japan, as well as in the U.S.A. and Mexico. Oury believes that the system should be initiated on a regional scale to the whole of south-east Asia through ASEAN (the Association of south-east Asian nations).
Oury, B., "Crop insurance, credit-worthiness and development", BBMR, Oct. 1970.

(2) Source: Dept. of Land Co-operatives.



MAP 9.1 NO. OF FAMILIES IN LAND CO-OPS IN NE THAILAND JUNE 1969

Source: Dept. of Land Co-ops

association, but it seems unlikely that he would choose to be so. It is important therefore that there be some measure of co-ordination between these associations in the future.

At the moment none of these groups appear to have stimulated innovative activity within the area's agriculture. This is a reflection of their low rate of membership rather than of their impotence.

IV. Experimentation

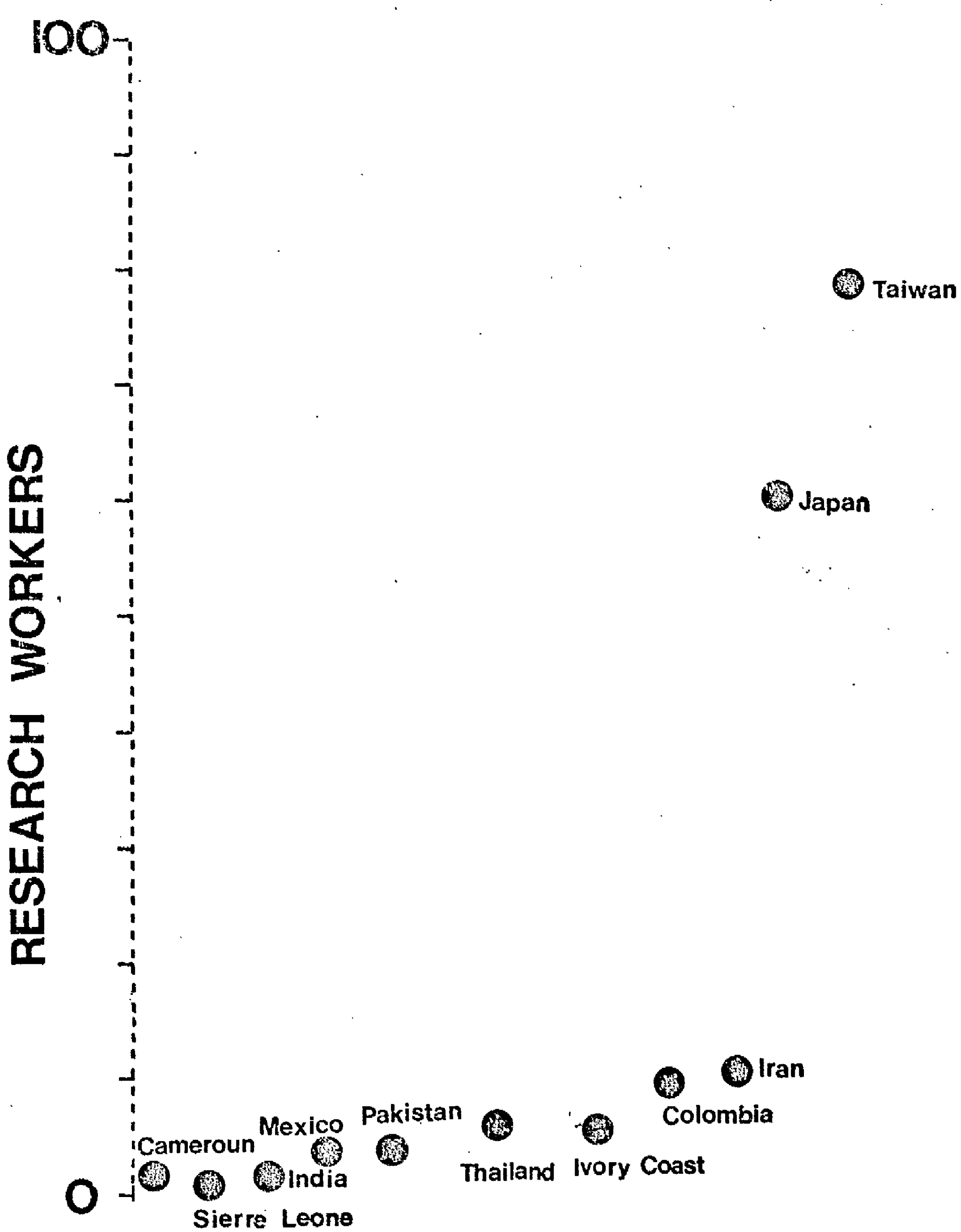
Institutes of higher education have a dual function: as well as training teachers and extension agents, they carry out research in all branches of agriculture. In addition to such institutions there is a wide variety of experimental stations throughout Thailand, including regional research centres at Chai Nat in the Central Plain and at Tha Phra, Khon Kaen in the north-east, eleven plant disease control centres, eighteen rice experimental stations and a Rice Protection Research Centre. There is a considerable overseas contribution. In fact American participation in agricultural development in Thailand dates back to 1950.[1] At present foreign projects include Danish and German dairy farms, New Zealand forage improvement and British cotton research. At Tha Phra the University of Kentucky carries out a wide variety of research, as does the Thai-Israeli team at the University of Khon Kaen. International organizations are also much in evidence. The FAO farm at Huey Si Thon serves the Lam Pao area.

Thailand has, however, only a moderate ratio of research workers per population by Third World standards, as Fig. 9.2 demonstrates. Moreover, it appears that maximum benefits are not being realized from the worthwhile research. Research priorities are established on a

(1) American Assistance to Thailand, op.cit.

FIG. 9.2 RESEARCH WORKERS PER 100,000 FARM WORKERS

Source: Directory of agric. research institutes & experimental stations. FAO, 1962.



departmental basis and research is often centred upon a specific commodity rather than upon the farm as an economic unit. Moreover, research findings are often not communicated to other interested departments. Fuhs, for example, claims that there is no link between the regional research centre at Tha Phra and the nearby Agricultural Faculty at Khon Kaen University.(1)

For research findings to be beneficial to the farmer it is necessary for all research to be assessed in terms of economic as well as agronomic feasibility. Findings must be further assessed as to their applicability to local areas, since these vary considerably one from another. Finally, these findings must be 'translated' for the farmer by knowledgeable extension agents. At present this painstaking procedure is not encountered. On the contrary, research often seems to be pursued for its own sake.

