Dietary diversity for ensuring food security

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Abstract. 10.8% of the population in the world, or more than 840 million people, are undernourished. The report of the FAO (Food and Agriculture Organization of the United Nations) states that although population growth has been slowing down in recent years, this growth is expected to increase in some countries until 2050. There is a high emergency of increasing food insecurity all over the world. In the case of Uzbekistan, the population is growing rapidly annually. Yet, in the country prevalence of both obesity and overweight are increasing. Additionally, micronutrient deficiencies remain high for women of reproductive age and children. In this article, one of the best indicators of food security in respect of food access is the Dietary Diversity Score (DDS) used to analyze and spread healthy diets in rural households of the Samarkand region. A total of 140 observations were taken from rural households. The mean Households DDS was 8.2. Results indicated most of the food groups consumed through their own production. However, more than 50% of all members in the households did not consume fruits, greens, pulses, and legumes due to a lack of food access. It seems there is a positive correlation between dietary diversity and own production in some circumstances, but not in all cases. In that case, own production is positively associated with dietary diversity in some situations, but not an absolute. Nevertheless, appropriate nutrition-sensitive agricultural programs will encourage both food production and consumption. Analysis shows nutrition information has a significant role in improving DDS. Promoting nutrition education via interventions, for example, information on healthy eating and a well-balanced diet through mass media, educational institution curriculum, and field days to upgrade better nutrition at household and individual levels.

1 Introduction

Agriculture plays a crucial role in the sustainable food supply of the world's population. Although the positive effects of technological changes have increased food production in this sector in recent years, there are still cases of hunger and malnutrition worldwide. 10.8% of the population in the world, or more than 840 million people, are undernourished [1]. The report of the FAO (Food and Agriculture Organization of the United Nations) states that although population growth has been slowing down in recent years, this growth is expected to increase in some countries until 2050 [2]. In the case of Uzbekistan, the
The population is increasing rapidly annually, and according to the end of 2021, the population exceeds 35 million and got leading dominance among the countries of Central Asia. However, undernutrition decreased from 16.2% in 2002 to 2.5% by 2020[3]. But the rate of obesity in the country is increasing annually. The Ministry of Health of the Republic of Uzbekistan reported that 51% of the population is overweight, and 28% have a higher level of obesity. The regulation on the procedure for organizing the activity of the "Healthy Lifestyle" platform was approved in 2021 to solve the country's obstacle and prevent it from increasing in the future. According to the regulation, 3000 sums will be transferred to the electronic wallet of the citizens of Uzbekistan aged 18 and older who walk ten thousand or more steps in one day in the territory of Uzbekistan. In addition, various marathons on walking are held in all organizations in the country.

Nevertheless, many programs are being implemented to support a healthy lifestyle and sports; at the same time, the population's lack of micronutrients remains high. Sadly, 1/4 of children under the age of two is anemic, and 75% of these cases result from iron deficiency [4]. The level of iron deficiency in teenage girls was almost 50 percent, and it was also found that women of reproductive age in Uzbekistan suffer from strong hidden hunger [5]. 1/5 non-pregnant women is anemic and deficient in vitamin B12. 50 % of women of reproductive age experience folate deficiency. The cause of these deficiencies is an unhealthy diet can be explained. Because FAO and WHO experts mutually recommended at least 400g of fruit and vegetable intake per day (except starchy tubers, potatoes, and others) for the protection of various chronic illnesses and to mitigate several micronutrient deficiencies [6].

Furthermore, most rural households are vulnerable in terms of food insecurity. Therefore, we considered our research at a rural household level. Previous empirical research at rural households' levels has been conducted on topics related to nonfarm income[7] and analysis of the possibility of contract sales of farm products[8], and diversification of smallholder agricultural production[9]. However, food security research has been conducted more at the national level than at the household level [10].

In this article, we intend to determine food access using DDS offered by international organizations in the case of rural households and provide a broad overview of its possibilities. Based on the above food security and nutrition problems, we addressed to find out following research questions: 1. Which aspects affect dietary diversity in the country? 2. Does nutrition information affect the improvement of dietary diversity? We hypothesize that there is a positive association between farm production and nutrition information in rural areas in Uzbekistan.

