



Factors Influencing Household Food Security among Smallholder Farmers: The Case of the Jordan Valley

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Abstract: This experiment was conducted in the field of laying hens affiliated with the Department of Animal Production at the College of Agriculture at Basrah University during the period from 27/12/2021 to 21/2/2021. It was applied to 90 experimental units (a 45-week-old laying hens) of Lohmann Extra, randomly allocated to five treatments. Each treatment has three replicates, with six chickens per replicate. The treatments included: - T1: Negative control treatment (basal diet without Addition) T2: Positive control treatment, the addition of dried skim milk at a level of 1 g / kg of feed. T3, T4, T5: add the manufactured bacterial preparation at a level of (0.5, 1, and 2) g/kg feed, respectively. To study the effect of manufactured bacterial preparation on some cellular and biochemical blood characteristics of laying hens. There was a significant ($P \leq 0.05$) improvement in cellular blood parameters, packed cell volume (PCV) and biochemical parameters of blood serum (cholesterol, total protein, albumin, globulin) in laying hens, and there were no significant differences in the ratio of heterophile cells to lymphocytes (H/L), glucose, and liver enzymes Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT).

Keywords: Household food security; Smallholder farmers; Jordan Valley; Jordan.

Introduction and Background

Food security is of great importance; it is a topic that greatly interests policymakers, practitioners, and academics around the world in large part because the consequences of food insecurity can affect nearly every aspect of society (Jones et al., 2013). This increasing attention from such categories and program implementers especially, started since the world food crisis of 1972–1974 and the 2006–2008 food price shock, given the high incidence of hunger and micronutrient malnutrition (Gebre, 2012; Sasson, 2012). Evidence from these two periods suggests that poor households (most of them from developing countries) are hardest hit during these crises (Gebre, 2012; Abdullah et al., 2017). The 870 million people worldwide consume fewer calories than they need, of whom 850 million live in developing countries, and the myriad associated physical and mental health consequences of such deprivation make the public health importance of food security indisputable (Jones et al., 2013). According to (Babar and Mirgani, 2014; Ahmed et al., 2017) there has been a steady growth of food imports to the Middle East and North Africa (MENA) countries stimulated by rapid population growth and changing patterns of food consumption based on rising incomes that prefer higher valued foods. Furthermore, the growing population connected with increased intensity of extreme environmental events such as droughts, floods, extreme variability in temperature and rainfall, and other aspects of climate change has increased the pressure on current food production systems and has threatened the current food security in most developing countries (GOP, 2014). As a result of these demand and supply factors, most Arab countries at present import at least 50 % of the food products they consume and the region is the largest importer of cereal in the world (Babar and Mirgani, 2014). Given the higher food demands and reduced crop productivity, the higher food prices may further

negatively affect the food access and availability for low income and already poor households (GOP, 2014).

Measuring food security is the main prominent issue in food security studies. A general limitation in the literature on the topic is the inability to obtain a clearly defined measure of food security to identify and compare food-secure and food-insecure households (Nkegbe et al., 2017). Since food security is an abstract term, its measurement depends on how we conceptualize and define it. According to the World Food Summit 1996, "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (WFP, 2009).

Four main dimensions of food security are identified: food availability, food access, food utilization, and stability (FAO, 2008; WFP, 2009; Ashby et al., 2016). Food availability is related to the physical presence of food in the area by all forms of domestic production, commercial imports, and food aid, while food access is concerned with the households ability to acquire adequate amounts of food, through one or a collection of own home production and stocks, purchases, barter, gifts, borrowing, and food aid (WFP, 2009). Thus, food may be available but not accessible to certain households during a certain period of time if they cannot acquire a sufficient quantity or diversity of food through these mechanisms (Huluka and Wondimagegnhu, 2019). This necessitates the methodological development of tools to identify and assess the different dimensions of food security.

