

Crop Diversification Analysis at the Farm Level: Empirical Evidence from Different Regions of Uzbekistan

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Abstract

In Uzbekistan, land is more appropriate for cultivating fruits and vegetables. Since independence, the government of Uzbekistan has implemented a number of agricultural policies such as making some crucial structural reforms at the farms, comprising different institutions and enhancing diversification of agricultural production in order to stabilize on agricultural sector of the country. Therefore, crop diversity has an important role in sustainable agriculture. The main purpose of the study is to examine the degree of crop diversification among farmers. We calculated the diversification index based on the Simpson Diversity Index method. The study revealed the mean computed Simpson Index values indicate that diversity index was found 0.59, 0.45, 0.56 and 0.62 for Andijan, Karakalpakstan, Kashkadarya and Tashkent regions, respectively. This implies that Tashkent region farmers shifted towards more diversification cropping patterns than other counterparts of the country. The overall result in the four states combined in this study reveals a mean Simpson Index within the sample of farmers was 0.56. This suggests that the farmers in the study areas were not too diversified in their cropping pattern. While cultivating several crop species also helps the farmers to manage both price and production risks which attains more food options for the household and income through marketing the produce from the surpluses.

Keywords

Crop Diversification, Simpson Diversification Index, Cropping Patterns, Uzbekistan

1. Introduction

Agriculture plays a highly important role in Uzbekistan's overall economy. The agricultural sector is one of the leading sectors of the national economy and contributing with over 28.8% of the annual gross domestic product (GDP) and engages 27% of the country's total workforce and earns 25% of all export revenue [1, 2]. Importantly, about 50% of the country's population resides in rural areas and depend on agriculture as well as other related activities [3]. Since independence in 1991, the government of Uzbekistan has been doing several important reforms in order to find out the best options to increase income of the agricultural sector.

The main important reform was to be replaced state and collective farms by private farms and shirkats. However, the

productivity and occupied land area of the shirkats was decreasing throughout the years which led them abolish in agriculture. Instead, the role of private farms and dekhans has increased in the agricultural output [4]. Private farms predominantly produce state-order crops which are wheat and cotton, whereas smallholders are occupied in the livestock and partly produce other agricultural crops such as fruits and vegetables [5].

The production of higher value crops, such as fruit and vegetables, was constrained by limited access to land, inputs, modern crop-specific technologies, and finance. Additionally, Uzbekistan's agricultural policies were more highlighted at the strategically significant crops cotton and winter wheat. Additionally, the state planning system has only retained for these crops whilst fruits and vegetables obtained less policy attention in terms of the lack of state procurement system [5,

6]. Following independence, the country has managed to gradually move away from cotton monoculture towards a more diversified pattern of agricultural produce, including cereals, potatoes, vegetables and melons [2, 5, 7].

Recently, agricultural policy in Uzbekistan has launched paying more attention to intensify high-value diversification of agricultural production while focusing on the development of fruits and vegetables. Therefore, the national administration has recently issued several legislative acts in order to enhance the crop diversification through the country [8, 9]. The National Development Strategy for 2017-2021 recognizes the need for diversification for cotton and cereal crops into high value-added and labor-intensive production and processing, including, horticulture, fruits, and vegetables, which are expected to significantly contribute to significant growth of rural jobs, food security and exports revenues [10].

2. The Concept of Crop Diversification

Crop diversification is defined as a shift in production portfolio away from mono-cropping to adopting a multiple cropping system. There are two common and complementary ways to crop diversification in agriculture, namely horizontal and vertical diversification [11]. Karimov (2013) indicated that enhancing crop productivity on the farm level plays an essential role in developing economic growth, improving food security and easing poverty in the country. Whilst government ought to carry on crop diversification among farmers, as it supports to obtain extra income, improves food security as well as lessens famine [12]. Dagar (2018) defined that, crop diversification is planned to give a wider choice in the production of a variety of crops in a specified area so as to increase production related activities and minimize risk [13].

Furthermore, crop diversification is a strategy to maximize the use of land, water, and other resources and for the overall agricultural development in the country. It provides farmers with viable choices to grow diverse crops on their land [14]. In line with the existing views, Saraswati (2011) also suggested that the diversification in agriculture is practiced with a view to avoiding risk and uncertainty due to climatic and biological vagaries. It can also help to minimize the adverse effects of the current system of crop specialization and monoculture for better resource use, nutrient recycling, reduction of risks and uncertainty and better soil conditions. In addition, it also ensures better economic viability with value-added products and the improvement of ecology as well [14].