2 Materials and methods

The research was conducted in Samarkand province, a major agricultural area in Uzbekistan, whose agricultural production share was the highest (12.9 percent) in 2021. Data collection through in-person interviews started from January up to the end of March 2021. 140 respondents were randomly selected regarding the methodology of collecting DDS data in nine districts (Akdarya, Bulungur, Ishtixan, Jambay, Kushrabat, Payarak, Pastdargom, Taylak, Urgut) of Samarkand province.
Table 1. Data collection by districts

<table>
<thead>
<tr>
<th>District name</th>
<th>Number of households interviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akdarya</td>
<td>19</td>
</tr>
<tr>
<td>Bulungur</td>
<td>20</td>
</tr>
<tr>
<td>Ishtixan</td>
<td>15</td>
</tr>
<tr>
<td>Jambay</td>
<td>26</td>
</tr>
<tr>
<td>Kushrabat</td>
<td>4</td>
</tr>
<tr>
<td>Pastargom</td>
<td>6</td>
</tr>
<tr>
<td>Payarik</td>
<td>18</td>
</tr>
<tr>
<td>Taylak</td>
<td>17</td>
</tr>
<tr>
<td>Urgut</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>140</strong></td>
</tr>
</tbody>
</table>

Source: Data from the survey conducted by authors in 2021.

In this article, one of the best indicators of food security in respect of food access, DDS [11] is used to analyze and spread healthy diets in rural households of the Samarkand region. Since it has been verified that DDS reflects both physical and economical food access, the adequacy of nutrients in the diet is a result of several previous scientific and practical studies[12].

Methodological usage and calculation of the DDS were developed by the international organization Food and Agriculture (FAO) in 2010 on the framework Food and Nutrition Technical Assistance (FANTA) project[13]. According to the guidelines, there are several crucial points and requirements to get correct data during a survey. Thus, we constructed and conducted this research under the following requirements.

1. We considered measuring DDS at the household level; information given from a respondent covers a period of 24 hours. As a result of the conducted research, the most optimal period of 24 hours was highlighted due to the reduction of incorrect answers by the respondents and the ease of recall [14-16].

2. It is important to focus on consumption patterns when creating DDS. We considered the usual daily food consumption in the household; unusual days, such as holidays, weddings, and Ramadan, did not coincide with periods that affected food patterns. Also, the food source will indicate food access more clearly: 1=self-grown; 2=bought is specified. We considered all household members consumed food at home in this period. Since it is not possible to accurately capture DDS at the household level.

3. In addition, it is essential to categorize food intake. Swindale and Bilinsky proposed using data on food intakes categorized into 12 food groups[13]. The DDS count variable includes 12 food groups from 0 to 12. The paper categorizes food groups into cereals, roots and tubers, vegetables, greens, fruits, nuts and pulses, meat, eggs, milk and dairy products, sugar, beverages, oil, and fat.

4. When calculating the dietary diversity index in rural areas, it is appropriate to take a survey in each season, paying attention to seasonality. In several studies, it was considered important the study should hold during the lean period after harvesting the main crop in rural areas because it was noted that there might be difficulties in ensuring food security during this period.

5. Knowing the names and composition of local foods during the survey made it possible to get accurate information; Several food groups are used at the same time in the preparation process, and there is no need to set minimum amounts of food at the household level, so even a small amount of food (for example, meat included in a mixed meal is a very small part) is taken into account. Whereas the score is tailored to reflect the economic access to food, and therefore even a small amount of a food item reflects the ability to...
purchase that item. Regarding on the technical requirements the above we listed the strengths and weaknesses of DDS in Table 2.

