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Untangling the nexus between marketization, crop diversity, farmers' wealth and nutrition: The case of Uzbekistan

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Abstract

The effects of marketization on crop diversity and dietary diversity is very contested. Therefore, more empirical work is needed to unpack the multidimensional factors that underpin these processes. This article expands the analytical understanding of the linkages between these dimensions by looking at the case of Uzbekistan. First, it uses quantitative methods to assess the hypotheses that (a) wealth leads to higher dietary diversity; (b) agricultural marketization leads to lower dietary diversity; and (c) crop diversity leads to higher dietary diversity. Regression analysis shows that only wealth is an independent determinant of dietary diversity. Second, the article uses qualitative data to argue that state policies and social norms, by influencing food availability, knowledge and nutritional values, are key to unpacking the relationships between marketization, crop diversity and dietary diversity.

KEYWORDS
agriculture, crop diversity, dietary diversity, marketization, Uzbekistan, wealth

I declare that I have neither financial nor personal interests that could have inappropriately influenced the study. This work is original and it has not been published elsewhere.

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1 | INTRODUCTION

Malnutrition is one of the biggest challenges the world has been facing in the last century. Most malnourished people live in rural areas of the global South, and many of them are smallholder farmers (Pinstrup-Andersen, 2013). In Uzbekistan, similarly to many developing contexts, around 17 million people, namely 50% of the population, still live in rural areas and 3% of the population, mostly in rural areas, suffer from undernutrition while 38% of them lack vitamin A (Sedik, 2017). Uzbekistan is a unique case to analyse because, in opposite direction to many low- and middle-income countries, for three decades its governments adopted state-oriented policies, which slowed-down marketization of agriculture and food.

Farmers' income has been often identified as one of the main determinants of good nutrition because, by increasing purchasing power, it can improve households' capability of obtaining food (von Braun and Kennedy, 1986; Komarek, 2010). Furthermore, since marketization in agriculture is considered the core driver of farmers' income increase, a continuous interest persists in the literature to understand if that affects dietary diversity (Ickowitz et al., 2019; Jones, 2017). The literature has largely focused on three outcomes of marketization: first, the upgrade from subsistence agriculture to market-based production, distribution, and consumption. Second, the reduction of crops produced, which often led to cash-cropping monoculture and agricultural intensification (Fafchamps, 1992; Ickowitz et al., 2019; Von Braun & Kennedy, 1986). Third, the diversification of the sources of income in off-farm activities, through the development of food processing industries (Swinnen & Vandeplas, 2011). However, marketization patterns are highly influenced by state policies and social norms, namely the formal and informal rules that govern behaviour in groups and societies (Bicchieri et al., 2014), which contribute to shape nutrition outcomes (Dixon, 2009). Thus, it is necessary to look at these factors in order to understand the possible ways in which marketization and dietary diversity interplay (Carletto et al., 2015; FAO, 2013; Unicef & WHO, 2017). The literature has explored the link between dietary diversity, marketization and crop diversity in some Central Asian countries (i.e., Takeshima et al., 2020; Zanello et al., 2019). This article specifically focuses on how state policies and social norms contribute to shape marketization and/or crop diversity in the context of Uzbekistan. Using primary data and adopting a mixed methods approach, this paper examines quantitatively the nexus between dietary diversity, marketization, wealth and dietary diversity. Then, using qualitative methods, it discusses the state policies and social norms that underpin such relationships. It argues that state regulations on inputs and outputs of production can mediate the negative impacts on nutrition of processes of marketization and related intensification. Social norms also play a key role in shaping such outcomes. The paper is structured as follows: Section 2 reviews the literature. Section 3 outlines the policy context, data and methodology. Section 4 discusses the results. Section 5 concludes by outlining policy implications.

2 | THE NEXUS BETWEEN AGRICULTURAL MARKETIZATION, CROP DIVERSITY AND DIETARY DIVERSITY

Starting with the Green Revolution in the 1980s and 1990s, agricultural marketization gained popularity in the global South (Ickowitz et al., 2019). Marketization was recognised as conducive to increasing productivity enhancement and thus long-term agricultural growth (Ickowitz et al., 2019; Von Braun & Kennedy, 1986). Scholars and policymakers have proposed moving away from self-subsistence farming to overcome the inefficient use of inputs and resources (Fafchamps, 1992). Because of their natural comparative advantages in abundant land and low-skilled labour, it was argued that low-income countries should intensify their cash-crops production for export (Haddad, 2002; Naylor & Falcon, 2010), and import food from the international market. Farmers have been encouraged to produce cash-crops because they are considered to be more remunerative, thus able to increase farmers' disposable income. This would improve farmers' well-being other than free resources from householdproduction (Collier & Dercon, 2013; Dorward et al., 2009). In this context, crop diversity has often been associated with extensive and

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inefficient forms of subsistence-oriented agriculture because, being based on a direct link between production and consumption, it would create a barrier to specialisation and economies of scale (Carletto et al., 2015; Fafchamps, 1992).

Instead, a diametrically opposite strand of the literature argues that malnutrition can be reduced by maintining diversity in food production, namely by maintaining crop diversity (Isaacs et al., 2016). The benefits of crop diversity appear to be many. It tends to reduce economic vulnerability to price and market shocks. Crop diversity helps maintain biodiversity and reduces the exposure to climatic risks, and it serves as a direct source of food for the producers (Jones et al., 2014; Nyantakyi-Frimpong, 2017). From an agro-ecological perspective, multiple cropping can reduce pest and disease, weed competition, and ensure sustainable access to soil nutrients. A right balance of crops rotation can also increase the level of nitrogen (Jones et al., 2014) as well as water-use efficiency (Bobojonov et al., 2013). Overall, multi-cropping is seen as a risk-diversification strategy aimed at reducing food insecurity as it serves as a direct source of food for local producers (Dorsey, 1999; Ickowitz et al., 2019). Crop diversification is also a coping strategy to offset information asymmetry and market imperfections for smallholder farmers (Webb & von Braun, 1994).

There studies that have systematically examined the relationship between nutrition and agricultural production and more specifically the relationship between crop diversity and dietary diversity (Carletto et al., 2015). Those that have focused on the diversification at the farm-level have very often found a positive association between crop diversity and dietary diversity (Bélanger & Johns, 2008; Dillon et al., 2015; Jones et al., 2014; Kumar et al., 2015; Malapit et al., 2015). Empirical studies have shown that crop diversity appears to have positive effects on agricultural incomes, economic growth, and nutritional indicators (Jones, 2016, 2017; Sunderland, 2011; Von Braun, 1995; Zanello et al., 2019). In Kenya and Tanzania, Herforth (2010) found that the number of crops grown was positively associated with dietary diversity. Results are particularly positive when these crops are home-grown fresh fruits and vegetables (FFVs). Similar results were found in Malawi (Jones et al., 2014). In their cross-country analysis, Pellegrini and Tasciotti found that the production of more crops was associated with an increase in the number of food items consumed by the household (Pellegrini & Tasciotti, 2014:6). They found a significant negative relationship between the production of cash-crops, namely cotton and coffee, and children's nutrition (Carletto et al., 2015; Von Braun & Kennedy, 1986). In fact, market-oriented agricultural policies have led in many developing countries to a concentration of cash-crops, mostly for export, at the cost of crop diversity (Maxwell and Fernando, 1989). The expansion of cash-crops has been implemented at the expense of food crops for domestic consumption. The displacement of important sources of nutrients such as millets, greens and pulses had negative effects on food security (Jones et al., 2014). These findings may suggest that policies oriented towards crop specialization might be less effective than crop diversification in achieving food security and dietary diversity goals.