Within the Lam Pao Sample only seventeen farmers (7%) have ever visited an experimental farm. There is however a significant relationship between such visits and the incidence of second cropping (significant at the 5% level).

V. Assessment

Progress in education, organization and experimentation requires at the top level increasing funds and increasing training of personnel. Such funds are available in the form of overseas aid at the present. From 1950 to 1970 American funds for Thai agricultural development totalled over 30 million U.S. dollars.(2) At the same time the proportion of the Thai population receiving higher education is

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(1) Fuhs, op.cit.

(2) American Assistance to Thailand, op.cit.

expanding. Education abroad, always a status symbol, is increasing in importance. From 1950 to 1970 over 1,400 Thai personnel were trained abroad.(1) It is the difficult task of the government to persuade the educated to divert their talents into the agricultural sector in some way or other.

Fig. 9.3 shows the Second Plan development projects financed by government appropriation. The main emphasis is upon research and surveys, whilst agricultural organizations received less than extension activities. In the future funds must continue to be allocated to irrigation projects, since the availability of water is a crucial factor in crop diversification and increased productivity. However, emphasis upon agricultural organizations and extension activities should be improved in relation to research and survey expenditure. Map 9.2 shows the still relatively sparse distribution of schools in Loan Project for the improvement of vocational education in north-east Thailand.

At the farm level it is necessary to extend the availability of secondary elementary education and the overall education of rural youth. Co-ordination should exist between vocational schools, the extension service, co-operatives, irrigation associations and experimental farms, since all have basically an educational rôle. Possibly the most fundamental education is, however, the acceptance of the idea among both rural and non-rural people that farming need not necessarily be a low status activity.

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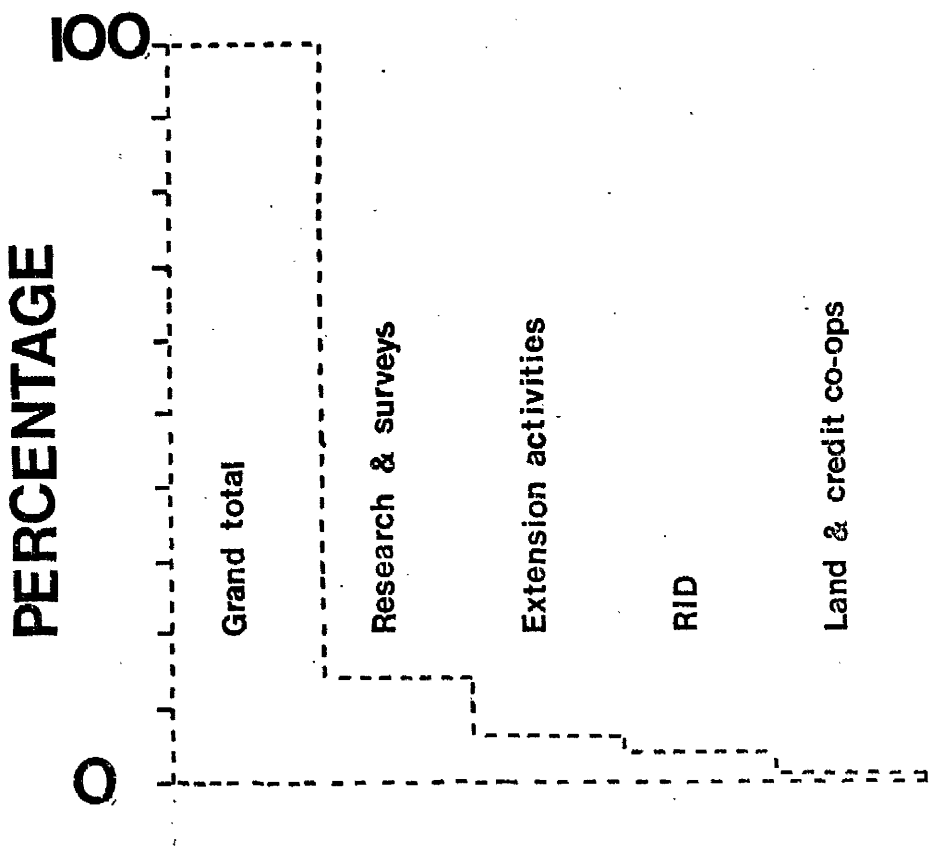
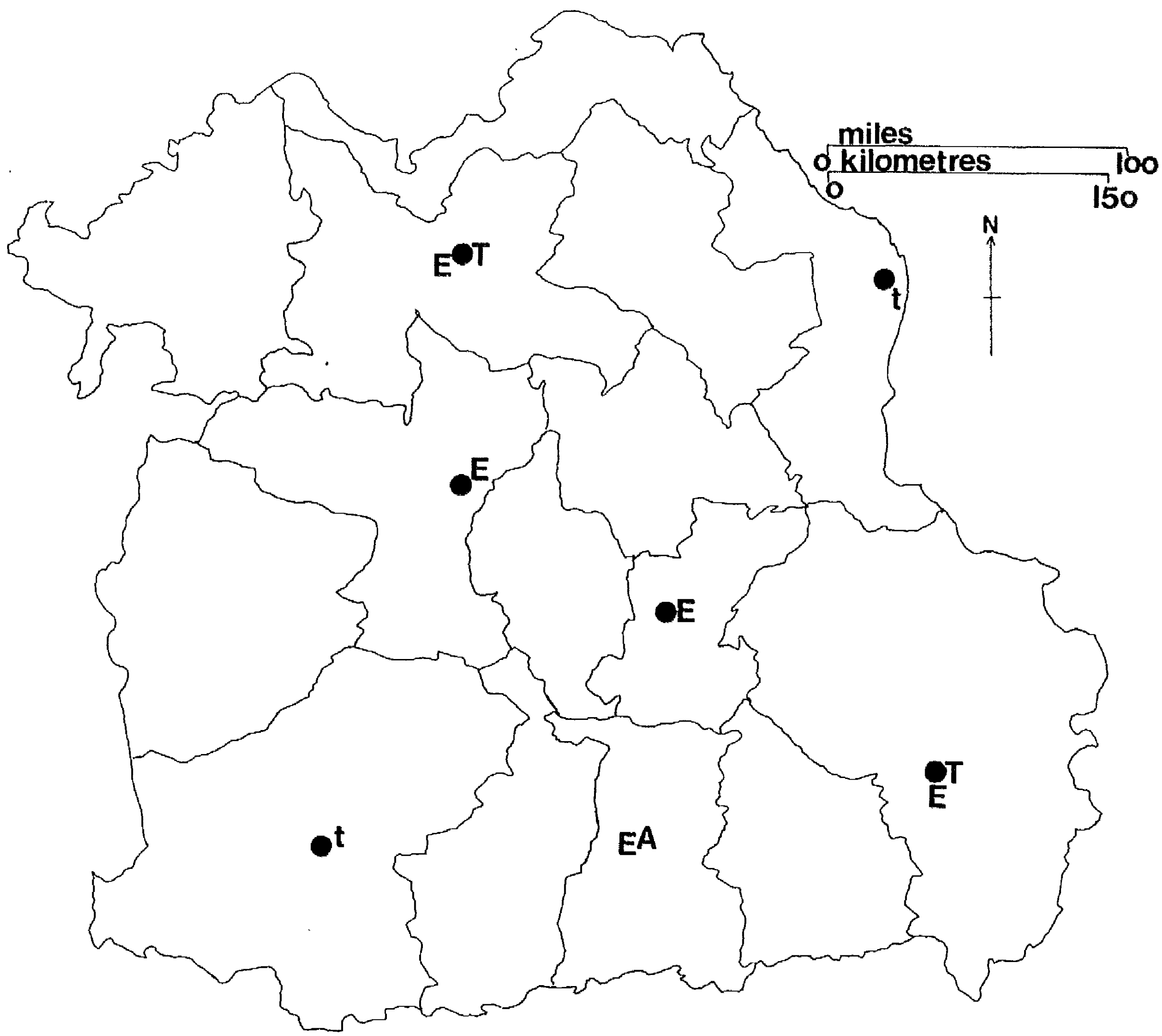
(1) American Assistance to Thailand, op.cit.