Despite these facts, Bobojonov (2013) also indicated that, diversification is explained as the addition of more crops into the existing cropping system and increase farm income and minimizes risk management practice on the farm level and crop diversification is an effective strategy to deal with such problems as water scarcity, drought and salinity. Additionally, easing of cotton and wheat production would increase crop diversification and farm income [15].

The results of the previous studies emphasized that most of the achievements in cotton and wheat production are based on high input use technologies such as water, seed, fertilizers, and pesticides which are not sustainable on a long-term basis. Therefore, high input use technologies will not be appropriate for all private farms [7]. Furthermore, the area available for high-value alternative crops however, cultivation of these types of crop is very limited in spite of high economic and ecological potential [16, 17].

Hence, it is the right time to look for a suitable and realistic strategy by which cropping intensity could be enhanced and diversification achieved. Moreover, comprehensive studies of crop diversification in Uzbekistan are still sparse and mostly studies based on hypothetical scenarios and multi-sensor remote sensing data results, only limited research on this subject has been conducted in Uzbekistan to date [15, 18]. To the best of our knowledge, there are currently no study to date has attempted to provide comprehensive understanding of the status and degree of crop diversification at the farm level in different parts (regions) of the Uzbekistan.

The rest of the paper is organized as follows: Introduction gives the literature on the concepts of crop diversification and crucial reforms in study regions. The second section outlines the research methodology adopted by this study. Third section illustrates the results and discussions, and the study conclusions and policy implications are summarized in the fourth section.

3. Methodology

3.1. Data Sample

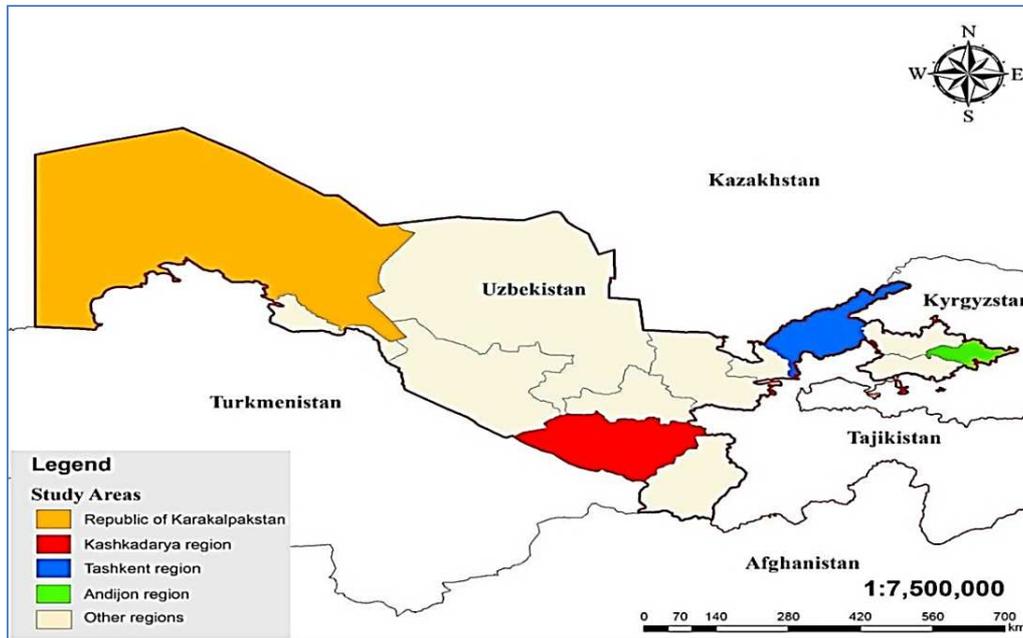
One of study aims is to examine the extent of crop diversification index at the farm level. The study is based on farmers interviewed during a baseline survey in Uzbekistan for 2009-2017 growing season. This section briefly describes sampling methods used to measure crop diversification index at the farm level. The study has used the panel data collected by Official Statistical Agency. A total of four regions (Karakalpakstan, Kashkadaryo, Tashkent, and Andijan) from Uzbekistan were chosen in collecting this data. The four districts were purposively selected in terms of agro-ecological, crop production and marketing access. Tashkent and Andijan provinces are great potential in both cases, however, Karakalpakstan and Kashkadarya provinces are in low potential zones, respectively.

