

DOES AGRICULTURAL PRODUCTION DIVERSITY CONTRIBUTE DIETARY DIVERSITY? EVIDENCE FROM RURAL HOUSEHOLDS OF SAMARKAND REGION IN UZBEKISTAN

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Abstract: *Most of the world’s poor and food insecure live in rural area. Together with, smallholder farmers produce 70–80% of the world’s food and yet are largely food insecure. This article describes the results of a study on the example of small farms in Samarkand region, which has a high share in agricultural production in Uzbekistan. In Uzbekistan, almost half of the population lives in rural areas and majority of them are smallholder farmers. This paper examines how agricultural production diversification impact rural household’s dietary diversity using crop and livestock diversification separately at a household level. Data were analysed using multivariate regression model, which showed livestock and crop diversification were positively associated with household dietary diversity which consumed own production. Nevertheless, in terms livestock diversification there was negative association household dietary diversity which consumption comes from market. Results suggest that interventions that increase production diversity, especially livestock diversification in beneficial for household nutrition. Along with, the government should remain promoting crop diversification, including high-value crops like horticulture, that can increase production can lead to improved nutrition through linking with agriculture in Uzbekistan. Besides that, dissemination of information on healthy eating by community self-government bodies, in the mass media and at educational institutions will further increase their knowledge on dietary diversity as one of the indicators of food security.*

Key words: *Dietary diversity, crop diversification, livestock diversification, multivariate regression model, nutrition*

INTRODUCTION

Most of the world’s poor and food insecure live in rural area [1]. It has been widely reported that smallholder farmers produce 70–80% of the world's food[2] and yet are largely food insecure [3]. In the first years of independence, Uzbekistan was considered an agrarian country because the main production of the economy was strongly related with agriculture. In recent years the share of agriculture in GDP has been declined due to rapid growth of other sectors of the economy. At the same time, structural changes have taken place in agriculture, which the types of agricultural enterprises have also changed radically. State and collective farms have been replaced by private farmers and dehqons(Hereinafter rural households)

as the main producers of agricultural products. In Uzbekistan, almost 50 percent population lives in rural areas and majority of them are smallholder farmers.

Private farms mainly produce a state-ordered strategic products cotton and wheat on large areas of plots. Rural households mainly use land plots as backyard kitchen gardens and are free to choose their crops to plant and to sell at their demands. Besides more than 90 percent of meat and milk and 60 percent of egg produced by rural households in 2020. It means rural households are highly engaged in animal husbandry. Still, rural households have too small in land sizes to generate profits at a scale that would negate the need to generate additional income via other means.

Recently, “The agricultural development strategy of the Republic of Uzbekistan for 2020 – 2030” has adopted as a legal framework and roadmap for sustainable agricultural development in the country. The main and first priority toward of the strategy is ensuring food security of the population. Promote healthy consumption, intensify and diversify the production of agricultural products, increase productivity in livestock, conduct research aimed at sustainable intensification of production of fish and poultry, as well as milk production were set as main tasks of the priority direction of the strategy.

Accordingly, exploration and evaluation of the activities, agricultural production diversification rural households play an important role in the performance of these tasks. Recent research emphasized that in the case of Samarkand region, the main agricultural food producers are rural households [4]. Besides that, empirical studies have been conducted on the impact of socio-demographic factors on the growth of income from farm activities [5], as well as the analysis of the possibility of contract sales of farm products [6]. Additionally, scientists have been carried out the investigation on crop diversification in case of Uzbekistan [7]. Although the available literature on agricultural diversification has been disclosed, only crop diversification has been identified at the level of private farms [8]. This paper examines how agricultural production diversification impact rural household’s food security using crop and livestock diversification separately at household level.

MATERIALS AND METHODS

The study conducted in Samarkand region which is major agricultural area in Uzbekistan. Agricultural production was the highest (12.9 percent) share of in this region in 2021. Survey data was collected through the face-to-face interviews from respondents from the beginning of January to the end of March in 2021. Total 328 respondents randomly selected in nine districts (Akdarya, Bulungur, Ishtixan, Jomboy, Kushrabad, Payarik, Pasdargom, Taylak, Urgut) of Samarkand region.

Household dietary diversity score was calculated for each household using recall data on consumption of foods over the previous 24 hour [10]. The food items were categorized into 12 different food groups with each food group counting toward the household score if a food item from the group was consumed by anyone in the household in the previous 24 hour. The Household dietary diversity score is a

count variable and include 12 food groups from 0 to 12. The food groups used to calculate Household dietary diversity score such as cereals, roots and tubers, vegetables, greens, fruits, meat, eggs, pulses and nuts, milk and milk products, oils and fats, sugar, beverages. In order to link between agricultural production diversity and household dietary diversity score divided into Household dietary diversity score_{own} from own production and Household dietary diversity score_{bought} bought from market.