Jordan is one of the developing countries in the Middle East with an average per capita income of \$ 3284 in 2019. Despite the low contribution of the agricultural sector to the GDP (370

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JOD Million), it is considered one of the important sectors in the national economy for its role in providing the country with a large part of the local food, especially the needs of fresh fruits and vegetables and some cereals. Jordan is considered at present self-sufficient in most types of vegetables and some fruits. Vegetables constitute the main part of agricultural exports, which in turn constitute an important source of foreign currencies consequent from the agricultural sector. The Jordan Valley population is 494,162 (Kool, 2016). The domestic people of this area were known in the early nineteenth century as Al Ghawarna or Ghorani (sense people of Al Ghor). In the Jordan Valley, known as the country's food basket, there is a small coterie of wealthy agricultural entrepreneurs, but also there is a large coterie of laborers who live close to the poverty line of JD 32.6 per person per month (Kool, 2016). The agriculture sector dominates the socio-economic landscape of the Jordan Valley. Fruit trees, field crops, and vegetables are the major crops in the Jordan Valley (Philippe, 2003). Enhancing food security is one of the most important public policies has adopted by the government of Jordan within the Jordan Economic Growth Plan 2018-2022 for the agricultural sector (The Economic Policy Council, 2018), and the Jordanian Ministry of agriculture has been having efforts to achieving progress in Sustainable Development Goals' related to sustainable agriculture and food security (UNIDO, 2016).

The issue of food security has several dimensions, starting at the global reaching to the individual level. To the best of the researchers knowledge, regions of the state or governorates-level research on these issues have been very limited, even studies at the national level have also been limited and in the form of official reporting. Since agriculture dominates the socio-economic landscape of Jordan valley, food security in Jordan valley is largely based on production from the households lands. The aim of the study is to increase the general understanding of households food security and its determinants and provide information to policymakers, in order to guide the development of appropriate interventions to achieve food security, targeting of the beneficiary households.

Conceptual Framework for Determinants and measures of Food Security

Through a review of relevant literature and past research findings to identify the potential determinants of household food security in the study area, it was found that factors that contribute to the variance of food security can be ascribed to household head factors comprising gender, age, education level, marital status, and farming experience; household factors including household size, remittances, and off-farm income; biophysical factors including farm size and land ownership; and exogenous factors, including access to credit and agricultural cooperatives, which are detailed as follows.

Several studies have investigated the effects of the gender of a household head on food security theme. Mallick and Rafi (2010) assessed how the gender of household heads was associated with food security in Bangladesh. They found that the gender of the household head had no effect on household security and this was attributed to the absence of cultural and social restrictions on women's participation in the workforce. A study by Babatunde et al. (2008), conducted a gender-based analysis in Nigeria about vulnerability to food insecurity. They documented that female-headed households were indeed more vulnerable than their male-headed households counterparts. Similar results were set by Felker-Kantor and Wood (2012), in a

study of female-headed households and food insecurity in Brazil. Their results revealed that the odds of food insecurity are higher among female-headed households when compared with male-headed households.

The age of the household head is a good proxy for farming experience, as the age of a household increases, it is assumed that farmers could acquire more knowledge and experience. They are more risk avoider and their opportunity to become more food secure increases with age. However, studies of this variable present contrasting results. Most studies confirm that households headed by older people are more likely to be food secure than those with younger heads. Among the studies that supported this view was the study of Zhou et al. (2019), which found in their sample data that household with the older household was food secure and household with smaller heads were not food secure. Similar results were found by Bogale and Shimelis (2009), in a study conducted on the household-level determinants of food insecurity in rural areas in eastern Ethiopia. The results revealed that the older household head tends to have food security in the study area. In contrast, the results of the study by, Gebre (2012), in Addis Ababa revealed that households with older heads are more likely to be food insecure than those with younger heads because it becomes less productive and more dependent on gifts and remittances

Education is an additional factor that is believed to affect food security. Educational attainment by the household head could lead to awareness of the possible advantages of sustainable agriculture practices and the use of information and builds its capacity to enhance food security. Kidane et al. (2005) investigated the causes of the household food insecurity situation in the Oromiya zone, Ethiopia. Education was found to have a positive relationship with household food security. Makombe et al. (2010) examined the determinants of food insecurity in rural Malawi. The findings of the regression model predicted that extending the education of household heads would reduce food insecurity.