However, other studies have raised scepticism about the positive impact of crop diversity on dietary diversity. Some show that, although crop diversity is positively associated with dietary diversity, education, income and market access play a more significant role in improving dietary diversity (Snapp & Fisher, 2015). Sibhatu and Qaim (2016) show that crop diversity contributes less to diet quality than the revenue generated through the sale of cash-crops. Similar conclusions have been developed in an econometric study on maize-based farm households in Tanzania (Rajendran et al., 2017). Crop diversity would be ineffective or decrease producers' dietary diversity if the food-crops grown would not provide different and/or additional nutrients (ibid). Dorsey (1999), by investigating the relationship between marketization, diversification, intensification, and concentration of crops argues that specialising according to market comparative advantages would be more functional than producing a diversified set of crops because it would increase cash-income (ibid). Moreover, farmers would respond and be able to benefit fully from market prices' incentives. In Tanzania cash cropping did not negatively affect food security because coffee was intercropped with food crops (Lev, 1981). Positive association between marketization and children' nutrition was found in Nepal (Shively & Sununtnasuk, 2015). Based on the above review, empirical evidence on the relationship between marketization, dietary diversity and crop diversity at the farm-level produced conflicting results. However, two important points can be emphasised: first, agriculture is both a source of food and income, and these two dimensions can enter

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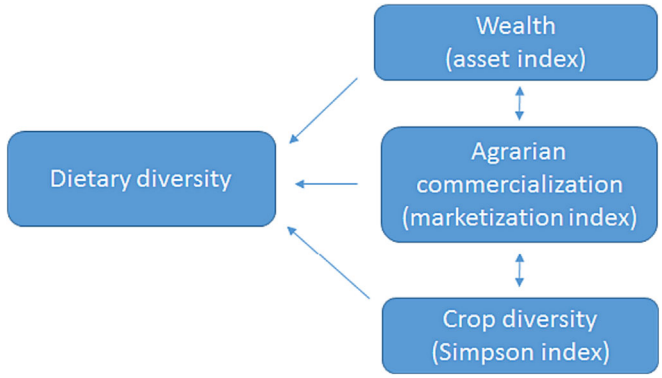

FIGURE 1 Hypotheses of association.

in conflict between each other. Second, food production and food consumption can be separated as a result of marketization. In contexts of transition such as the post-Soviet countries, processes of agrarian transformation are often not-linear and the linkages between commercialization, crop diversity and dietary diversity are diverse and multifaceted (Carletto et al., 2015). Figure 1 illustrates the different hypotheses of association.

Therefore, unveiling the policies and norms that shape marketization, crop diversity and wealth is crucial to understanding how food production affects dietary diversity. Marketization is rarely just a linear shift from subsistence mode of production to market mechanisms. Studies have found that in the early stages of marketization, and due to market failures, households may decide to diversify their crop to minimise market risks and still maintain self-subsistence production (Singh et al., 1986). Cash-crop marketization, in contexts with high transaction costs and risks, does not fully replace food-crops because of the need for food self-sufficiency (Leavy & Poulton, 2007: 6). Government policies and social norms can help explain such outcomes. Indeed, policies around marketization are heterogeneous. In some countries commercial agriculture has led to a concentration and specialization in cash-crops (Maxwell and Fernando, 1989) while in others marketization has been driven by crop diversification at national or regional level, usually through FFVs, livestock, and aquaculture (Headey, 2011). Such nutrition-sensitive agricultural policies have been supported as part of the objective of food security and rural business development (Shankar et al., 2017; Shively & Sununtnasuk, 2015; Unicef & WHO, 2017; Webb & Block, 2012). Empirical studies have shown that government policies can shift production towards more nutrient-rich crops such as FFVs positively affect nutritional outcomes (Miller & Welch, 2013). Governments have also intervened by providing incentives for local infrastructure investment and subsidies to commercialise new food-crops, or by intensifying existing food production (Walls et al., 2023). By contrast, the lack of infrastructure in remote areas often resulted in high transport costs, which made subsistence production and consumption persist (Pellegrini & Tasciotti, 2014) but also favour the consumption of ultra-processed food with negative effects on nutrition (Mogues et al., 2015). As Remans et al. (2015) argued, the relationship between production and consumption diversity must be understood beyond farm-level production and should consider the institutional, policy and social dimensions that contribute to shape specialization of production and marketization processes. In addition, marketization in low-income countries is underpinned by political objectives. For instance, although they often aim at supporting market returns, governments also acknowledge the crucial link between agrarian production and food security.

To summarise, crop diversity, marketization, and dietary diversity have often been described in the literature as incompatible. However, empirical results have been contradictory. The literature reviewed so far suggests that marketization is neither a driver nor an obstacle to dietary diversity and crop diversity. Universal conclusions would therefore be inappropriate because they would not take into account the context-specific production structure and macro- and micro-economic policies that influence which and how crops are produced and consumed. The ways in which marketization

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takes place are highly context-specific, highly dependent on the scale of observation and the time frame chosen. Marketization may therefore lead to different nutritional outcomes. The literature shows that the policy mechanisms that shape marketization, crop diversity and dietary diversity are still under-investigated. Furthermore, there is very limited discussion on the methodologies that are available to clearly understand how intensification in agrarian production affects nutrition (Remans et al., 2015) and how to select and evaluate empirical evidence (Carletto et al., 2015).

In this sense, mixed-methods analysis can shed light on the under-explored linkages between food production and consumption. In conclusion, marketization can take many forms, can be more or less nutrition-sensitive, and it can be driven and shaped by different political and economic objectives, thus affecting dietary diversity.

3 | POLICY CONTEXT, DATA AND METHODOLOGY

3.1 | The policy context

With nearly 35 million people reported by the World Bank in 2021, Uzbekistan is the most populous country in Central Asia. The Government of Uzbekistan (GoU) has often been criticised in the literature for its highly centralised approach (Djanibekov et al., 2012). However, it is useful to reflect on how its agricultural policies have shaped nutrition in the country. Food security was indeed an objective embedded in the national long-term strategy (Sedik, 2017), for instance through the resolution No. 251 "Approving the Concept and Action Plan on Healthy Nutrition of the Population for the 2015-2020 Period". In rural areas, where 50% of the population live, agriculture is still the main source of livelihood for many households. Over the last decades, farms have been subject to various land reforms resulting in a series of fragmentation and consolidation of agricultural land (Djanibekov et al., 2012). Cotton was until the early 1990s the main crop cultivated in the country by *fermers* (large farms). In the 1990s the GoU decided to rotate cotton with winter wheat to improve national food self-sufficiency and move away from cotton monoculture. Both winter wheat and cotton have been subject to state procurement and state-regulated input supply until March 2020. GoU decided on the quantity, scale and location of cotton and wheat production (Rudenko, 2008). Until the late 1990s, FFVs production was almost exclusively done by small household farms (*dekhans*). However, starting from the early 2000s, national state-led investments intensified FFVs production beyond the household level. *Fermers* started to produce less cotton and land was converted towards more nutrition-sensitive FFVs. This is observable from available official data which show that the production of potatoes, tomatoes, fruits gardening increased at both regional and national level to the detriment of cotton, which declined (Lombardozzi, 2019; Figures 2).