**Table 2.** Advantages and disadvantages of DDS

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Convenient and easy to use;</td>
<td>• Does not collect information on quantity;</td>
</tr>
<tr>
<td>• It takes less time to get a questionnaire;</td>
<td>• It is impossible to estimate the extent to which consumption is sufficient in terms of calories.</td>
</tr>
<tr>
<td>• Allows monitoring of seasonal changes in food consumption;</td>
<td></td>
</tr>
<tr>
<td>• It can be determined at individual and household levels;</td>
<td></td>
</tr>
<tr>
<td>• It is possible to adjust according to rural and urban areas;</td>
<td></td>
</tr>
<tr>
<td>• It is possible to repeat and compare;</td>
<td></td>
</tr>
<tr>
<td>• Can determine economic and physical availability of food for households</td>
<td></td>
</tr>
</tbody>
</table>

6. At the household level, the respondent was chosen as the person responsible for preparing food for the household on the previous day. The respondent was asked about all the meals eaten at home by all household members during the day and night.

**3 Results**

Based on the survey results, the household DDS was found to have an average value of 8.2. According to the 5-point categories of the Likert scale [17], out of 49% of HDDS were recorded at the medium level, 37% at the high level, 5% at the very high level, 8% at the low level, and 1% at the very low level respectively.

![Fig. 1. Categorization Households Dietary Diversity by value](image)

Source: Data from the survey conducted by authors in 2021.

Table 3 presents the indicators of Households which largely consumed food groups included Cereals (100%), Root and tubers (86), Vegetables (98.5%), Oil and fat (98.5), Sugar and sweets (81%), Beverages (84%) respectively. Low consumption among food groups was witnessed in Greens (37%), Eggs (39%), and Fruits (46%). In terms of the main source, high consumption of food groups through their own production observed Root and...
tubers (91%), Greens (71%), Nuts and pulses (77%), fruits (70%), milk and dairy products (85%). Contrarily, households' consumption through own purchasing among food groups were meat (96%), sugar and sweets (81%), beverages (95%), and Oil and fat (77%).

Table 3. Households' consumption of food groups and its sources, %

<table>
<thead>
<tr>
<th>Food groups</th>
<th>Consumption</th>
<th></th>
<th>Main source</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nb</td>
<td>%</td>
<td>Nb</td>
<td>%</td>
<td>Bought</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cereals</td>
<td>140</td>
<td>100</td>
<td></td>
<td>2</td>
<td>1.5</td>
<td>138</td>
<td>98.5</td>
</tr>
<tr>
<td>Root and tubers</td>
<td>120</td>
<td>86</td>
<td></td>
<td>109</td>
<td>91</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Vegetables</td>
<td>138</td>
<td>98.5</td>
<td></td>
<td>80</td>
<td>58</td>
<td>58</td>
<td>42</td>
</tr>
<tr>
<td>Greens</td>
<td>52</td>
<td>37</td>
<td></td>
<td>37</td>
<td>71</td>
<td>15</td>
<td>29</td>
</tr>
<tr>
<td>Nuts and pulses</td>
<td>60</td>
<td>43</td>
<td></td>
<td>46</td>
<td>77</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>Meat</td>
<td>100</td>
<td>71</td>
<td></td>
<td>4</td>
<td>4</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>Eggs</td>
<td>55</td>
<td>39</td>
<td></td>
<td>24</td>
<td>44</td>
<td>21</td>
<td>56</td>
</tr>
<tr>
<td>Milk and dairy products</td>
<td>82</td>
<td>58</td>
<td></td>
<td>70</td>
<td>85</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Sugar and sweet</td>
<td>113</td>
<td>81</td>
<td></td>
<td>21</td>
<td>19</td>
<td>92</td>
<td>81</td>
</tr>
<tr>
<td>Beverages</td>
<td>118</td>
<td>84</td>
<td></td>
<td>7</td>
<td>5</td>
<td>111</td>
<td>95</td>
</tr>
<tr>
<td>Oil and fat</td>
<td>138</td>
<td>98.5</td>
<td></td>
<td>45</td>
<td>33</td>
<td>93</td>
<td>77</td>
</tr>
</tbody>
</table>

Source: Data from the survey conducted by authors in 2021.

According to the results of the calculations, all respondents engaged in crop growing, and out of 82 percent of households engaged in animal husbandry. Additionally, 53 percent of households reported that their main income source comes from agriculture. In sum, households mainly cultivated vegetables, roots, and tubers regarding land sizes. Regarding animal husbandry, poultry and cattle rearing were observed to be more common in these households compared to sheep and goats and others.