Farming experience is viewed as a potential approach to achieving food security. Farming experience is expected to have a positive influence on household food security. More experienced farmers tend to have more food in their households, indicating experience improves farmers farming skills and thus improves the chances of achieving a good livelihood. Maziya et al. (2017), examined linkages between agricultural skills and household food security in farming households in the Msinga local municipality in South Africa. The study found that farming experience was negatively related to food insecurity. The study by Adeniyi and Dinbabo (2020), analyzed factors influencing household food security among smallholders in northwest Nigeria. The findings showed that farming experience has a positive relationship with the food consumption score.

Another influencing factor in food security is household size. This factor represents the consumption level needs of a household and shows the burden it faces to feed its members. With larger households, the number of bread-winners that households may depend on for household provision is higher. A study by Bogale (2012), investigated the determinants of food insecurity for smallholder rural households in eastern Ethiopia, and the multivariate regression analyses found that household size had a significant negative impact on expected food expenditure, and bigger household size was more likely to be food insecure. Similar results were found by Gebre (2012), in a study conducted on the determinants of food insecurity among

households in Addis Ababa city, Ethiopia. The obtained results revealed that larger household size tends to be food insecure compared to smaller family size in the study area. In contrast, the results of the study by Maitra and Rao (2015), in India revealed that a larger household size was less likely to be found in a food insecure category.

There is a view that income from non-farm work is crucial to food security and poverty reduction in rural areas of developing countries. Among the studies that supported this view was the study of Owusu et al. (2011), which applied the probit model to examine the impact of non-farm income on household food security among farm households in the northern region of Ghana. The results showed that off-farm income exerts a positive effect on food security status. Harris-Fry et al. (2015), focused on the main socio-economic determinants of household food security and women's dietary diversity in rural Bangladesh. The results demonstrated that households who derive a large percentage of their income from non-farm are more likely classified as high dietary diversity groups.

Remittances represent an alternative source of income. Households with access to remittances can purchase more nutritious and appropriate foods. As such, households with access to remittances are likely to be food secure unlike those without this source of income. The study by Obi et al. (2019), in Nigeria, examined how international remittances could affect food security in the short and long term of households during food crises. Results showed that remittance is valuable in meeting both short and long-term food security, and it is an essential coping strategy for meeting household food security during food crises, particularly crucial for female-headed households. They also emphasized that although remittances do not improve dietary diversity, households receiving remittances are unlikely to adopt unhealthy coping practices such as eating less nutritious foods, and are less likely to worry about meeting the household's food needs due to lack of funds. Using the unadjusted logistic regression, Ebadi et al. (2018), analyzed the relationship between receiving remittances and food security status in the Global South countries. The findings demonstrated that severe food insecurity was significantly related to not receiving remittances. Adams and Cuecuecha (2010), examined the economic impact of international remittances on poverty and household consumption and investment in Indonesia. Results found that households receiving remittances spent 8.5% more on foods than what they would otherwise have spent. On the contrary, Kaiser and Dewey (1991) found that remittance income was negatively associated with the percentage of total income allocated to foods.

The size of the farm is another influencing factor in food security. Larger farms denote great wealth and availability of capital. Farmers who possessed larger sizes of farms have greater flexibility in decision-making and therefore have more ability for resource allocation and investment in farm inputs that increase food production. Adeniyi and Dinbabo (2020), argued that larger land sizes increase income and household food security in northwest Nigeria. Similarly, the study of Muraoka et al. (2018), examined the linkage between land access and food security in rural Kenya. The findings demonstrated that farm size has a positive influence on food security. The study of Alhassan (2020), examined the influence of flood adaptation strategies on farm households food security in the Upper East Region, Ghana. The findings demonstrated that farm size is one of the drivers behind the farmers decision to adopt on-farm and non-farm

activities as adaptation strategies to achieve food security. However, Abay et al. (2017), observed that the difference in food security indicators was not very large between households with large farms and small farms in Ethiopia, as farmers who are owners of small farms adopted sustainable agriculture practices such as cultivated intensively and diversified their livelihoods in a bid to enhance the food security status.