Agricultural production diversification measured in a given time and space by a single quantitative indicator. Different types of indices have been used in the literature to measure agricultural production diversification. [11] The magnitude of diversification can be measured by a number of statistical tools which includes Simpson Index, Entropy Index, Shannon Index, Ogive Index, Composite, Herfindahl-Hirschman Index, etc[12]. Each of these tools has its own advantages and limitations in terms of data requirement, level of sophistication, and ease of computation and interpretation. Herfindahl-Hirschman index, which is the most popular method in economics to measure market concentration [13]. Previous studies have been used to measure crop diversification[14, 15, 16]; only a few studies applied to measure livestock diversification[17,18] In this paper, Herfindahl-Hirschman index was used to measure the extent of agricultural diversification. The index (Ht) was calculated using Equation:

$$Ht = 1 - \sum (S_{it})^2$$

S_{it} is the share of crop in total cropped area in the year 't'. For the livestock diversification index, the different types of livestock kept and the number of each is used to construct a common measure of livestock ownership, total livestock units (TLU), which is then used to calculate the diversification index. This index is bound between zero and one value. Higher is the value of the index, the larger is the degree of diversification. The index provides only the magnitude of diversification, and not its nature or direction.

NUTRITION KNOWLEDGE

Being an abstract category, nutrition knowledge is hard to measure. In the current study, the aim was to have a simple but multidimensional tool for identifying the level of awareness about a healthy diet. In determining the Households nutrition education, the survey included a nutrition knowledge index of 12 questions on a variety of healthy eating, knowledge of daily fruit and vegetable consumption, and knowledge of diseases caused by excessive consumption of fat. Since the index covers only a limited area of diet awareness and lacks important information on, for example, sources of nutrients, it therefore cannot be appropriate for use in measuring the overall nutrition knowledge.

Market access. Several empirical studies have highlighted the relative importance of markets for farm household dietary diversity and reported that markets are critical for dietary diversity than subsistence production. Measuring market access also different considering research aim and scope. In this study

Distance to the nearest market is used to measure market access. Credit access, land size household assets, access to pure water and natural gas, household socio-demographic characteristics used control independent variables.

ESTIMATION STRATEGY

To investigate the relationship between crop diversification, livestock diversification, nutrition knowledge on dietary diversity, we estimated multivariate regression analysis. Multivariate regression is a technique that estimates a single regression model with more than one dependent variable. Finn (1974) provides a succinct mathematical explanation of the model. Briefly, in the fixed effects regression model, each dependent variable in a sample of n observations may be expressed as a linear function of a set of independent variables plus a random error, ε . The number of independent variables (x) is denoted by q , and the β s are the regression coefficients as follows: [19]

$$y_n = \beta_0 + \beta_1 x_{n1} + \beta_2 x_{n2} + \dots + \beta_q x_{nq} + \varepsilon_n$$

The general form of the model can be expressed as follows:

$$Y_{1,2} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \varepsilon_{1,2}$$

X_1 -Crop diversification	X_7 -Access pure drinking water
X_2 -Livestock diversification	X_8 - Access natural gas
X_3 - Nutrition knowledge	X_9 -Credit access
X_4 - Household monthly income, logarithmic	X_{10} -Land size
X_5 - Market access	X_{11} -Household head age
X_6 - Household facilities	X_{12} -Household head education
	X_{13} -Household head experience

RESULTS AND DISCUSSIONS

Table 1 describes household characteristics. Above shows household dietary diversity from own produced and bought from market. Mean household dietary diversity from own production and bought from market are respectively 3.6 and 5.024; that is, the average household has consumed food groups during 24-hour recall. The average farm household crop and livestock diversification calculating with Herfindahl Hirschman indexes are respectively 0.76 and 0.20. In terms of market access, the nearest market distance average 4.2 km. Household assets more than 50 percent of respondents have own car, 57 percent households use refrigerator. Only 7 percent of respondents in sample size have stove for cooking and contemporarily more than 68 percent of households use electric oven. 25 percent of household's heads acquired high education. Average head age and experience is respectively 53 and 23 years.