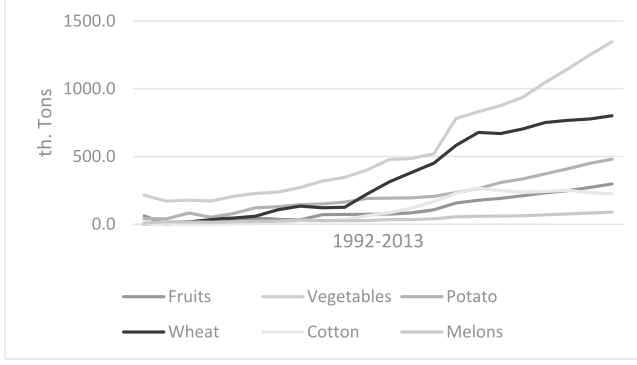

FIGURE 2 Patterns of crop diversification (gross harvest). Source: State Committee of Statistics of Uzbekistan

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As a result of the diversification towards FFVs, private farms have increased their exposure to the market (Bobojonov et al., 2013; Djanibekov et al., 2012; Hasanov, 2016). The production of FFVs has also been stimulated by the establishment of Public-Private-Partnerships (PPPs) and private agri-businesses which are involved in the distribution and processing phases of the FFVs value chain (Khidirov et al., 2015). The gradual liberalisation was aimed at achieving several socio-economic objectives in rural areas, including increasing productivity and creating jobs, as well as reducing national food insecurity, which was halved between 2006 and 2012 (Sedik, 2017). The Uzbek case therefore provides a distinctive example for assessing the links between state-led initiatives for agricultural marketization, crop diversification and food security objectives.

3.2 | Data and methodology

The lack of secondary data on nutrition and agriculture is one of the main problems in conducting applied research in Uzbekistan, which makes necessary the collection of primary data. Cross-sectional data for this case study were collected from 2015 to 2022. The first round of fieldwork took place between August and December 2015. A survey composed of 120 farmers was conducted in the Samarkand region and included cotton-wheat *fermers*, wheat-fruit and vegetables *fermers*, rural wage workers, and smallholders (Dekhans), through an equally distributed stratified sample. The strata, namely *fermers* producing cotton and wheat, *fermers* producing FFV and wheat, small farm households and wage workers (Table 1) were identified based on classifications used in previous surveys (Djanibekov et al., 2012) and were reflective of the state planning of agri-food production. The first stage of the selection process was to identify equal representatives of the four strata of the farmers' population and then to randomly select from these with the help of local experts based at Samarkand Agricultural University, who provided official affiliation, logistical support and expertise in designing the survey questionnaire. The survey questionnaire consisted of 87 questions, including the sub-questions, and was thematically divided into four modules: 1) general socio-demographic characteristics; 2) commercialisation indicators for inputs and outputs; 3) asset index; 4) nutrition security (Food Security Index and Dietary Diversity Index Score).

The sample was selected in the Samarkand region, the most populous region of the country, which is also at the forefront of crop diversification because of its favourable ecological characteristics to cultivate FFVs (Hasanov, 2016). Although the results have a limited ability to be representative of the country as a whole, which can be seen as a limitation of the paper, the low variance within each stratum indicates the homogeneity and validity of the sample strata identified in relation to the objectives of the analysis. It has been argued that the size of the population sample has no real effect on how well the sample is able to describe the main trends within the population if the variables included are relevant and significant characteristics are revealed (Oya, 2004). Johnston (1997) also noted that while large surveys may provide good statistical numbers, they may not contribute to understanding

TABLE 1 Stratified survey sample.

	Fermers: cotton/wheat	*Fermers*: FFV/wheat	*Dekhans*	Agriculture wage workers
State procurement/ market	Cotton and Wheat (quota) + market	Wheat (quota) + market	Only market	Only market
Labour relation	Family/wage labour	Family/wage labour	Family/off-farm labour	Family/hired in Fermers
Land tenure	Long-term lease	Long-term lease	Lifetime inheritable	Lifetime inheritable
Average hectares	59	32	0.27	0.21

Source: Author.

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the dynamics within the community. Finally, the sample was the result of careful consideration of the feasibility of the exercise given the time and budget available. It was therefore decided that in order to achieve statistical significance for all strata, a minimum of 30 units should be interviewed for each stratum. The statistical analysis was conducted with SPSS software and all the 120 observations were included in the dataset. This exercise provides an opportunity to reflect on the benefits and drawbacks of the agrarian reforms of the first 25 years of Uzbekistan's transition which is beyond the immediate scope of this paper but can be explored in future research. Two enumerators from the Samarkand Agricultural University assisted in the data collection process. The interviews were conducted by the author in Russian language or with the help of the enumerators in Uzbek language.

In addition, qualitative data were collected through three rounds of fieldwork in 2015, 2018 and in 2022, rigorously drawing on scholarship on qualitative research methods and mixed methods (Mayoux, 2006; Morgan, 2007; Olsen, 2004). The author conducted over 50 semi-structured and unstructured stakeholder interviews with Uzbek policymakers, international organisations, local academics, local administrators and farmers in the capital Tashkent and Samarkand. These interviews were triangulated with the quantitative data and provided further insights into the analysis, for example on patterns of food consumption and crop production. Interviewees were kept anonymous to ensure confidentiality, and interviews were transcribed manually. In addition, direct observations were conducted on farms in Samarkand and in bazaars in Tashkent and the Samarkand region to examine the dynamics of food availability and access.

3.2.1 | Dietary diversity

Dietary diversity can be defined as the variety of food types consumed by an individual in a diet in a given period of time, classified according to the variety of the nutritional components they contain. Both policymakers and nutritionists consider dietary diversity indices to be able to estimate macro- and micro-nutrients in terms of dietary adequacy (Arimond & Ruel, 2004; Rajendran et al., 2017; Ruel, 2003). Marshall et al., 2014 report the use of 80 different diet quality indices. As Perry et al. (2015) note, many indices rely heavily on detailed dietary assessments, which are burdensome for both respondents and researchers. In this exercise dietary diversity has been assessed through the Individual Dietary Diversity Score (IDDS) developed by the FAO and it serves as time- and cost-effective assessment tool (Ruel, 2003). The IDDS used a 24-hour recall and it has been implemented at the individual level and includes all the available primary source of food provision (Kennedy et al., 2011). Questions about what was eaten or drunk the day before (24-hour recall) for breakfast, lunch, snack and dinner, either consumed or produced at home or away from home were asked to both female and male farmers involved in the production or preparation of food, using 15 food groups. Very often eating away from home is very common especially for men, so it was important also to include the dimension of eating or drinking outside the home and to include 'street food' consumption habits. The content of the food groups was designed and adapted to the specificity of local diet, taking into account common practice of eating mixed dishes (for example the traditional meal *Plov*, which contains different sources of nutrients, has been broken down into its ingredients in the food group classification of the IDDS). Although the FAO guideline table consists of 16 food groups, it was decided to evaluate 15 food groups[1] and to combine tubers and white tubers to reflect the local availability of the respective food types (for instance, yams, sweet potatoes and cassava are not available in Uzbekistan and are not even imported, and would therefore bias the overall score downwards). The index score therefore indicates results on a scale from 0 to 15. The use of 24-hour recall may not capture daily variation, but this is relatively small in poor rural households.

3.2.2 | Asset index — wealth

In order to understand the different levels of wealth, an asset index has been developed. Assets are considered a good proxy for wealth in contexts where wage labour is rare and money is not the main medium of exchange.