Agricultural land ownership is a factor mentioned in previous studies as associated with food security. A study that Muraoka et al. (2018) conducted in rural Kenya to explore the linkage between land access and food security showed that indicators of land productivity and investment are lower on rented land than on own land. Koirala et al. (2014) scrutinized the influence of land ownership on the productivity and efficiency of rice growers in the Philippines. They found that land ownership plays an important role in rice production and farmers who lease land are less productive, compared to owner farmers. A study by Sawaneh and Badjie (2019) discussed the factors influencing households' food security status in south of The Gambia. The results demonstrated that landownership positively affected food security.

Concerning the influence of access to credit on improving household food security, Hussain and Thapa (2012), analyzed the situation for smallholders with landholdings up to 5 acres in the Punjab province of Pakistan. The findings of the study revealed that credit caused the shift of a significant proportion of smallholders from conventional agricultural systems to commercial practices and the findings of the study also refuted the conventional assumption that shifting from subsistence to commercial agriculture may cause deterioration in household food security, where study revealed that household income improved significantly, showing nearly 70% rise. Subsequently, improved income together with enhanced on-farm food production resulted in an almost 20% rise of households' calorie intake. Bocher et al. (2017), investigated how credit access affects the welfare of the Ethiopian rural household. The study relied on the food security indicator and total food expenditure to measure household welfare variable. The findings showed that households with access to credit have more consumption expenditure than those without access to credit. Similar results were found by Annim and Frempong (2018), in a study carried out on the effects of access to credit and income on dietary diversity in Ghana. Their results revealed that access to credit contributes to the consumption of a diversified diet.

Agricultural cooperatives are viewed as a vital institution that enhances members efficiency by easing access to productive inputs and facilitating extension linkages to raise incomes, and thereby reduce poverty. The agricultural cooperatives can for example provide market access, credit, and information to producers. Tolno et al. (2015), investigated the effects on farm income of group membership among smallholder potato producers in Middle Guinea. Results of a probit model found positive farm income effects of a group membership. Furthermore, Tolno et al. (2015), argued that agricultural policies should focus on the intensification of farmers organizations as they are related to the transformation of smallholder farming, increase productivity and incomes thereby reducing poverty. Debela et al. (2017), focused on the impact of cooperatives membership on the economy in the Oromia region of Ethiopia. The findings showed cooperatives have a positive impact on smallholders income and productivity. Wang et al. (2019), analyzed the impact of agricultural cooperatives on-farm profits

in Taiwan and found that participating in cooperatives increases farm profits and this effect is more pronounced for producers with higher profits. Mwangi et al. (2020) explored the food insecurity among smallholder farmers and pastoralists in sub-Saharan Africa. The results indicated that membership in farmers' associations positively contributed to household incomes.

The HDDS is defined as a qualitative free recall of all food or drink consumed by any household member during the last 24 hours (FAO, 2010; Mango et al., 2014; Vellema et al., 2015). According to Uruguchi (2012), the HDDS indicates the number of food groups and items that households consume in a 24-hour period for 7 days. Dietary diversity is usually measured by summing the number of food groups consumed over a reference period (Steyn et al., 2006).

Dietary diversity can be used as an indicator of micro-nutrient adequacy, and the dietary diversity score (DDS) is a proxy measure of the nutritional quality of the diet (Swindale and Bilinsky, 2005). Dietary diversity data can be collected and analyzed either at the household level or individual level. The difference between them is that the individual dietary diversity score IDDS is used as a proxy measure of the nutritional quality of an individual's diet, while the HDDS is used as a proxy measure of the socio-economic level of the household (Swindale and Bilinsky, 2005; WFP, 2009, FAO, 2008; Harris-Fry et al., 2015).

Research studies in several countries have demonstrated the contribution of HDDS as an important proxy indicator of food security. Some of these include Ogle et al. (2001) in Vietnam, McDonald et al. (2015) in Cambodia, Vellema et al. (2015) in Colombia and Ecuador, Hussein et al. (2017) in Ethiopia, and Huluka and Wondimagegnhu (2019) in Ethiopia. One advantage of the HDDS is that it is shown how varied the foods typically consumed by a household are (Smith and Subandoro, 2007), in another meaning the adequacy of a household's intake of calories, protein, and other nutrients (Goshu et al., 2013). As well as it shows the households economic capacity to consume a variety of foods (Hoddinot and Yohannes, 2002; Swindale and Bilinsky, 2005; WFP, 2009, FAO, 2008; Harris-Fry et al., 2015).