FIG. 9.3 SECOND PLAN DEVELOPMENT PROJECTS FINANCED BY GOVERNMENT APPROPRIATION. 1967-'71

Source : RTG



MAP 9.2 SCHOOLS IN LOAN PROJECT FOR THE IMPROVEMENT OF VOCATIONAL EDUCATION IN NE THAILAND



t TECHNICAL TEACHERS' TRAINING COLLEGE
E ENGINEERING SCHOOL
T TRADE AND INDUSTRIAL SCHOOL
● SCHOOL
A AGRICULTURAL SCHOOL

CHAPTER TEN

CONCLUSION

I. The North-east within the Thai State

This study has largely confirmed the popularly held notion (both within the region and within the nation as a whole) that the north-east is a disadvantaged region within Thailand. Its obvious physical defects, such as unreliable rainfall and predominantly poor soils, have been compounded by historical neglect.

The north-east fares badly with respect to a wide variety of developmental criteria employed in this study. The Gross Regional Product growth rate lags behind the Gross Development Product of the Kingdom as a whole. This region has lower yields for rice, although there is controversy over whether this is a result of environmental or varietal and cultural factors; moreover, annual yields of rice in this region appear to be decreasing. In addition, the north-east has lower yields for almost all other crops, including kenaf, which is regarded as a peculiarly 'north-eastern crop'. Farming in the north-east is less capital-intensive than elsewhere and cash returns per rai are accordingly lower for most crops. This in turn contributes to the lower per caput incomes which characterize this region. The agriculture of the region could be described as more subsistent, whilst at the same time the agricultural sector is proportionately more important, since the urban population is comparatively small.

The north-eastern agriculture remains bound to the subsistence cultivation of glutinous rice for which there is but limited commercial potential. New improved strains of rice are an innovation which have, as yet, made slight impact. Similarly, non-glutinous rice must be regarded as an innovation in the area, except in certain areas of mixed 'Isan-Khmer' population, where it is traditional. The production of both glutinous and non-glutinous rice is on the increase, but recent wide fluctuations make it difficult to determine whether the proportion of non-glutinous rice of all rice cultivated is increasing.

Of other crops kenaf is the most important. Moreover, it is primarily a north-eastern innovation. However, it has not brought permanent benefits to the region or even to many individual farmers, since the price and demand have fluctuated considerably. In fact it is possible that this crop has led to the impoverishment of some farmers.

Throughout the north-east there is a wide variety of cash crop innovations cultivated, but their cultivation is generally on a small scale. Moreover most of these cash crop innovations are also cultivated, often on a larger scale, in more edaphically and climatically favoured areas of the Kingdom.

However, the north-east has retained its traditional rôle as the most important region in the country for the production of cattle and water buffaloes. It is an important supplier of cattle and water buffaloes as work beasts for the farms in the Central Plain and a major supplier of pigs to the Central Plain for fattening.

Contrary to expectations, the incidence of disease and death from disease among cattle and water buffaloes in the north-east is disproportionately low. However, in the main the incidence of vaccination is likewise low, whilst improvements in breeding and the development of artificial insemination are still relatively insignificant.

Moreover, livestock production in the north-east faces severe, but not insurmountable, problems. These include the lack of both improved pasture and of feeding concentrates, the lack of security to protect herds and the prevalent 'rustling', the long cattle drives to market with 'shadow taxing' by police on the highways and the lack of control over slaughtering.

The value of livestock production has increased but its relative importance in the agricultural sector of the Kingdom as a whole has diminished.

Technical innovations, such as fertilizer, pesticide and mechanization are, as yet, relatively unimportant in Thailand. Their impact upon the north-eastern region has been correspondingly even more slight.

Similarly, agricultural co-operatives and farmers' associations have made proportionately little impact upon the north-east. Moreover, the region remains an educationally backward one with respect both to the academic education of schoolchildren and the vocational education of farmers. It is in addition the region with the highest incidence of disease and malnutrition.