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Fieldwork has confirmed that in rural informal economies, where the market is less developed than in urban areas, and where agriculture can still be considered a 'state-sector', the definition of poverty or wealth can be based, although not exclusively, on very heterogeneous and context-specific non-monetary variables. Indeed, measures of income rather than consumption or asset ownership have been mistakenly used to assess welfare or accumulation patterns. In low-income contexts livelihoods often depend on transfers in-kind, and non-marketed food accounts for a large share of the consumption basket. Indeed, many studies based on monetary measures have often overlooked important factors that explain labour markets and household social structures (Johnston & Abreu, 2016). For these reasons, it could be more effective in such contexts to ask "what do you own?" rather than "what did you buy?" (Johnston & Wall, 2008). As a reference, I have considered the asset indicators used in the 2002 Uzbekistan national survey.[2] Only 13 assets out of the 30 assets collected were used, because they better explained the variation in the total set of assets across the population, but also reflected the stratifications of farmers and the appropriateness of size. Data-driven weights were assigned to each of the 13 selected assets.[3]

3.2.3 | Crop diversity

Crop diversity was measured using the Simpson Diversity Index. The Simpson's index (D) is a measure of diversity that takes into account the richness and evenness of species, in our case crops, present in an ecosystem. The index is calculated as follows:

where n_i is the total number of organisms of each individual species, N = the total number of organisms of all species. Simpson diversity index means the greater the value the greater the sample diversity. The calculation has been done based on an estimation of the size of the area devoted to each crop (in hectares). The Simpson Index is one of the few indices able to combine measures of both richness and abundance. The data are taken from the survey question in which each farmer was asked to list to the best of their knowledge the type of crops produced on their land in the previous 12 months, (household plot- *tomarqa*- for *dekhan* and workers, and *tomarqua* and farm combined for cotton-wheat *Fermers*). The index does not include livestock. Typical crops produced were wheat, cotton (only cotton *Farmers*), tomatoes, fruits and different vegetables. Sibhatu and Qaim (2016) note how different crops have different nutritional properties, which affect the outcomes of production-consumption. In the case of a non-food crop the nutritional contribution is negative. So, in this case cotton may have an opportunity-cost for food access.

3.2.4 | Marketization index

Two components formed the marketization index. The *output* component assessed the varying degrees of market integration based on a combination of self-consumption; state procurement; sale to local bazaar; sale to wholesale/processing company/export. The *input* component assessed differences in access to inputs and hiring of permanent labour. These two indices were then combined into a 'marketization index'. Information obtained from survey questions "Where do you sell your crops?" and "list state-provided inputs" and "Do you hire permanent labour?" showed a different degree of integration into different market channels but also different access to inputs for different types of farmers. Only cotton and wheat farmers had access to government-subsidised fertiliser, seeds, tractors, and extension services. Smallholder *dekhans* could only buy seeds and certain types of fertiliser from the market.

For each of these four indicators, namely dietary diversity (to assess food security), asset endowment (to assess wealth), crop diversity, and marketization (to assess marketization), four indices were developed using Principal Component Analysis (PCA). PCA is a statistical technique that collapses a data matrix into a smaller number of components to emphasise variation and highlight strong patterns in a dataset.

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TABLE 2 Pairwise Pearson Correlations between diet diversity, commercialisation index, crop diversity index, asset index.

	Diet diversity	Market. index	Simpson index
Market. index	0.4033**		
Simpson index	0.3264**	0.5588**	
Asset index	0.5137**	0.5839**	0.4135**

Note: ** indicates significance at the 1% level (2-tailed test). Based on N = 120 observations.

4 | RESULTS

4.1 | Quantitative results

In this section, I first examine the correlations between the variables outlined above, namely dietary diversity, wealth, crop diversity and agrarian marketization. I then use a multivariate analysis to investigate these correlations after controlling for other social characteristics.

Table 2 shows a positive correlation between dietary diversity, asset index, marketization and crop diversity. These positive correlations suggest that the wealthiest respondents eat better, and the degree of marketization is positively associated with wealth, as expected, but also with crop diversity.

However, pairwise correlation coefficients capture associations in isolation without consideration of third factors. To analyse the joint relationship between the four variables of interest, I estimated a simple multivariate regression model (1).

$$\boldsymbol{y} = \boldsymbol{X\alpha} + \boldsymbol{Z\beta} + \boldsymbol{\varepsilon} \tag{1}$$

$\boldsymbol{y}$ is a vector of the dietary diversity of the **N** individuals in the survey. $\boldsymbol{X}$ is a set of vectors including a vector of 1_n, crop diversity (Simpson index), wealth (asset index), and agrarian marketization; the key variables of interest. $\boldsymbol{Z}$ is a vector of control variables, including university education,[1] land size, household size, and gender. I used a dummy for female farmers where female is 1 and male is 0. $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are vectors of coefficients and $\boldsymbol{\varepsilon}$ is a vector of residuals. The model is estimated by ordinary least squares (OLS). Regression results are reported in Table 3.

The results of the first regression Model 1 in Table 3 show that the asset index is the only significant predictor of dietary diversity, namely as the asset index increases so does the dietary diversity. Neither marketization nor crop diversity seemed to have an independent effect on dietary diversity. To test the hypothesis that both the marketization index and the crop diversity index affect dietary diversity only through the asset index, two further experiments were conducted, excluding the asset index and the marketization index in Models 2 and 3. Indeed, agricultural marketization became significant when the asset index was excluded (model 1), and crop diversity became significant when both the asset index and the marketization index were excluded. These results were confirmed when the outliers were removed. These results suggest that agricultural marketization was mediated by wealth but had no direct effect on dietary diversity. Similarly, crop diversity was mediated by agrarian marketization and wealth, and had no direct effect on dietary diversity when controlling for the mediating factors. The relationship between the explanatory variables of interest is shown in Figure 3.

However, diets are not well balanced across the board. In particular, the breakdown of IDDS by food type shows that some foods are not widely consumed by all groups. For example, only 8% of *fermers* consumed fish, and only 25% consumed dark green vegetables. Therefore, even if wealth is an important factor in explaining diets, it is

[1]Given the Soviet Union legacy, literacy rate in Uzbekistan is 99% (WB, 2015) and university is the level of higher differentiation in education.

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TABLE 3 Dietary diversity results with and without asset index, and without marketization.

	Model 1 With asset index		Model 2 Without asset index		Model 3 Without asset index and marketization index	
Asset index	0.171**	(0.049)				
Marketization index	0.054	(0.056)	0.114*	(0.056)		
Simpson index	0.534	(0.573)	0.718	(0.600)	1.234*	(0.546)
Household size	−0.023	(0.037)	−0.026	(0.039)	−0.022	(0.039)
Land size	0.000	(0.004)	0.004	(0.004)	0.007	(0.004)
University	−0.136	(0.321)	0.212	(0.321)	0.300	(0.322)
Gender	−0.287	(0.399)	−0.542	(0.412)	−0.663	(0.413)
Constant	7.220**	(0.452)	7.712**	(0.045)	7.513	(0.447)**
N	120		120		120	
Adj. R- Squared	0.249		0.173		0.151	

Notes: ** indicates significance at the 1% level (two-tailed test). * indicates significance at the 5% level. Based on N = 120 observations.

necessary to explore the institutional context and social norms through qualitative data to disentangle further such relationships.

4.2 | Qualitative results

I will now discuss the findings on the association between dietary diversity, agricultural marketization and crop diversity by extending the analysis to the institutional mechanisms and social norms.

4.2.1 | Dietary diversity and crop diversity

I now investigate the relationships between crop diversity and dietary diversity. Using descriptive survey data, I first assess how crop diversity (Simpson Index) differs by farmer' type, i.e. which type of farmer among the cotton-wheat and wheat-FFV *fermers*, *dekhans* and wage farmers surveyed cultivated the highest number of crops.

As can be seen in Figure 4, although *fermers* were obliged to grow wheat and cotton to meet the public procurement obligations, they managed to produce a wider range of crops than *dekhans* and wage workers (see average value in vertical axes 'Simpson_3' (D) at 0.9 and 0.78), and this was particularly significant in the case of wheat producers who also produced FFVs. *Fermers* performed better than *dekhans* because they benefited from larger plots of land (see Table 1- average plot size for *fermers* in the case study was 59 ha for cotton-wheat producers and 32 ha for wheat-FFV producers as opposed to 0.3 ha for *dekhans*). This finding suggests that state regulations on land leasing did not prevent crop diversification and intensification among *fermers*. On-farms observations and unstructured interviews show that *fermers* growing state-crops, namely cotton and wheat, once their procurement quota was met, used the land for other purposes. Sometimes they produced food crops to meet their own subsistence needs or to sell it on the market as cash-crops, or it was cultivated by wage workers through sharecropping. This may also be due to state investments in irrigation technology, which facilitates the production of secondary crops (e.g., vegetables) after the state-crops. By contrast, although the *dekhans* were not subject to any state procurement restrictions, the small size of the available plot did not allow them to grow many crops and they did not have, on average, a high level of crop-diversity (D of 0.46 and 0.38 for farm workers and *dekhans* respectively). As a test, I

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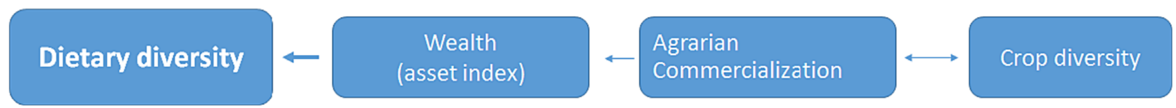

FIGURE 3 Revised hypothesis of association.