3.2. Study Regions

In this study, the four regions of Uzbekistan, namely, the Republic of Karakalpakstan, Kashkadaryo, Tashkent, and Andijan were chosen for the analysis because these provinces are located in different part of the country, as shown in Figure 1. The Republic of Karakalpakstan in northwest Uzbekistan, located southeast to southwest of the Aral Sea, whilst Kashkadarya province is located in the southern part of Uzbekistan. In both provinces, soil salinization is the main

agricultural problem. In Karakalpakstan and Kashkadarya provinces about 500,000 ha and 514,000 ha are arable lands where farmers mainly cultivate wheat and cotton crops and these two crops are controlled by the government in terms of state procurement policy [6, 19, 20]. Andijan province is located in the eastern part of the Fergana Valley where Tashkent region is situated in the northeastern part of

Uzbekistan. These areas have greater independence to choose their own cropping and subsequently often focus on fruits and vegetables. In these ‘non cotton’ areas, it is common to see vegetables being produced as second crop after winter wheat, with farmers cultivating vegetable, beans and potato or melon crops (Tashkent - 15.5%, Andijan - 12.9%, respectively) [2, 21].



Source: Own illustration.

Figure 1. Map of surveyed areas of the study regions.

A total of four regions (Karakalpakstan, Kashkadaryo, Tashkent, and Andijan) from Uzbekistan were included in gathering this data. The four districts were purposively selected in terms of agro-ecological, crop production and marketing access. Tashkent and Andijan provinces are great potential in both cases, however, Karakalpakstan and Kashkadarya districts are in low potential zones, respectively. The Simpson Diversity Index was measured while utilizing Stata version 14 statistical software tools in order to measure the degree of crop diversification index for the particular crops of interest in the study areas.

3.3. Crop Diversification Analysis

The extent of crop diversification can be measured by using several indices Simpson’s Index (SI), Herfindahl Index (HI), Margalef Index (MI), Composite Entropy Index (CEI), Entropy Index (EI) and Shannon Index (ShI). These indices have been widely used by many other researchers to estimate the nature and extent of crop diversification practices of farmers [22, 23, 24, 25, 26]. However, in terms of data availability and crop patterns, this study is employed Simpson Diversity Index (SDI) because it is the most commonly used index in numerous studies related to crop diversification [23, 25] including in Uzbekistan [15, 18]. The Simpson Index (SID) is calculated using the following

equation:

$$SID = 1 - \sum_{i=1}^n P_i^2 \tag{1}$$

$$P_i = \frac{A_i}{\sum_{i=1}^n A_i} \tag{2}$$

where, A_i is the value or area of the i^{th} commodities and P_i is the proportionate value or area of the i^{th} commodities in the total value or area.

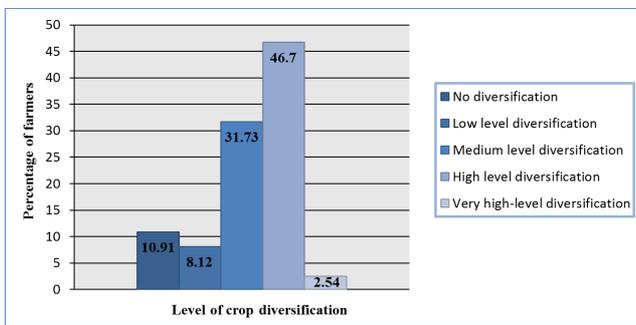
The index ranges between 0 and 1 value. If the values close to 1 point at more diversify cropping pattern or complete diversification, value of 0 indicates in contrast a situation of monoculture or complete specialization. In this study, we used several agricultural crops in order to calculate the index common in smallholder farming in four provinces of Uzbekistan. Crops included cereals (barley, rice, wheat), pulses (bean and leguminous), potatoes, spices, vegetables and others. Based on literature review the level of crop diversification was classified as shown in Table 1.

Table 1. Level of crop diversification.

Category	SID value
No diversification	≤ 0.01
Low level diversification	0.01 to 0.25
Medium level diversification	0.26 to 0.50
High level diversification	0.51 to 0.75
Very high-level diversification	> 0.75

4. Results and Discussions

At the time of survey period, farmers have been cultivated around 23 crops including cereals, pulses, root and tubers and vegetables on a given piece of land through allocating the crop season into four different periods. In terms of diversification, the result indicated that the average crop diversification index within the sample of farmers was 0.56 with a standard deviation of 0.17. The result implies that most of the farmers had a quiet high level of crop diversification intensity in different part of the Uzbekistan (Figure 2) whereas still around 11% of farmers have not practiced any types of crop diversification activities or cultivate only one or two state order crops cotton and wheat. The finding was almost comparable with the findings of [15] and [18] who found 0.65 and 0.68 in Khorezm (in 2008) and Fergana Valley (during 2010-2012), respectively.