Despite its traditional neglect the government now regards the north-east as a major developmental priority. Such development was made more urgent by the strategic importance of the region (bordering on Laos) and the problem of internal insurgency.

Irrigation is quite rightly considered to be an essential factor in the promotion of such agricultural development. However, irrigation as a significant factor of production in the north-east is recent and incomplete, and at present the north-east lags behind the Central Plain with respect to both its actual and projected irrigated area.

II. Internal Divisions of North-east Thailand

Although the north-east is indubitably a real region, in which the physical, social and economic delimitation corresponds with the popular perception, it is, nevertheless, a far from homogeneous region, as this study has demonstrated.

In general in the north-east there is a relationship between the production of glutinous rice and the size of the rural population, although production in changwat Loei and Chaiyaphum owes much to yields above the north-eastern average. The comparative unimportance of glutinous rice in Nakhon Ratchasima is an innovative feature, whilst in Buri Ram, Si Sa Ket and Surin it is a traditional feature.

Similarly, the cultivation of non-glutinous rice is generally relatively unimportant, but it is an innovative feature in Nakhon Ratchasima and a traditional feature in Buri Ram, Si Sa Ket and Surin. Cultivation is also noticeable in Khon Kaen, Udon Thani and Nong Khai, through which changwat the Friendship Highway passes, enabling greater access to the metropolitan market.

As far as kenaf is concerned, Nakhon Ratchasima clearly emerges as the entry point of the innovation in the 1950's, although by 1960 production had decreased in this changwat and become concentrated in a core area of Chaiyaphum, Khon Kaen and Maha Sarakham. By 1966 the crop was being grown throughout the north-east, but a definite core area based upon Maha Sarakham and Khon Kaen had emerged.

In general cash-crop innovativeness was found to be uniformly low in north-eastern Thailand, with the exception of Nakhon Ratchasima.

As far as livestock is concerned, those changwat bordering the Central Plain emerge as the leading suppliers of cattle and water buffaloes, whilst Roi Et, surprisingly, has the greatest surplus of pigs.

Deficits of cattle and pigs are found only in Nong Khai.

Nakhon Ratchasima similarly emerges as the entry point of mechanization in the north-east, whilst the central north-eastern and the southern north-eastern changwat are singularly undeveloped with respect to this innovation.

Agricultural co-operatives are concentrated in Khon Kaen, Chaiyaphum and Nakhon Ratchasima and ill-developed in the politically sensitive changwat.

Nakhon Ratchasima has the highest proportion of irrigated land, followed by Kalasin, albeit with a much lower proportion. The riparian changwat of Nong Khai and Nakhon Phanom have comparatively high proportions of irrigated land, as does Roi Et. In all the other changwat the proportion of irrigated land is uniformly low.

Accordingly, it was decided to rank the north-eastern changwat according to their innovativeness, based upon their scores with respect to seven selected indices, viz. the percentage irrigated area per changwat, the number of families in land co-operatives, the pig surplus, the water buffalo surplus, the cattle surplus and cash-crop innovativeness. It goes without saying that such a resulting measure will be crude, since so many other innovation indices could have been included, had they been available. Moreover, the indices themselves may not be entirely faultless, as has been pointed out in the preceding relevant chapters.

The scores thus derived are relative rather than absolute. For any particular variable the score is derived from the position of a particular changwat with respect to all other changwat. Thus, for example, Map 6.2, showing water buffalo surplus, is divided into five (arbitrarily chosen) categories. Nakhon Ratchasima falls into the first category; therefore it has a score of 1. Roi Et, Buri Ram and Udon Thani all fall in the third category; they therefore all attain a score of 3. For any variable it therefore follows that the lower the score attained by a changwat, the more innovative that changwat is with respect to that particular variable.

Table 10.1 shows the scores achieved by the fifteen changwat of the north-east for the seven selected variables. These scores were then summated for each individual changwat. Since Nakhon Ratchasima is clearly the most innovative changwat, this changwat was given a value of 1 and then the other changwat were ranked relative to Nakhon Ratchasima. Table 10.2 shows the resulting scale.

Thus it is apparent that Nakhon Ratchasima is not only the most innovative changwat, but is considerably more innovative than all other changwat. At the other end of the scale Si Sa Ket and Nong Khai are least developed, whilst Buri Ram and Surin, and perhaps Udon Thani, together with Maha Sarakham, Kalasin, Sakon Nakhon, Loei, Ubon Ratchathani and Nakhon Phanom constitute an almost equally undeveloped group. Khon Kaen emerges as a comparatively innovative changwat, as do Chaiyaphum and Roi Et.

It must be stressed that this is rather a crude measure and is suggestive rather than conclusive. Certain points strike the writer as surprising and, perhaps, unlikely. Thus, the writer's observations in the field in Roi Et make it seem anomalous that this changwat should achieve such a relatively high ranking. Similarly, the most cursory field observations suggest that Maha Sarakham is more innovative and developed than Sakon Nakhon and Nakhon Phanom. Possibly a more comprehensive choice of innovation indices (if available) would lead to a finer differentiation in this ranking.

Table 10.1 Scores of North-eastern changwat for 7 Indices of Innovation

changwat	% irrig. area	No. of families in land co-ops	Pig surplus	Water buffalo surplus	Cattle surplus	Cash-crop Innov-ativeness	Schools in loan project
Nakhon Ratchasima	1	2	4	1	1	1	2
Buri Ram	5	3	4	3	4	3	4
Surin	5	3	5	4	5	4	2
Si Sa Ket	5	5	5	4	5	3	4
Ubon Ratchathani	5	5	3	4	5	4	1
Roi Et	4	3	1	3	5	4	2
Nakhon Phanom	4	5	4	4	5	3	2
Maha Sarakham	5	3	4	4	4	3	4
Kalasin	3	4	4	4	5	3	4
Chaiyaphum	5	1	4	1	2	3	4
Khon Kaen	5	1	2	1	3	3	2
Loei	5	3	5	4	5	1	4
Udon Thani	5	2	5	3	5	4	1
Sakon Nakhon	5	5	4	2	3	4	4
Nong Khai	4	2	6	5	6	3	4