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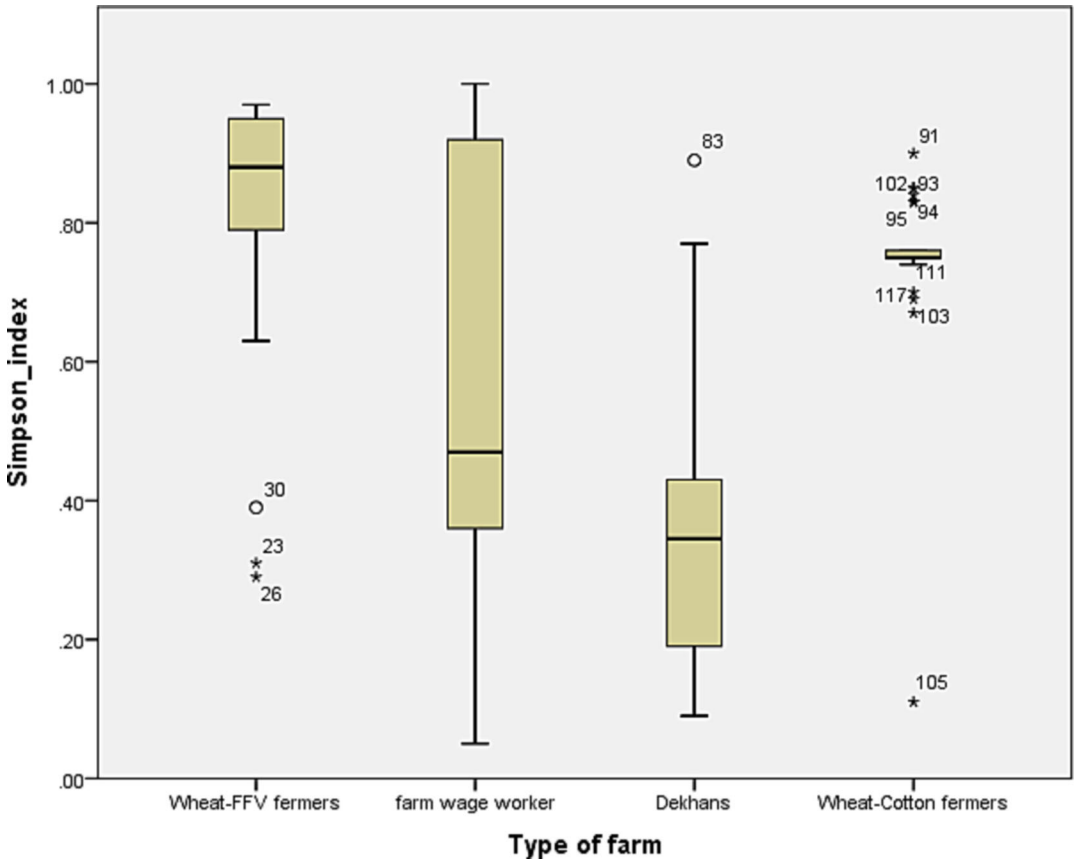

FIGURE 4 Plot of Simpson index (crop diversity) by type of farmer surveyed. Source: Survey.

looked at the multiple correlations of the sub-productions, and cotton did not correlate significantly with many FFVs, unlike wheat, which instead correlated positively with carrots, onions, and fruits. In fact, the most diversified farms were those producing wheat and FFVs, which on average benefited from smaller land sizes compared with the larger cotton producers. These results therefore challenge the hypothesis of a direct and linear relationship between farm size, crop diversity and dietary diversity. The survey results show that higher crop diversity has led to positive outcomes in terms of direct food access and hence dietary diversity. However, this case study also shows that the assumption that cash-crops create a substitution or competition effect with food is not always confirmed empirically. Instead, this case study shows that the outcomes of marketization are highly dependent on state policies that provide access to land, inputs of production, and thus food. Although diversification and specialisation are often perceived as a trade-off for nutrition (Pellegrini & Tasciotti, 2014; Webb & Block, 2012), multidimensional social factors and supply- and demand-oriented public policies are important for creating a functional food system and balanced diets.

4.2.2 | Dietary diversity and assets wealth

Although the quantitative results suggested a direct association between wealth and dietary diversity, qualitative data collected through interviews and observations with farmers confirmed the results shown by the IDDS's

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disaggregation, namely that diets were often monotonous even among the wealthiest respondents. This suggests that it cannot always be assumed that the additional income from commercial crops will be used to consume more and better nutritious food. Instead, supply-related issues such as food availability need to be considered to assess access to a diversified diet. In addition, the assumption that wealthier respondents would eat better was tested by asking the 120 farmers what kind of items or activities they would buy if they had extra income. Although the question did not specify the amount of extra income, the survey question listed a closed set of options for respondents to choose from, so that the choice made did not depend on the hypothetical availability of income, but rather on their personal desires.

As shown in Figure 5, in most of the cases non-food related options such as buying agricultural inputs and investing in their children's education were preferred over buying more nutritious food such as fish or different types of imported fruits or food stuff (Girard et al., 2012). These responses are very relevant for understanding the priorities that drive consumption patterns. Indeed, farmers tend to save on food. This suggests that nutritional objectives very often compete with a number of other human and social needs, so that even several rational choices and desirable preferences can coexist and compete in a situation of budgetary constraints (Girard et al., 2012 Thus, supply and demand mechanisms depend on multifaceted factors, and income may not be the only driver of food choices.

Moreover, empirical evidence confirms that, in contexts where food production is not fully commercialised and the food market is not fully liberalised, farmers have an incentive to rely on self-subsistence or local production (Ickowitz et al., 2019; Muller, 2009). The persistence of self-subsistence consumption could in turn slow down food marketization and the consumption of ultra-processed food, as it was observed in the context of Uzbekistan. Consumers are therefore less exposed to ultra-processed food, even at higher income levels. It has also been observed that strong social norms around traditional meals can make farmers and non-farmers reluctant to change their diets. Such dynamics could help prevent unhealthy consumption behaviours, challenging the 'dietary transition' theory, which suggests that economic growth automatically leads to the consumption of ultra-processed food. Instead, food availability and consumption depend on the way the market is regulated. Nevertheless, the lack of food in markets can be a source of diet dysfunction, especially in the absence of alternatives to affordable and healthy food, which