Table 4. Descriptive statistics of the households' agricultural activities

<table>
<thead>
<tr>
<th>Types of crop/livestock</th>
<th>Total area of each crop (hectare)/number of livestock in each group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>12.35</td>
</tr>
<tr>
<td>Fruits</td>
<td>2.35</td>
</tr>
<tr>
<td>Pulses, Legumes and Nuts</td>
<td>1.68</td>
</tr>
<tr>
<td>Greens</td>
<td>0.16</td>
</tr>
<tr>
<td>Root and tubers</td>
<td>3.95</td>
</tr>
<tr>
<td>Cattle</td>
<td>344</td>
</tr>
<tr>
<td>Sheep and goat</td>
<td>191</td>
</tr>
<tr>
<td>Poultry</td>
<td>544</td>
</tr>
<tr>
<td>Other livestock (horse, rabbit)</td>
<td>31</td>
</tr>
</tbody>
</table>

Source: Data from the survey conducted by authors in 2021.

Following previous literature, we constructed three questions, and those questions were asked to each household member which responsible for food preparation and having nutritional knowledge, which is important in dietary diversity[18].

1. Do you aware of any health problems or diseases which are related to consuming too much oil and fat products?
2. In your view, how many grams of fruit and vegetables should be consumed daily by an average person of your age and sex to maintain good health?

3. Do you often get information on nutrition through medical personnel at your location, various training platforms such as health community clubs, digital communication platforms (Telegram, Instagram)

Results in each question presented that 80% of those households' members are aware of health diseases concerning oil and fat consumption, 35% of them know recommended norm of daily fruit-vegetable consumption, and only 28% of households reported that they received nutrition information (Figure 2).

![Bar Chart]

**Fig. 2.** Access to nutrition information of the households

Source: Data from the survey conducted by authors in 2021.

## 4 Discussions

As stated by the results, more than 50% of all members in the households did not consume fruits, greens, pulses, and legumes due to a lack of food access. Respectively, other households who consumed fruits, greens, pulses, and legumes as their main source of consumption of these food groups through their production was higher than 70 percent the day before the survey was conducted. It expresses that households positively associate DDS with their own fruit-vegetable production but less economic access for these food groups. Similar results were found in many developing countries [19-21]. Survey results showed high consumption of bread and grain-based products, oil and fat, and sweets as traditional Uzbek high energy-dense diet. As a result, year by year, the overweight and obesity rate is increasing in the country. Another point is that a lack of nutrition information can lead to the persistence of this diet. Thus, only 28% of respondents reported that they received the information. We can estimate there is a positive association nutrition information and dietary diversity. Besides that, 35% of them said that they know the recommended norm of daily intake of fruits and vegetables. As well as in the case of Zimbabwe and Ethiopia nutrition knowledge had considerable improvements in households' and individuals' dietary diversity[22]. Hence, increasing the promotion of nutrition education and dissemination of nutrition information will accelerate households' healthy eating diets.
5 Conclusions

In summary, results indicated most of the food groups consumed through their own production. Though more than 50% of all members in the households did not consume fruits, greens, and pulses, legumes were determined using DDS. In that case, own production is positively associated with dietary diversity in some situations but not in all. Nevertheless, appropriate nutrition-sensitive agricultural programs will encourage both food production and consumption. However, the Samarkand region has the largest share of the country in terms of agricultural production; in rural areas, there is a real shortage of fruits, vegetables, legumes, and egg consumption. To solve this problem, it suggests supporting the cultivation and processing of fruits for year-round harvests (apples, berries, bananas, kiwi) in home gardens. Mixed farming practices are also important in dietary diversity. The obtained results of the study showed that the share of households who received nutrition information is low. At the same time, in world practice, this factor might significantly influence increasing DDS as well as fruit, greens, pulses, and legumes consumption. Further, it leads inherent value of promoting nutrition education via interventions, for example, information on healthy eating and a well-balanced diet by way of mass media, educational institution curriculum, and field days to upgrade better nutrition at household and individual levels.

References

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