TABLE 1

Descriptive statistics of dietary diversity analysis

Variables	Obs	Mean	Std. Dev.	Min	Max
HDDS own	320	3.622	1.645	0	8
HDDS bought	320	5.024	1.663	1	10
Crop diversification (HHI)	320	.767	.125	.282	.903
Livestock diversification (HHI)	250	.204	.237	0	.663
Nutrition knowledge	320	9.293	1.717	4	12
Log Household monthly income	320	15.12099	.6501497	13.2 1767	16.7 0588
Market access, km	320	4.232	2.432	.5	12
Household facilities					
<i>Car</i>	320	.524	.5	0	1
<i>Refrigerator</i>	320	.573	.495	0	1
<i>Stove</i>	320	.72	.45	0	1
<i>Electric oven</i>	320	.683	.466	0	1
Credit access	320	.305	.461	0	1
Access pure drinking water	320	.878	.328	0	1
Access to natural gas	320	.28	.45	0	1
Household high education	320	.256	.437	0	1
Land size, ha	320	0.22	16.574	7	130
Head age	320	53.329	13.194	30	82
Head experience	320	23.146	14.732	0	60

TABLE 2

Multivariate regression Crop and livestock diversification on dietary diversity

Equation	Obs	Parms	RMSE	R-sq	F	P
HDDS_own	320	17	1.269198	0.3313	7.401066	0.0000
HDDS_bought	320	17	1.255928	0.2775	5.735947	0.0000

	HDDS_own	HDDS_bought
Crop diversification (HHI)	1.600* (0.948)	-1.036 (0.938)
Livestock diversification (HHI)	1.196*** (0.423)	-1.430*** (0.418)
Nutrition knowledge	0.124* (0.051)	-0.039 (0.050)

Log household monthly income	0.010 (0.141)	-0.101 (0.140)
Distance market	0.017 (0.052)	-0.039 (0.051)
Car	0.089 (0.183)	-0.112 (0.181)
Refrigerator	-0.126 (0.210)	0.227 (0.208)
Stove	-0.120 (0.222)	0.287 (0.219)
Electric oven	-0.484** (0.212)	0.540** (0.210)
Credit access	-0.775*** (0.197)	-0.101 (0.195)
Access pure drinking water	0.435 (0.295)	0.727** (0.292)
Natural gas	0.201 (0.262)	-0.943*** (0.259)
Head high education	0.402* (0.221)	0.552** (0.219)
Land size	0.034*** (0.006)	-0.007 (0.005)
Head age	0.017* (0.010)	-0.023** (0.010)
Head experience	0.003 (0.009)	-0.013 (0.009)
_cons	-0.575 (2.343)	8.359 (2.319)

Table 2 shows estimates of agricultural production diversification between household dietary diversity. Results from the multivariate regression show that both crop and livestock diversification have positive and significant associations with household dietary diversity which consumption comes from own production. Several previous research also found positive association between farm diversification and dietary diversity in developing countries [21,22]. There is a negative and significant association livestock diversification between household dietary diversity which bought from market. The meaning is that more diversified farms tend to buy less diversified foods in the market.

Nutrition knowledge has weak positive relationship with household dietary diversity with own production.

The presence of an electric oven in households showed a negative association with the dietary diversity from own production but a positive association with the dietary diversity bought from market and were statistically significant.

Credit access has a weak negative linkage with household dietary diversity from own production. It expresses These results express that households sell most of their own production on the market in order to pay money back the credit[23]

Results from access pure drinking water has positive association and access to natural gas has negative association with household dietary diversity bought from market at 5 and 1 percent statistical significantly respectively. Household head high education has strong positive and significant association household dietary diversity. It means having high education of the household head attempt to eat more diversified. Land size has strong positive association household dietary diversity from own production. Head age has weak positive association with household dietary diversity with own production and negative association with household dietary diversity bought from market at 10 and 5 percent of statistically significantly.

CONCLUSION

The study results show that crop and livestock diversity had a strong and positive association with household dietary diversity with own production but in terms livestock diversification there was negative association household dietary diversity which consumption comes from market. These results suggest that interventions that increase production diversity, especially livestock diversification in beneficial for household nutrition.

Along with the government should remaining promoting crop diversification, including high-value crops like horticulture, that can increase production can lead to improved nutrition through linking with agriculture in Uzbekistan. Besides that, dissemination of information on healthy eating by community self-government bodies, in the mass media and at educational institutions will further increase their knowledge on dietary diversity as one of the indicators of food security.