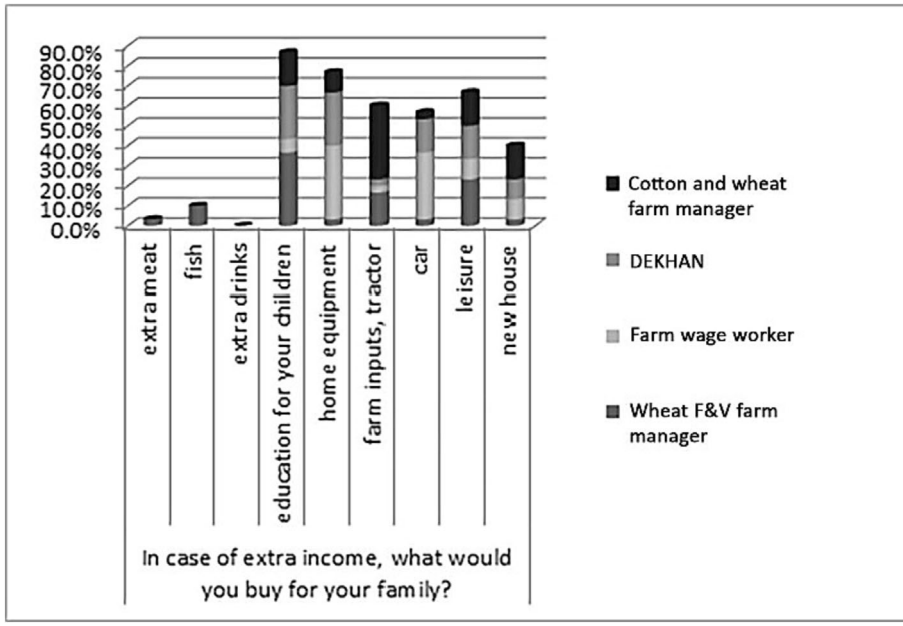

FIGURE 5 "In case of extra income, what would you buy for your family?" Source: Survey data.

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can occur in transition economies where the integration into Global Value Chains is slow. Therefore, there is not always a linear relationship between income and food intake. Consumption patterns are determined by food availability on the market, preferences, long-term personal goals, knowledge, nutritional and social norms, and beliefs about certain types of food (Hoddinott & Wiesmann, 2010). In sum, evidence shows that mechanisms of supply and demand are shaped by multi-layers factors and that income is not the only driver of nutrition.

4.2.3 | Dietary diversity and agrarian marketization

As discussed above, empirical works investigating the farm-level effects of marketization on nutrition have shown mixed results (Jones et al., 2014; Sibhatu & Qaim, 2016; Von Braun, 1995). Thus, a discussion of the socio-economic specificities of the marketization of Uzbek FFVs can provide an insightful lens through which to broaden our understanding of the linkages between nutrition and marketization. FFVs are sold through different market channels, namely to processing companies, wholesales, and international markets. This process of marketization has been driven by a state-led diversification strategy that has diverted land from cotton-wheat rotations to FFVs, and supported the transformation of the sector through a mix of trade protectionism and subsidies. Therefore, marketization in Uzbekistan did not occur, as often described in the literature, through the substitution of food-crops production with export-oriented cash-crop production. Instead, marketization was introduced through a state-planned crop diversification programme that strengthened food-crops production. Thus, these results show that marketization can take place in a variety of ways without negatively affecting crop diversification or dietary diversity. The results also highlight the need to pay more attention to the broader institutional frameworks and regulations that shape the reconfiguration of agricultural production and consumption patterns. Indeed, nutritional outcomes are not solely determined by the presence or absence of cash-crops, but also by market mechanisms (Hawkes & Ruel, 2006).

Interviews with farmers involved in the production of state crops confirmed that they had access to state-subsidised fertilisers and agrochemicals at a guaranteed price which were often diverted to food crops. Thus, the access to such subsidised inputs has had unintended but positive spillover effects on food production. This empirical evidence refutes the thesis that in a situation of scarcity, market-oriented production would divert the use of inputs to the detriment of self-subsistence in order to achieve higher market returns. Instead, this case study suggests that non-market and non-profit strategies play a key role in producers' decisions about how to meet their food needs. However, this also implies that input subsidies are positively associated with dietary diversity. Indeed, the case of Uzbekistan seems to be similar to the case of Malawi, where results have shown that fertilisers programmes had a positive impact on nutrition, increased food availability, and poverty reduction (Dorward & Chirwa, 2011; Harou, 2018). Finally, FFVs seem to support Bharadwaj's (1985) view that marketization tends to start with outputs rather than inputs, which adds a further layer of complexity to the analysis of marketization. Indeed, the literature has paid considerable attention to the marketization of outputs but has often overlooked that the commercialization of inputs such as fertilisers, land etc. has had a major impact on nutritional outcomes. In conclusion, the results suggest that marketization, if supported by appropriate state interventions that mediate market risks, does not automatically lead to loss of crop diversity and nutritional setbacks.

5 | CONCLUDING DISCUSSION

The findings of this case study provided new insights and reflections on the nexus between agricultural marketization, crop diversity, wealth, and dietary diversity. This research confirms that marketization is shaped by context-specific economic policies and social norms that lead to different nutritional outcomes. Therefore, an ad-hoc and inductive research methodology is needed to identify effective policy solutions for food security. This article problematises the understanding of agricultural marketization as a homogenous process and demonstrates the need

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for the use of mixed methods that take into account the specificities of production and exchange relations to explain dietary diversity outcomes.

It is argued that the dichotomy of agricultural 'commercialization' versus 'diversity' is often based on rather weak analytical starting points. These mechanisms need to be understood along two dimensions: first, how processes of commodification affect the access to and distribution of the means of production (Bernstein et al., 1996; Byres, 1991;). Secondly, through the analysis of relations of exchange, which also depend on the state policies that determine access to food. In contexts such as the post-Soviet space where food markets, but also input markets and credit are not fully marketized, the link between production and consumption is tight, and farmers often rely on self-subsistence. Dietary diversity will then depend on what and how much is produced at the farm-level and crop diversity will be crucial for nutrition (Muller, 2009). In these cases, it is appropriate to examine the relationship between farm-level production and dietary diversity. Conversely, in contexts where these linkages are strongly mediated by the market, government interventions, or induced preferences in the food supply, the analysis should be complemented by broader categories.

In conclusion, market regulations play an important role in preventing drastic shocks such as the risk of supply shortages. Governments and policy makers can intervene at the national and local levels to shape market distribution, ensure a stable and accessible food supply, and ultimately avoid friction between commercial agriculture and food consumption (Sibhatu & Qaim, 2016). Food and agricultural research should not focus on what it is produced, but rather on how it is produced. Only by re-orienting the focus on the multidimensional processes surrounding the marketization of both inputs and outputs will applied research be able to inform and unravel the tensions between food production and consumption.

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CONFLICT OF INTEREST STATEMENT

The authors declared that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTES

[1] Cereals, white tubers and roots; legumes, nuts, and seeds; vegetables; fruits; meat; eggs; fish and fish products; milk and milk products; sweets and sugars; oils and fats; and spices, condiments, and beverages.

[2] The survey included source of drinking water, type of toilet facility, has electricity, radio, television, refrigerator, bicycle, motorcycle, car/truck, floor material, wall material, roof material, telephone.

[3] The assets used for the construction of the index are: fridge, bank account, tractor, car, chairs, computer laptop, DVD, washing machine, bed, air conditioner, sewing machine, gas hitting, number of cows.

REFERENCES

Arimond, M., & Ruel, M. T. (2004). Dietary diversity is associated with child nutritional status: evidence from 11 demographic and health surveys. *The Journal of Nutrition*, *134*, 2579–2585. https://doi.org/10.1093/jn/134.10.2579

Bélanger, J., & Johns, T. (2008). Biological diversity, dietary diversity, and eye health in developing country populations: Establishing the evidence-base. *EcoHealth*, *5*, 244–256.

Bernstein, H., Brass, T., & Byres, T. J. (1996). *Agrarian questions: Essays in appreciation of TJ Byres*. Psychology Press.

10991328, 2024, 2, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3867 by Test, Wiley Online Library on [26/09/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Bharadwaj, K. (1985). A view on marketization in Indian agriculture and the development of capitalism. *Journal of Peasant Studies*, *12*(4), 7–25. https://doi.org/10.1080/03066158508438273

Bicchieri, C., Muldoon, R., & Sontuoso, A. (2014). *Social norms*. The Stanford encyclopedia of philosophy.