There are a benefit and advantage to HDDS; given the HDDS reflects dietary quality, in practice, it is likely to be inversely related to malnutrition; where a high HDDS indicates a diversified household diet, which is more likely to allow balanced micronutrient intakes (Mango et al., 2014). In contrast, a low the HDDS is associated with a high intake of starch staples; this contributes to nutritional problems because these staples are low in micronutrients (Mango et al., 2014).

HDDS is seen as an appropriate measure of food security proxying food access and availability aspects (Huluka and Wondimagegnhu, 2019). Examining the determinants of HDD is important to know what determines the availability as well as access to food (Huluka and Wondimagegnhu, 2019). While factors that affect food availability work on the demand side, determinants of access to food work on the supply side. Thus, a factor that affects the demand for and supply of food affects availability and access to food and ultimately affects household food security (Jones et al., 2014).

Despite the advantages of the HDDS, it has been questioned in terms of reliability and accuracy due to methodological problems (Uruguchi, 2012). Uruguchi criticized the HDDS for two main reasons: the first one, there is no universally-accepted standard for the main food set or food types to use; the second

one, HDDS is able to show changes in dietary energy consumption of households, but it has not been easy to empirically demonstrate the significance of HDDS in nutrient adequacy. Regardless of these weaknesses, the HDDS remains a useful proxy for the nutrient adequacy of a household's diet; therefore, use it as a measure of household food security.

HFIAS is a food insecurity measure developed by the United States Agency for International Development (USAID) in the Food and Nutrition Technical Assistance (FANTA) Project. Food security levels were determined by creating a HFIAS score indicator (Coates et al., 2007). The HFIAS score is a continuous measure of the degree of food insecurity (in terms of access) in the household in the past four weeks/ 30 days. The HFIAS reflects the three universal domains of household food insecurity: anxiety about household food insecurity, insufficient quality of food supplies, and insufficient quantity of such supplies (Deitchler et al., 2011; Nsabuwera et al., 2015). This indicator monitors and captures the members of the household's perception of their diet, regardless of its nutritional composition (Coates et al., 2007). The HFIAS indicator focuses on consumption-related strategies and captures the household's behavioral and psychological responses to perceived food insecurity. It is based on the assumption that households experiences of food insecurity cause predictable reactions and responses that can be monitored, captured, and quantified through a survey and then showed it off into a score (Mango et al., 2014).

In fact, the two measures used in the study are global measures, and according to the studies that have been reviewed, they have been applied in different countries and contexts, and there are two official studies that have applied these measures in Jordan on a national level, which are: The State of Food Security in Jordan (2013–2014), and The State of Food Security in Jordan (2010–2011).

Materials and Methods

Study area

The Jordan Valley represents the main agricultural productive area for Jordan which extends from the north near to Tiberius Lake to the south at the Dead Sea. The altitude ranges from -212 in the north to -450 meters below sea level in the south (Al-Qinna and Salahat, 2017). The Jordan Valley is about 104 km long; its width varies from 4 to 16 km between the Jordan River and the East Mountains chain (Mourad et al., 2010). Based on the high variability of the physical and chemical natures of the soils along the Jordan Valley, the areas were classified separately into (1) The Northern Ghor that lies below the Yarmouk River through the village of North Shounah and Addasiya to the village of Kreymeh ;(2) The Middle Ghor that lies between the villages of Kreymeh and Karameh near Al-Maghtas; and (3) The Southern Ghor that lies between the village of southern Karameh to Al-Maghtas to Dead Sea (Philippe, 2004). The Jordan Valley has a semi-arid hot climate: the average temperature is ranged between 15° and 22° from November to March and between 30° and 33° in summer; rainfall is very irregular: from 50 mm/year in the south, it can reach to 400 mm/year in the north of the valley. Based on water resources availability and quality, the Jordan Valley's agriculture suitability varies significantly from Northern to Southern Jordan Valley, therefore, each of the three parts of the Jordan Valley has distinct agricultural patterns (Kool, 2016). The Jordan Valley Authority (JVA) has divided the Jordan Valley into nine agricultural zones (Figure 1).