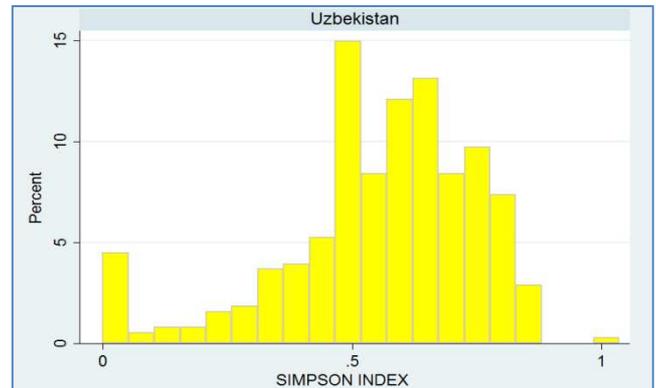


Source: Own estimation based on survey data.

Figure 2. Level of crop diversification of farmers in study areas.

Figure 3 also portrayed that the crop diversification index was normally distributed and moderately skewed to the right implying that most of the farmers were not too diversifier in their cropping portfolio because of the majority of farmers were more likely to cultivate only

cereal crops such as cotton, wheat and rice due to the strong regulation of the national government on the agricultural practices in the country [27].



Source: Own estimation based on survey data.

Figure 3. The mean crop diversification index in study areas.

Crop diversification as an effective strategy which can help farmers to mitigate potential risks associated with mono-cropping and reallocate productive resources away from low-value food grains towards high-value cash crops to help increase and sustain farm income. The survey results show that Tashkent regions farmers shifted towards more diversification cropping patterns than other counterparts of the country. In addition, the overall result in the four states combined in this study reveals a mean Simpson Index within the sample of farmers was 0.56. This implies that the farmers in the study areas were not too diversified in their cropping pattern. Regional and district level of crop diversification level are also presented in Table 2. The results in table 2 shows the mean Simpson Index was found 0.59, 0.45, 0.56 and 0.62 for Andijan, Karakalpakstan, Kashkadarya, and Tashkent states, respectively.

Table 2. Descriptive statistics of level of crop diversification in study areas.

Regions	Districts	Periods	Mean	SD	Min	Max
Andijan	Ulugnar	2009-2017	0.56	0.15	0.20	0.75
	Balikchi	2009-2017	0.66	0.11	0.45	0.83
	Andijan	2009-2017	0.55	0.17	0.02	0.78
	Djalakuduk	2009-2017	0.56	0.10	0.47	0.75
	Shumanai	2009-2017	0.41	0.15	0.11	0.63
Karakalpakstan	Chimbai	2009-2017	0.49	0.23	0	0.75
	Hoddjailli	2009-2017	0.36	0.24	0	0.69
	Turtkul	2009-2017	0.54	0.19	0.03	0.76
	Chirokchi	2009-2017	0.56	0.18	0	0.80
Kashkadarya	Yakkabog	2009-2017	0.60	0.08	0.47	0.74
	Kamashi	2009-2017	0.65	0.09	0.52	0.82
	Kasbi	2009-2017	0.51	0.17	0	0.82
	Kasan	2009-2017	0.50	0.09	0.37	0.77
	Nishan	2009-2017	0.54	0.10	0.41	0.67
Tashkent	Kuichirchik	2009-2017	0.61	0.12	0.35	0.83
	Urtachirchik	2009-2017	0.59	0.18	0.09	0.84
	Chinaz	2009-2017	0.67	0.09	0.49	0.76
	Buka	2009-2017	0.53	0.19	0.17	0.83
	Zangiota	2009-2017	0.71	0.13	0.37	0.82

Source: Own estimation based on survey data.

5. Conclusions

Crop diversification is considered a key potential strategy for improving inclusive farm income and household food security. The study has examined the degree and extent of crop diversification at farm level across different states of Uzbekistan. The Simpson Index values indicate that the mean computed diversity index was found 0.59, 0.45, 0.56 and 0.62 for Andijan, Karakalpakstan, Kashkadarya and Tashkent regions, respectively. This implies that Tashkent region farmers shifted towards more diversification cropping patterns than other counterparts of the country. The overall result in the four states combined in this study reveals a mean Simpson Index within the sample of farmers was 0.56. This suggests that the farmers in the study areas were not too diversified in their cropping pattern. Crop diversification also helps the farmers to improve on the right selection and cultivation of different crop types on their farms. We therefore conclude that crop diversification enhances availability of foods for the households and income of farmers.

The policy implication of the study is to encourage farmers cultivating several crop species helps them to manage both price and production risks which attains more food options for the household and income through marketing the produce from the surpluses. Therefore, the government needs to intensify the promotion of crop diversification in order to increase farm income and food security in the country. Crop diversification also helps the farmers to improve on the right selection and cultivation of different crop types on their farms. Alongside, crop diversification might contribute to the efficient use of labor in the farming.

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