Bobojonov, I., Lamers, J. P. A., Bekchanov, M., Djanibekov, N., Franz-Vasdeki, J., Ruzimov, J., & Martius, C. (2013). Options and Constraints for Crop Diversification: A Case Study in Sustainable Agriculture in Uzbekistan. *Agroecology and Sustainable Food Systems*, *37*(7), 788–811. https://doi.org/10.1080/21683565.2013.775539

Byres, T. J. (1991). The agrarian question and differing forms of capitalist agrarian transition: An essay with reference to Asia. In J. Breman & S. Mundle (Eds.), *Rural Transformation in Asia*. Delhi: Oxford University Press.

Carletto, G., Ruel, M., Winters, P., & Zezza, A. (2015). Farm- Level Pathways to Improved Nutritional Status: Introduction to the Special Issue. *The Journal of Development Studies*, *51*(8), 945–957. https://doi.org/10.1080/00220388.2015.1018908

Collier, P., & Dercon, S. (2013). *African Agriculture in 50 Years: Smallholders in a rapidly changing world* (Vol. 63) (pp. 92–101). University of Oxford. https://doi.org/10.1016/j.worlddev.2013.10.001

Dillon, A., McGee, K., & Oseni, G. (2015). Agricultural production, dietary diversity and climate variability. *The Journal of Development Studies*, *51*(8), 976–995.

Dorsey, B. (1999). Agricultural intensification, diversification, and commercial production among smallholder coffee growers in central Kenya. *Economic Geography*, *75*(2), 178–195.

Dixon, J. (2009). From the imperial to the empty calorie: how nutrition relations underpin food regime transitions. *Agriculture and Human Values*, *26*(4), 321–331. https://doi.org/10.1007/s10460-009-9217-6

Djanibekov, N., van Assche, K., Bobojonov, I., & Lamers, J. P. A. (2012). Farm Restructuring and Land Consolidation in Uzbekistan: New Farms with Old Barriers. *Europe-Asia Studies*, *64*(6), 1101–1126. https://doi.org/10.1080/09668136.2012.691720

Dorward, A., & Chirwa, E. (2011). The Malawi agricultural input subsidy programme: 2005/06 to 2008/09. *International Journal of Agricultural Sustainability*, *9*(1), 232–247. https://doi.org/10.3763/ijas.2010.0567

Dorward, A., Kydd, J., Poulton, C., & Bezemer, D. (2009). Coordination risk and cost impacts on economic development in poor rural areas. *Journal of Development Studies*, *45*(7), 1093–1112. https://doi.org/10.1080/00220380802550277

Fafchamps, M. (1992). Solidarity Networks in Preindustrial Societies: Rational Peasants with a Moral Economy. *Economic Development and Cultural Change*, *41*(1), 147–174. ISSN 0013–0079. https://doi.org/10.1086/452001

Food and Agriculture Organization of the United Nations (FAO). (2013). Synthesis of guiding principles on agriculture programming for nutrition. Rome: FAO.

Girard, A. W., Self, J. L., McAuliffe, C., & Olude, O. (2012). The effects of household food production strategies on the health and nutrition outcomes of women and young children: a systematic review. *Paediatric and Perinatal Epidemiology*, *26*, 205–222. https://doi.org/10.1111/j.1365-3016.2012.01282.x

Haddad, L. (2002). *Reducing child undernutrition: How far does income growth take us?* Washington, DC, USA: International Food Policy Research Institute.

Harou, A. (2018). Unraveling the effect of targeted input subsidies on dietary diversity in household consumption and child nutrition: the case of Malawi. *World Development*, *106*, 124–135. https://doi.org/10.1016/j.worlddev.2018.01.011

Hasanov, S. (2016). Agricultural polices to enhance the development of fruit and vegetable subsectors in Uzbekistan. *European Scientific Journal*, *12*(13), 479–491.

Hawkes, C., & Ruel, M. T. (2006). *Understanding the Links between Agriculture and Health*. International Food Policy Research Institute.

Headey, D. (2011). *Turning economic growth into nutrition-sensitive growth*. Conference Paper No. 6. 2020. Conference on Leveraging Agriculture for Improving Nutrition and Health.

Herforth, A. (2010). Promotion of traditional African vegetables in Kenya and Tanzania: A case study of an intervention representing emerging imperatives in global nutrition [PhD dissertation, Cornell University].

Hoddinott, J., & Wiesmann, D. (2010). The impact of conditional cash transfer programs on food consumption in Honduras, Mexico, and Nicaragua. In M. Adato & J. Hoddinott (Eds.), *conditional cash transfers in Latin America*. Johns Hopkins University Press for the International Food Policy Research Institute (IFPRI).

Ickowitz, A., Powell, B., Rowland, D., Jones, A., & Sunderland, T. C. H. (2019). Agricultural intensification, dietary diversity, and markets in the global food security narrative. Global. *Food Security*, *20*, 9–16. https://doi.org/10.1016/j.gfs.2018.11.002

Isaacs, K. B., Snapp, S. S., Chung, K., & Waldman, K. B. (2016). Assessing the value of diverse cropping systems under a new agricultural policy environment in Rwanda. *Food Security*, *8*, 491–506.

Johnston, D. (1997). Migrant workers on Free State Farms: The relevance for South African labour policy. *South African Labour Bulletin*, *4*(21).

Johnston, D., & Abreu, A. (2016). The asset debates: How (not) to use asset indices to measure well-being and the middle class in Africa. *African Affairs*, *115*, 399–418. https://doi.org/10.1093/afraf/adw019

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Johnston, D., & Wall, M. (2008). Counting Heads or Counting Televisions: Can Asset-based Measures of Welfare Assist Policy-makers in Russia? *Journal of Human Development*, *9*(1), 131–147.

Jones, A. D. (2016). On-Farm Crop Species Richness Is Associated with Household Diet Diversity and Quality in Subsistence-and Market-Oriented Farming Households in Malawi–3. *The Journal of Nutrition*, *147*(1), 86–96. https://doi.org/10.3945/jn.116.235879

Jones, A. D. (2017). Critical review of the emerging research evidence on agricultural biodiversity, diet diversity, and nutritional status in low-and middle-income countries. *Nutrition Reviews*, *75*(10), 769–782. https://doi.org/10.1093/nutrit/nux040

Jones, A. D., Shrinivas, A., & Bezner-Kerr, R. (2014). Farm production diversity is associated with greater household dietary diversity in Malawi: findings from nationally representative data. *Food Policy*, *46*, 1–12. https://doi.org/10.1016/j.foodpol.2014.02.001

Kennedy, G., Ballard, T., & Dop, M. C. (2011). *Guidelines for measuring household and individual dietary diversity*. Food and Agriculture Organization of the United Nations.

Khidirov, D., Larson, D. F., & Schuman, I. (2015). *Uzbekistan - Strengthening the horticulture value chain. Uzbekistan vision 2030 background paper series*. World Bank Group. http://documents.worldbank.org/curated/en/396111468301526337/Uzbekistan-Strengthening-the-horticulture-value-chain

Komarek, A. M. (2010). Crop diversification decisions: the case of vanilla in Uganda. *Quarterly Journal of International Agriculture*, *49*(3), 227–242.

Kumar, N, Harris, J., & Rawat, R. (2015). If they grow it, will they eat and grow? Evidence from Zambia on agricultural diversity and child undernutrition. *The Journal of Development Studies*, *51*(8), 1060-1077.

Leavy, J., & Poulton, C. (2007). Commercialisations in agriculture. *Ethiopian Journal of Economics*, *16*(1), 1–37.

Lev, L. (1981). *The Effect of Cash Cropping on Food Consumption Adequacy Among the Meru of Northern Tanzania*. M.Sc.Thesis. Michigan State University.