Presently, agriculture still dominates the socio-economic landscape of the Jordan Valley (Kool, 2016), and it is the mainstay of some households in the Jordan Valley for secured income for the household members. The scanty localized detailed studies conducted so far, reports, and general observations indicate that the region is of high agricultural potential because it is enjoyed suitable and productive land resources including favorable climate, fertile soils, diverse

ecology, and length of the growing period, so much so, that it is considered a food basket for the country. However, in practice, increased population density, land and water resource degradation, and climate extremes such as recurrent drought and frosts have exacerbated agricultural problems and increased losses suffered by the Jordanian farmer which inevitably affects the status of food security in the valley.

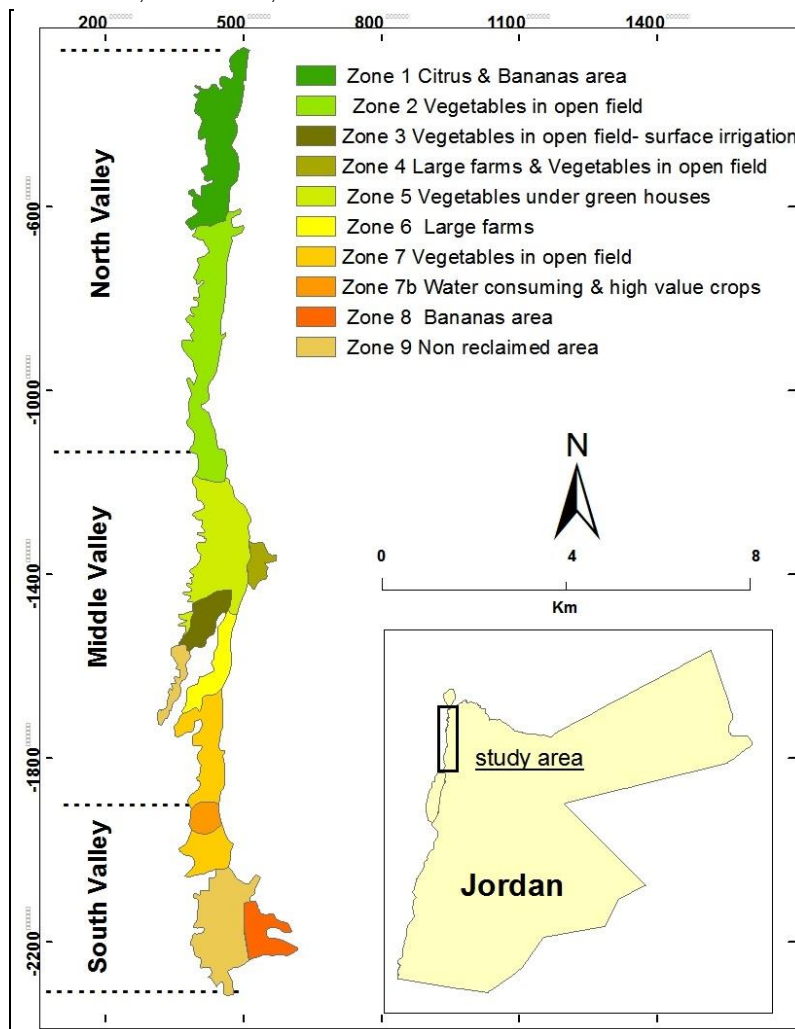


Figure (1): Study area.

Sample and data collection

It is challenging to get the precise number of smallholder farmers in the Jordan Valley. Therefore, simple random sampling was used. Then, to have more representative respondents of Jordan Valley smallholder farmers, the survey questionnaire was deployed to target smallholder farmers in the places where they sell their farm products. As a result, the survey questionnaire was successfully conducted during the period from October 1–29, 2020. Face-to-face interviews were conducted with smallholder farmers using a structured questionnaire. Responses were transcribed directly on the electronic questionnaire (to facilitate the researcher’s task) and subsequently exported into Microsoft Excel spreadsheets. As mentioned above, smallholder farmers were selected from places where they sell their farm products. The central market for fruit and vegetables at the Greater Amman Municipality (GAM) and the central market for fruit and vegetables at the Irbid governorate were selected, to draw a total sample of 211

smallholder farmers (The selection of the sample was based on two conditions; the land area less than two hectares in the Jordan Valley, and the households residing in the Jordan Valley). In carrying out the study, the standard ethical considerations were observed, which include obtaining farmers consent; where farmers huddled in the outer yard of the markets gave oral consent to participate in the study after they heard a brief explanation of the study’s aim, in addition to ensuring confidentiality. The survey collected information on household socioeconomic and demographic characteristics, a household dietary diversity assessment involving 24-hour recall of food consumption from major food groups, and food insecurity.