Table 10.2 Ranking of North-east Changwat according to Innovativeness

1.	Nakhon Ratchasima
2.	
3.	
4.	
5.	
6.	Khon Kaen
7.	
8.	
9.	Chaiyaphum
10.	
11.	Roi Et
12.	
13.	
14.	Udon Thani
15.	Buri Ram
16.	Maha Sarakham, Kalasin, Sakon Nakhon, Loei, Ubon Ratchathani, Nakhon Phanom
17.	Surin
18.	
19.	Nong Khai
20.	Si Sa Ket

Nevertheless, the measure does serve to underline the heterogeneity of the north-east. It further suggests that Nakhon Ratchasima, par excellence, but also Khon Kaen and Chaiyaphum have achieved a disproportionately high level of development and innovation (albeit not absolutely of great magnitude) and that certain other changwat have somewhat stagnated. This is a type of study which should be repeated and refined, since it is no solution to the north-east's regional problems to create or exacerbate intra-regional inequalities.

III. Innovations in the Lam Pao Sample

The Lam Pao Irrigation Project Area is, according to the RID, of "good to moderate irrigable land for both paddy and field crops". However, since work on the provision of irrigation throughout the area is behind schedule, it is difficult to judge whether irrigation is having or will have the desired effect as a "catalyst for innovations". Within the Lam Pao Sample use of irrigation is so far small. However, this reflects the unavailability of irrigation rather than its rejection, although there is evidence for a rejection rate.

Despite the great variety in the Sample both within and between villages most farmers are practising to a greater or lesser degree subsistence agriculture and liable to suffer considerably as a result of the vagaries of weather and damage to their crops from insects, drought and inundation. The epithet "subsistent" may, moreover, be applied with equal justification to those farmers who produce a commercial crop, be it commercial rice or a field crop, because their commercial enterprises constitute only a minor part of their total farm enterprises and because they still desire the wherewithal to provide their families with most of their sustenance.

The concomitant of subsistence agriculture is a low standard of living. Thus in the Lam Pao Sample the level of education is low, although most of the populace are literate and all the children go to school, and there is abundant evidence of dietary deficiencies. Nevertheless, it must be added that by Asian standards the Lam Pao standard of living does not seem low.

However, the Lam Pao Sample is not at present overpopulated and there is still considerable uncleared forest land within the area (government policy favours forest conservation). This study found no evidence that a state of zero marginal productivity had been attained in the agriculture of the area. On the contrary, increasing inputs of labour in most cases lead to increasing productivity on both rice and field crops. There is, however, a marked seasonal concentration of labour and, hence, seasonal unemployment.

Within the Sample the range of paddy sizes varies considerably, but the area cultivated is related directly to the size of the labour force and the number of dependents per household. Smaller holdings are farmed more intensively and are proportionately more productive than larger holdings. Productivity of land is closely connected with productivity of labour. Sale of rice remains unimportant and does not appear to be related to the degree of investment in rice farming. However, sale is directly related, as expected, to the production of a surplus above subsistence needs. Increasing commercialization of glutinous rice has in turn led to increasing productivity, most markedly on the smaller holdings.

Improved strains of rice and the cultivation of non-glutinous rice are both innovations within the Sample and both have, as yet, made little impact. Although non-glutinous rice is essentially a commercial crop, the degree of investment in cultivation in the form of purchased inputs is generally lower than is the case for the glutinous rice plots on the same holding, although the intensity of labour inputs for glutinous and non-glutinous rice are not dissimilar. There is no evidence that cultivation of non-glutinous rice has led to neglect or decreasing productivity of glutinous rice cultivation on the same holding. Non-glutinous rice appears to be an innovation which is adopted only when subsistence requirements with respect to glutinous rice are fully satisfied.

The relative prosperity of the subsistence glutinous rice holding seems to be the most crucial factor in determining development and innovation within the farm as a whole. This development and innovation may be directed towards commercial rice production or, alternatively, towards field crop production, small scale vegetable production, <u>suan</u> crops or livestock.

Kenaf is the single most important cash crop innovation in the Lam Pao Sample. The rate of adoption reproduces the S-shaped curve, familiar in the study of innovations. However, the individual farmer may change his total area under kenaf quite markedly from year to year.

The typical kenaf grower in the Sample is a young family man who possesses a relatively large holding. It appears that farmers in the Sample consciously choose between kenaf cultivation and investing in traditional glutinous rice cultivation, e.g. in the form of purchased inputs. Similarly, a choice seems to be made between utilizing available farm labour in kenaf production or seeking off-farm work. However, there is no evidence that the farmer chooses between kenaf cultivation and glutinous rice cultivation. On the contrary, it seems that a farmer must have achieved a modicum of security through production of a glutinous rice surplus before he is able or willing to innovate with respect to a purely commercial field crop like kenaf. It appears that farmers who have adopted the two innovations, kenaf and non-glutinous rice, cultivate each of these two crop innovations on a smaller scale than farmers who have adopted only one of the two crop innovations. It appears that a farmer's response to kenaf, and perhaps other crop innovations, is directly linked to his experiences in the first year of cultivation.

There is a wide variety of other cash crop innovations in the

Lam Pao Sample but their cultivation is at present on such a small scale that no meaningful conclusions can be reached regarding them.

Within the Sample water buffaloes are far more important than cattle as work beasts. However, the innovation of relatively large-scale water buffalo or cattle-rearing is rare. Large-scale cattle-raising is closely related to the possession of unplanted land, forest or fallow, which provides grazing and is also related to both the sale of glutinous rice and to kenaf cultivation. Pig-keeping is relatively unimportant in the Sample. However, pig-rearing is generally associated with large-scale cattle-rearing.

Large-scale chicken-raising, positively associated with kenaf cultivation rather than commercial glutinous rice cultivation, is negatively associated with large-scale cattle-raising. Large-scale duck-raising also seems to be an alternative to large-scale cattle-raising; it is, moreover, positively associated with kenaf cultivation and negatively associated with commercial glutinous rice cultivation. The innovation of duck-raising appears to be first adopted as a sideline to the more common chicken-raising, but, should the farmer wish to engage in large-scale duck-raising, then the decline of chicken-raising is absolute as well as relative.