Lombardozzi, L. (2019). Can distortions in agriculture support structural transformation? The case of Uzbekistan. *Post-Communist Economies*, *31*(1), 52–74. https://doi.org/10.1080/14631377.2018.1458486

Malapit, H. J. L., Kadiyala, S., Quisumbing, A. R., Cunningham, K., & Tyagi, P. (2015). Women's empowerment mitigates the negative effects of low production diversity on maternal and child nutrition in Nepal. *The Journal of Development Studies*, *51*(8), 1097–1123.

Marshall, S., Burrows, T., & Collins, C. E. (2014). Systematic review of diet quality indices and their associations with health-related outcomes in children and adolescents. *Journal of Human Nutrition and Dietetics*, *27*, 577–598. https://doi.org/10.1111/jhn.12208

Maxwell, S., & Fernando, A. (1989). Cash crops in developing countries: The issues, the facts, the policies. *World Development*, *17*(Issue 11), 1677–1708. https://doi.org/10.1016/0305-750X(89)90193-9

Mayoux, L. (2006). Quantitative, Qualitative or Paticipatory? Which Method, for What and When? In V. Desai & R. B. Potter (Eds.), *Doing Development Research* (pp. 115–129). Sage Publications Ltd.. https://doi.org/10.4135/9781849208925.n13

Miller, D. D., & Welch, R. M. (2013). Food system strategies for preventing micronutrient malnutrition. ESA Working Paper No. 13-06. Rome. FAO.

Mogues, T., Fan, S., & Benin, S. (2015). Public investments in and for agriculture. *European Journal of Development Research*, *27*, 337–352. https://doi.org/10.1057/ejdr.2015.40

Morgan, D. L. (2007). Paradigms lost and pragmatism regained: Methodological implications of combining qualitative and quantitative methods. *Journal of Mixed Methods Research*, *1*(1), 48–76.

Muller, C. (2009). Do agricultural outputs of partly autarkic peasants affect their health? Evidence from Rwanda. *Food Policy*, *34*, 166–175.

Naylor, R. L., & Falcon, W. P. (2010). Food security in an era of economic volatility. *Population and Devevelopment Review*, *36*(4), 693–723.

Nyantakyi-Frimpong, H. (2017). Agricultural diversification and dietary diversity: A feminist political ecology of the everyday experiences of landless and smallholder households in northern Ghana. *Geoforum*, *86*, 63–75.

Olsen, W. (2004). Triangulation in social research: qualitative and quantitative methods can really be mixed‘. In M. Holborn (Ed.), *Developments in sociology*. Causeway Press.

Oya, C. (2004). The empirical investigation of rural class formation: methodological issues in a study of large and mid-scale farmers in Senegal. *Historical Materialism*, *12*(4), 289–326.

Pellegrini, L., & Tasciotti, L. (2014). Crop diversification, dietary diversity and agricultural income: empirical evidence from eight developing countries. *Canadian Journal of Development Studies/Revue Canadienne d'études du développement*, *35*(2), 211–227.

Perry, C. P., Keane, E., Layte, R. P., Fitzgerald, A. J., Perry, I. M., & Harrington, J. (2015). The use of a dietary quality score as a predictor of childhood overweight and obesity. *BMC Public Health*, *15*, 581.

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Pinstrup-Andersen, P. (2013). Nutrition-sensitive food systems: From rhetoric to action. *Lancet*, *382*(9890), 375–376.
Rajendran, S., Afari-Sefa, V., Shee, A., Bocher, T., Bekunda, M., & Lukumay, P. J. (2017). Does crop diversity contribute to dietary diversity? Evidence from integration of vegetables into maize-based farming systems. *Agriculture & Food Security*, *6*(1), 50.
Remans, R., DeClerck, F. A., Kennedy, G., & Fanzo, J. (2015). Expanding the view on the production and dietary diversity link: Scale, function, and change over time. *Proceedings of the National Academy of Sciences of the United States of America*, *112*(45), E6082. https://doi.org/10.1073/pnas.1518531112
Rudenko, I. (2008). *Value Chains for Rural and Regional Development: The Case of Cotton, Wheat, Fruit and Vegetable Value Chains in the Lower Reaches of the Amu Darya River, Uzbekistan*, PhD dissertation. Hanover Universit.
Ruel, M. T. (2003). Operationalizing dietary diversity: a review of measurement issues and research priorities. *Journal of Nutrition*, *133*, 3911S–3926S.
Sedik, D. (2017). *Regional overview of food insecurity: Europe and Central Asia*. Rome, Italy: Food and Agriculture Organization of the United Nations (FAO).
Shankar, B., Agrawal, S., Beaudreault, A. R., Avula, L., Martorell, R., Osendarp, S., Prabhakaran, D., & Mclean, M. S. (2017). Dietary and nutritional change in India: implications for strategies, policies, and interventions. *Annals of the New York Academy of Sciences*, *1395*(1), 49–59. https://doi.org/10.1111/nyas.13324
Shively, G., & Sununtnasuk, C. (2015). Agricultural Diversity and Child Stunting in Nepal. *The Journal of Development Studies*, *51*(8), 1078–1096. https://doi.org/10.1080/00220388.2015.1018900
Sibhatu, K. T., & Qaim, M. (2016). Farm production diversity and dietary quality: Linkages and measurement issues. Global Food Discussion Papers. No. 80, Georg-August-Universität Göttingen, Research Training Group (RTG) 1666 - GlobalFood, Göttingen.
Singh, I., Squire, L., & Straus, J. (Eds.). (1986). *agricultural household models*. The Johns Hopkins University Press.
Snapp, S., & Fisher, M. (2015). Filling the maize basket supports crop diversity and quality of household diet in Malawi. *Food Security*, *7*(1), 83–96.
Sunderland, T. C. H. (2011). Food security: Why is biodiversity important? *International Forestry Review*, *13*(3), 265–274.
Swinnen, J., & Vandeplas, A. (2011). Rich Consumers and Poor Producers: Quality and Rent distribution in Global Value Chains. *Journal of Globalization and Development*, *2*(2), 1–28.
Takeshima, H., Akramov, K., Park, A., Ilyasov, J., Liu, Y., & Ergasheva, T. (2020). Agriculture–nutrition linkages with heterogeneous, unobserved returns and costs: Insights from Tajikistan. *Agricultural Economics*, *51*(4), 553–565.
Unicef & World Health Organization. (2017). The state of food security and nutrition in the world 2017: Building resilience for peace and food security.
Von Braun, J., & Kennedy, E. (1986). *Marketization of subsistence agriculture: Income and nutritional effects in developing countries*. International Food Policy Research Institute.
Von Braun, J. (1995). Agricultural commercialization: impacts on income and nutrition and implications for policy. *Food Policy*, *20*(3), 187–202. https://doi.org/10.1016/0306-9,192(95)00013-5
Walls, H., Johnston, D., Matita, M., Chirwa, E., Mazalale, J., Quaife, M., Kamwanja, T., & Smith, R. (2023). How effectively might agricultural input subsidies improve nutrition? A case study of Malawi's Farm Input Subsidy Programme (FISP). *Food Security*, *15*(1), 21-39. https://doi.org/10.1007/s12571-022-01315-7
Webb, P., & von Braun, J. (1994). *Famine and Food Security in Ethiopia: Lessons for Africa*. John Wiley and Sons for the International Food Policy Research Institute.
Webb, P., & Block, S. (2012). Support for agriculture during economic transformation: Impacts on poverty and undernutrition. Special Feature on Agriculture, Development and Nutrition Security. *Proceedings of the National Academies of Science*, *109*(31), 12309–12314.
Zanello, G., Shankar, B., & Poole, N. (2019). Buy or make? Agricultural production diversity, markets and dietary diversity in Afghanistan. *Food Policy*, *87*(101), 731.

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