REFERENCES:

- [1] FAO. 2020. COVID-19 and Rural Poverty: Supporting and protecting the rural poor in times of pandemic[Online], pp 10 Available at: <http://www.fao.org/3/ca8824en/CA8824EN.pdf>
- [2] FAO, 2014. The State of Food and Agriculture 2014: Innovation in Family Farming Food and Agriculture Organization of the United Nations [Online], pp 161 Available at: <https://www.fao.org/3/i4040e/i4040e.pdf>
- [3] IFAD, UNEP. "Smallholders, food security and the environment." Rome: International Fund for Agricultural Development 29 (2013). Available at: https://www.ifad.org/documents/38714170/39135645/smallholders_report.pdf/133e8903-0204-4e7d-a780-bca847933f2e;
- [4] Saydullaeva F. J. Main directions of food security in Uzbekistan (the case of Samarkand province. Irrigation and Melioration Journal. vol.3, 2021, pp.39-44;

- [5] Muratov, S. A. The economic assessment of factors affecting small household (tomorka) in rural areas and their income. *Irrigation and Melioration*, vol.3, 2021, pp.45-51;
- [6] Пардаев, X. Smallholders preferences for contract design attributes, a case of Samarkand province. *Иқтисодиёт ва таълим Journal* vol. 5, 2021, pp. 59-66;
- [7] Bobojonov I. et al. Options and constraints for crop diversification: a case study in sustainable agriculture in Uzbekistan. *Agroecology and Sustainable Food Systems Journal*. Vol.37, 2013, pp. 788-811;
- [8] Hasanov S. Agricultural policies to enhance the development of fruit and vegetable subsectors in Uzbekistan *European Scientific Journal*. Vol.12, 2016, pp.479-491;
- [9] Abdulla P. Status of Crop Diversification in Uzbekistan and its Empirical Analysis. *Journal of Marketing and Emerging Economics*. vol 5, 2021, pp. 7-12;
- [10] Anne.S, Bilinsky.P. Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (v.2). 2006, Available at: https://www.fantaproject.org/sites/default/files/resources/HDDS_v2_Sep06_0.pdf;
- [11] Pal, S., Kar, S. Implications of the Methods of Agricultural Diversification in Reference With Malda District: *International Journal of Food, Agriculture and Veterinary Sciences*. Vol.2, 2012, pp. 97–105;
- [12] Kumar, A., Kumar, P., & Sharma, A. N. Crop diversification in Eastern India: Status and determinants. *Indian Journal of Agricultural Economics*. Vol.67, 2012, pp. 600–616. <https://doi.org/10.22004/ag.econ.204840>;
- [13] Ferreira, C. Bank market concentration and bank efficiency in the European Union: A panel Granger causality approach. *International Economics and Economic Policy Journal*. Vol.10, 2013, pp. 365–391. <https://doi.org/10.1007/s10368-013-0234-y>
- [14] Pellegrini, L., Tasciotti, L. Crop diversification, dietary diversity and agricultural income: Empirical evidence from eight developing countries. *Canadian Journal of Development Studies*. Vol. 35, 2014, pp.211–227. <https://doi.org/10.1080/02255189.2014.898580>;
- [15] Adjimoti, G. O., Kwadzo, G. T. M., Sarpong, D. B., Onumah, E. E. Input Policies and Crop Diversification: Evidence from the Collines Region in Benin. *African Development Review Journal*, vol. 29, 2017, pp. 512–523. <https://doi.org/10.1111/1467-8268.12286>;
- [16] Auffhammer, M., Carleton, T. A. Regional crop diversity and weather shocks in India. *Asian Development Review Journal*. Vol. 35, 2018, pp. 113–130. https://doi.org/10.1162/adev_a_00116;
- [17] Munialo, S., Nyawade, S., & Oluoch-Kosura, W. Invited paper presented at the 6th African Conference of Agricultural Economists. 6th African Conference of Agricultural Economists, September 2019, pp. 1–23;

[18] Mulwa, C. K., Visser, M. Farm diversification as an adaptation strategy to climatic shocks and implications for food security in northern Namibia. *World Development Journal*. Vol. 129, 2020, 10 p. 104906. <https://doi.org/10.1016/j.worlddev.2020.104906>;

[19] Cleff T. *Applied statistics and multivariate data analysis for business and economics*. – Cham, Switzerland : Springer International Publishing, 2019. – C. 433-441

[20] Nandi R., Nedumaran S., Ravula P. The interplay between food market access and farm household dietary diversity in low and middle income countries: a systematic review of literature *Global Food Security Journal*. Vol.28, 2021, P.100484;

[21] Murendo, C., Nhau, B., Mazvimavi, K., Khanye, T., & Gwara, S. Nutrition education, farm production diversity, and commercialization on household and individual dietary diversity in Zimbabwe. *Food & Nutrition Research*, Vol.62, 2018, pp. 1-12;

[22] Romeo A, Meerman J, Demeke M, Scognamillo A, Asfaw S. Linking farm diversification to household diet diversification: evidence from a sample of Kenyan ultra-poor farmers. *Food Security Journal* vol.8 2016,1069-1085;

[23] Cele T., Mudhara M. Impact of Market Participation on Household Food Security among Smallholder Irrigators in KwaZulu-Natal, South Africa. *Journal of Agriculture*. Vol. 12, 2022, p 261.