Although a little over half of the farmers in the Sample use chemical fertilizer on their glutinous rice, its use on other crops is unimportant. There is a not insignificant rejection rate of this innovation. However, overall fertilizer inputs on glutinous rice are rewarded with increased yields. It is possible that use of fertilizer is related to the sale of glutinous rice, but the farmer's income and his indebtedness seem to be the most important variables in determining fertilizer use.

However, it appears in the Lam Pao Sample that capital-intensive and labour-intensive cultivation (albeit relative to the scale of operations) are not mutually exclusive alternatives. On the contrary, they coincide, since both bespeak an attempt to optimize production and an awareness that production can be improved.

Use of insecticide has, as yet, made little impact in the Lam Pao Sample. However, the rate of rejection is disproportionately high when compared with the adoption rate. Most insecticide is used on glutinous rice. Similarly, although the majority of farmers have heard of mechanization, the rate of adoption is insignificant.

Within the Lam Pao Sample agricultural associations have so far made little progress. None of these associations appear to have stimulated innovative activity within the area, but this is a reflection of their low rate of membership rather than their impotence. The results of research and experimentation likewise have had little impact in the area; few farmers have ever visited an experimental farm.

At the farm level the individual is presented with a confusing array of innovations. It is of importance to know how the individual farmer ranks these innovations, since his ranking system may not coincide with that of the extension agent or researcher. Table 10.3 indicates that in the Lam Pao Sample chemical fertilizer has the highest adoption rate of any of the group of innovations studied. Tractor hire has the lowest rejection rate, but this is coupled with a low adoption rate. Only when a low rejection rate accompanies a high adoption rate may one venture to state that the populace are 'satisfied' with an innovation. In this group of innovations the innovation of new strains of rice is closest to meeting these requirements. Conversely, the figures suggest dissatisfaction with the innovation of insecticide and, more markedly,

Table 10.3 Comparison of Adoption and Rejection Rates of Innovations

Innovation	% Adopted of those who have heard of innovation	% Rejected of those who have adopted innovation
Chemical fertilizer	74	14
New strains of rice	59	2
Insecticide	42	39
Irrigation	10	11
Water pump	9	28
Tractor hire	5	0+

\+ There was one case of a farmer rejecting tractor hire in the Sample but this was masked when the raw data was originally converted into percentages (vide Fig. 7.7). For the sake of consistency these figures were derived from the processed data rather than from the raw data.

with the water pump, in which case the rejection rate is over three times greater than the adoption rate. It would be unreasonable to draw any conclusions about the farmers' attitudes to irrigation from these figures, however, since the projected irrigation facilities are behind schedule. Because the absolute impact of all innovations in the Lam Pao Sample is not great and because not sufficient time has elapsed since the introduction of these innovations, the writer feels that it is unwise to come to any definite conclusions on the basis of these adoption and rejection rates. However, at a later stage further study might reveal a precise mathematical relationship between the adoption and rejection rates.

The use of the Guttman scale provided no clear evidence that the adoption of individual crop innovations was linked or that the adoption of individual animal innovations was linked. Furthermore, there appears to be no link between the adoption of crop innovations as a group and the adoption of animal innovations as a group. However, there seem to be strong links between the adoption of individual technical innovations. Likewise the rejection of all types of innovations appears to be linked and tends to have a "snowball" effect.

IV. Prospects

Any attempt at predicting future developments in north-east Thailand or in the Lam Pao Irrigation Project Area must be cautious. The Lam Pao area cannot be considered *in vacuo*, but must be related to the development of the north-eastern region and to the Lower Mekong Basin as a whole. Such developments are obviously directly related to the decisions and priorities of the Royal Thai Government and the Mekong Committee. However, less directly but just as surely, these decisions and priorities will depend upon the prevailing political climate within the world as a whole and in particular the developments in Indo-China and the changing relations between the United States of America and the People's Republic of China.

It is axiomatic that economics cannot be studied in isolation from politics. Thus it would be rash to predict what future demands for individual agricultural products in the Lam Pao area and the north-east might be. Indeed, for every agricultural product that the north-east produces for export one finds that it has a competitive producer in an underdeveloped country in Asia, Africa or Latin America. Such a competitive country is likely to have economic, social and political ills just as pressing as those of north-east Thailand and, moreover, to be competing in the international arena for aid and development. Moreover, for certain crops the north-east is competing on the world market with the advanced producers of Australia and South Africa. Finally, in this context, the entire world market situation for probably all north-eastern products would be drastically transformed (probably to the detriment of the north-east) by the entry of the People's Republic of China into the world arena as a major producer. Obviously, therefore, the topic is too vast and complex to permit prediction.

Accordingly, the writer merely attempts to view his study area at a specific point in time and to assess the trends in and potential of individual agricultural innovations at this point in time, *ceteris paribus*. Thus, it appears likely that glutinous rice will continue to be the principal crop of the Lam Pao area and the north-east in the foreseeable future, but that the importance of non-glutinous rice and new improved strains of rice will increase. It seems possible that the area will become less subsistent. There may be an increasing world demand for kenaf for a few years, but the long term prospects of this crop seem less promising; therefore, investment in this crop, e.g. in the form of communal retting facilities, seems not worthwhile. Of the potential crops for expansion it appears that sorghum, maize and various oilseeds offer the best prospects at present, although some of them have major disadvantages. Cassava might in the short term be a profitable innovation and might achieve the most immediate and rapid spread throughout both the Lam Pao area and the north-east as a whole. However, its effects upon the soil could be irrevocably deleterious and its export potential could conceivably decline.

However, it seems that there exists an as yet unrealized potential in the north-east of Thailand and in the Lam Pao area for cattle-raising and with it associated pig-raising. The large ranch and livestock station could have an important stimulating rôle in this context. This cattle-raising could be promoted without undue disruption of the existing farm economy. Cattle-raising could with comparative facility be combined with the existing paddy and field crop cultivation; some upland fields could be sown with improved pasture or fodder crops, perhaps on a rotations system, and the cattle (and pigs) could be fed the stalks and residues from such crops as sorghum, maize, cassava and rice. Similarly, the nation could develop its own compound feed industry based upon these crops. These developments would lessen the dependence of the north-east upon the export market for its field crops.

It is predicted and desired in official circles that the north-eastern farmer will become more 'modern', i.e. that his farming will become more capital-intensive, that he will utilize fertilizer, and insectidice and will mechanize his operations. It seems to the writer that the most crucial factor affecting the adoption of fertilizer is its present high price. Since it seems unlikely that the purchasing power of the north-eastern farmer will rise markedly in the immediate future, it follows that there must be a drop in the price of fertilizer for its use to become widespread. The controversy rages in the scientific world as to the merits and demerits of pesticide use and this controversy has had an impact upon users in the agricultural sectors of the developed countries. It is, therefore, difficult to judge what will be the future for pesticides in north-east Thailand. Likewise, the value of mechanization is no longer as implicitly accepted as previously, but it seems likely that mechanization will proceed in north-east Thailand in the future, not least because it is now in the hands of the private entrepreneur rather than the state.

However, as frequently stressed, the success of most of these changes and innovations in the north-east will be dependent upon the increased availability of irrigation.

It is axiomatic that the most crucial innovations and developments are those that occur in the mind of the farmer. Thus it will be necessary to extend the availability of secondary elementary education and the overall education of rural youth, whilst greater co-ordination should exist between vocational schools, the agricultural extension service, agricultural co-operatives, irrigation associations and experimental farms. Likewise the emphasis upon agricultural organizations and extension activities should be improved in relation to research and survey expenditure. However, perhaps the most fundamental education is the acceptance of the idea among both the rural and urban populations that farming need not necessarily be a low status activity, since it is difficult to think of a nation which has achieved true progress and development in its agriculture without the farmer being accorded dignity and respect.

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APPENDIX I

The Scope of the Lam Pao Questionnaire

The Lam Pao questionnaire was written and delivered in Thai. There is no official translation in English. Therefore, instead of producing an "unofficial" translation, the writer here confines himself to expressing the scope of the questionnaire.

Question 1. This question elicits the names, ages, sex, years of education, dates of birth, years of residence in the village and mutual relationships of all the resident members of each household. It asks the name, relationship to household head, age, sex, years of marriage, years of education, job, place of work, years of absence, frequency of return home, amount of salary and amount of salary remitted of family members who reside elsewhere.

Question 2. This question establishes the size of the individual holding and the number of plots in the holding. For each crop it discovers the area planted and harvested, the total production, the total sale and the income from sale, the price received, the month and the place of sale and the type of buyer.

Question 3. For each plot this question discovers the crop cultivated, subdivision of the plot (if any), the method of acquisition, the adequacy of water in all seasons, the crop cultivated in the previous year and the area planted to that crop, the amount of the last crop lost through drought, flood, insects, disease and miscellaneous causes, the amount of the crop harvested, the total production per plot, which is compared with production in the previous year and with normal production, the amount of the crop sold. Information is also sought on the month of ploughing, planting, transplanting, weeding and harvesting and the amount and type of labour used in these operations and the amount of time devoted to them, as well as the rate of pay for hired labour. Information is also sought on the amount of chemical and organic fertilizer used and the amount of insecticide used. The amount of second cropping is assessed: for the second crop questions are asked on the area planted, the month of planting and harvesting, the amount and type of labour used, the amount of the crop sold, the month of sale and the price received. For all crops the degree of mechanization is assessed. In this question the farmer is also asked what his reactions would be if irrigation water were available: which crops would he grow, what area would he plant to them, would he cultivate them in the wet or the dry season, would he construct a pond to raise fishes. The farmer's opinion of the potential of kenaf, cassava, groundnuts, sweet potatoes, maize and cotton is sought. Finally, in this question the amount of long khaek activity in the previous year is assessed.

Question 4. This question establishes the size of the suan, the fruit and vegetables grown therein, the amount, month and place of sale and the type of buyer, as well as the price received.

Question 5. This question is concerned with animals on the farm. With regard to water buffaloes it enquires how many the farmer has under three years of age, between three and five years, and over five years, how many he bought last year and their price, month of purchase, place of purchase and type of seller, how many he sold last year with the price, month of sale, place of sale and type of buyer. Information is sought on the number of native and pedigree cattle that the farmer possesses. The farmer is also questioned on his hire of animals for work, the time of hiring and the payment, as well as his hiring out of his own beasts for work. With regard to pigs, the farmer is asked how many he has under 6 months old, between 6 and 12 months and over 1 year, the sex of the animals, the date and place of purchase, the type of seller, and the price, as well as how many pigs he has himself sold and the price received, the date and place of sale and the type of buyer. With regard to poultry (chickens, ducks and geese) the farmer is asked how many he has under 3 months old, between 3 and 6 months and over 6 months, how many birds he has sold and how many eggs he sells, and when and to whom he sells these commodities. The farmer is also asked how many fish he caught last year, in which month he caught them, the method of fishing employed, the cost of the fishing equipment, the amount of fish sold, the price received, the place of sale and the type of buyer.

Question 6. This question is concerned with off-farm income. It establishes the amount of income from handicrafts, off-setting it with the cost of labour and equipment, and the amount of income from other sources.

Question 7. This question is generally concerned with the standard of living. First, the farmer is asked whether his house belongs to him or not, when it was built, when, if at all, it was repaired and the cost of repair, when, if at all, it was extended and the cost of extension. Secondly, the farmer is asked whether he possesses a watch, radio, bicycle, sewing-machine, water pump, or motor cycle. Finally, the extent of his travelling is assessed. He is asked whether in the previous year he went to Kalasin, Yang Talat, Maha Sarakham, Roi Et, Khon Kaen and Bangkok and whether he has ever been to the northern region, the southern region, or the Central Plain (outside Bangkok). If he has been to these other regions he is asked to name the changwat he visited.

Question 8. This question assesses the importance of farmers' associations. The farmer is asked whether he is a member of a farmers' group or co-operative. If he is a member, he is asked whether he has ever borrowed money from there, the amount borrowed and the amount paid back, the purpose of borrowing and the interest rate.

Question 9. This question assesses the farmer's credit-worthiness. He is asked how much (if any) money he has in the bank and the name of the bank. He is further asked whether he has ever borrowed money from the bank, the amount borrowed, the purpose of borrowing, the amount paid back and the rate of interest. He is similarly asked about borrowing from other sources.

Question 10. The farmer is asked whether he has ever received assistance for buying land, clearing land, purchasing animals, seed, fertilizer, insecticide, implements, or for hiring a tractor, repairing or extending his house, tree planting or canal cutting. He is asked what he considers he needs help for. Finally, he is asked if he had a larger income what he would spend it on.

Question 11. This question assesses the farmer's innovativeness. He is asked whether he has ever been to an experimental station; if so, to which one and when. He is further asked whether he has ever heard of, used at all or used in the year of the survey any of the following innovations: new rice, new field crops, water pump, irrigation, fertilizer, insecticide, tractor. Finally, some opinions are sought from the farmer. He is asked whether he considers the price received for rice, kenaf, other crops and animals to be sufficient. If he has borrowed money, he is asked whether he considers the interest rate too high. He is asked whether he considers transportation too expensive. Finally he is asked whether he needs advice on rainy season farming of rice, cassava and kenaf and whether he needs advice on dry season farming.

APPENDIX II

Questionnaire Applied to Small Sample

This questionnaire was devised in English by the writer and translated into Thai by Khun Raphee Urasayanandana of the Mekong Office.

A.

1. What is your name?

2. How old are you?

3. i. How many people are there in your family altogether?
   ii. How many children under 15 years of age?
   iii. How many men?
   iv. How many women?

B.

1. How much paddy land do you possess?

2. How much upland do you farm?

3. What area of suan do you cultivate?

4. What area of uncleared land do you possess?

C.

1. On your paddy land do you grow a) glutinous rice b) non-glutinous rice c) other crops?

   For each of these crops:

   i. What area do you cultivate?
   ii. What is your production?
   iii. What amount do you sell?
   iv. What is the price received?
   v. Do you use fertilizer or not?
   vi. If you do, how much fertilizer do you use?
   vii. What does it cost?
   viii. Do you use insecticide or not?

2. After rice do you grow any other crop on your paddy land?

   If so:

   i. Which crop?
   ii. What area do you plant to this crop?
   iii. How much did you harvest?
   iv. How much did you sell?
   v. What price did you receive?
   vi. To whom did you sell your crop?

D.

1. How much kenaf did you harvest last season: i. area ii. amount?

2. i. Was any of your crop damaged by a) insects b) disease c) drought?

   ii. If so, how much was thus damaged by each of the three causes?

3. How many a) days and b) men were spent in i) land preparation ii) weeding iii) harvesting iv) retting?

4. How far is your source of water for retting from your plot: a) less than $\frac{1}{2}$ km. b) 1 km. c) 2 km. d) over 3 km.?

5. i. Is this source of water satisfactory?
   ii. If not, why not?

6. i. Did you use hired labour on your kenaf plot or not?
   ii. If so, how many men did you use?
   iii. How many days did they work?
   iv. What was their rate of pay?

7. i. Did you use insecticide on your kenaf plot?
   ii. If so, what was the total cost of the insecticide used?

8. i. Did you hire a tractor for use on your kenaf plot?
   ii. If so, for how many days?
   iii. At what cost?

9. i. How many times do you sell your kenaf?
   ii. In which months?
   iii. At what prices?

10. i. Was any of your kenaf sold before harvest?
    ii. How much?
    iii. At what prices?

11. i. To whom do you sell your kenaf?
    ii. Do you have to pay transport costs for your kenaf?
    iii. If so, what is the rate?

E.

1. How much kenaf did you plant last year?

2. How much kenaf did you harvest last year?

3. What price did you receive?

4. How many years ago did you commence cultivating kenaf?

5. What was growing on that land before you started growing kenaf there or did you have to clear the land from the forest?

6. What area of land did you plant with kenaf in that first year?

8. What price did you receive for your kenaf in that first year?

9. From where did you obtain the kenaf seed in that first year?

10. When you first started growing kenaf, did you seek help from
a) neighbours b) government officials c) extension officers
d) other sources?

F.

1. i. What was your best year for kenaf?
ii. What was yourproduction that year?
iii. What price did you get that year?

2. i. What was your worst year for kenaf?
ii. What was your production that year?
iii. What price did you get?

3. Would you still be growing kenaf at the following prices:
a) 1.75 Baht/kg. b) 1.50 Baht/kg. c) 1.00 Baht/kg. d) 0.50 Baht/kg.?

4. If the price of kenaf increased to 3 Baht/kg. would you increase your production of kenaf in the following way: a) clear more land
b) use a tractor c) use fertilizer?

G.

1. i. After kenaf do you grow a second crop on your kenaf plot?
ii. If so, which crop?
iii. What area did you plant to this crop?
iv. What was your yield?
v. How much of it did you sell?
vi. What price did you get?
vii. When did you plant it?
viii. When did you harvest it?

2. How many men and how many days did you use in the following operations:
a) land preparation b) weeding c) harvesting?

3. i. Which other upland crops do you cultivate?
ii. How long have you been growing each crop?
iii. What area do you plant to each crop?
iv. What is your production of each crop?
v. How much of each crop do you sell?
vi. When do you sell it?
vii. What prices do you receive?
viii. Do you use fertilizer on any of these crops?
ix. Do you use insecticide on any of these crops?
x. How many days did you spend in land preparation for each crop?
xi. How many days did you spend in weeding each crop?
xii. How many days did you spend in harvesting each crop?

4. How long have you been using a) fertilizer and b) insecticide anywhere on your farm?

<u>H</u>.

1. Which <u>suan</u> crops do you grow?

2. What area do you plant to each crop?

3. What is your production of each crop?

4. What is your sale of each crop?

<u>I</u>.

1. What other crops would you be prepared to grow?

2. Would you grow these crops if the price were 2 Baht/kg?

3. What area would you plant to these crops?

4. Would you clear more land in order to cultivate these crops?

5. Would you grow these crops instead of your existing crops?

6. Would you practise double-cropping?

7. From whom would you seek advice in the techniques of cultivating these new crops?