Research variables

Dependent variables

Household dietary diversity score

In this study, the data on food items were generated by asking respondents to recall what all family members consumed

in the last 24 hours (excluding food consumed outside the household). All types of foods were then classified into one of 14 standardized food groups according to the classification of the FAO (2008). The responses to the questions were either yes (score = 1) if he or she consumed a given food item in the category or otherwise (score= 0) if he or she did not consume a given food item in the category. The groups are as follows: A, cereals; B, vitamin-rich vegetables and tubers; C, white tubers and roots; D, dark green, leafy vegetables; E, other vegetables; F, vitamin-rich fruits; G, other fruits; H, meat; I, eggs; J, fish; K, pulses, legumes, nuts and seeds; L, milk and milk products; M, oils and fats; and N, sweets.

The HDDS is calculated according to Swindale and Bilinsky (2005) as follows:

$$\text{HDDS (from 1 to 14)} = \text{sum (A + B + C + D + E + F + G + H + I + J + K + L + M + N)}$$

Household food insecurity access score

The respondents were asked nine questions, reflecting an increasing level of food insecurity. The nine questions can be summarised as follows: (Q1) anxiety about food adequacy; (Q2) eating less-preferred foods; (Q3) eating foods of a limited variety; (Q4) inability to eat even less-preferred foods; (Q5) eating smaller meals than needed; (Q6) eating fewer meals in a day; (Q7) failing to obtain the food of any kind; (Q8) going to bed hungry; and (Q9) going the whole day or night without eating anything. Specifically, the respondents were asked whether a particular condition (Q1 to Q9) associated with the experience of

Table (1): Independent variables.

| Variable | Description | Type of variable |
|-------------------------------|--|------------------|
| <i>Household head factors</i> | | |
| Gender | Gender of household head (1= if male; 0= otherwise) | Dummy |
| Age | Number of years for household head | Continuous |
| Education level | 0= No formal education, 1= Primary level, 2= Basic level, 3= Secondary level, 4 = tertiary level | Factor |
| Marital status | Marital status of household head (1= if married; 0= otherwise) | Dummy |
| Farming experience | Number of years spent in farming | Continuous |
| <i>Household factors</i> | | |
| Household size | Total number of people living and eating together in household | continuous |
| Off- farm | Household has salaried or waged incomes/ (1= if yes; 0= otherwise) | Dummy |
| Remittances | Household receives money from relatives farmer (1= if yes; 0= otherwise) | Dummy |
| <i>Farm factors</i> | | |
| Land ownership | Ownership of land status (1= if Owned; 0= otherwise) | Dummy |
| farm size | farm size (dunum)a | Continuous |
| <i>Exogenous factors</i> | | |
| Access to credit | Access to bank credit (1= if household got credit; 0= otherwise) | Dummy |
| agricultural cooperatives | Member of agricultural cooperatives (1= if yes; 0= otherwise) | Dummy |

One dunum is equal to 0.1 hectare, that is, 10 dunum are approximately 1 hectare.

(According to the joint research center's world atlas of desertification, the size of small farms in Jordan is within the (>0.5 - 2 ha) category.

food insecurity occurred at all during the past 30 days: yes =1; no = 0. Each severity question was followed by a frequency-of-occurrence question, which asked how often the reported condition occurred during the previous 30 days: rarely (once or twice) =1; sometimes (three to ten times) =2, or often (more than ten times) =3. The minimum of HFIAS = 0 and is obtained when a household responds 'no' to all of these questions. The maximum of HFIAS = 27, which is obtained when a household responds 'yes' to an occurrence question and 'often' to the nine frequency of occurrence questions.

The HFIAS is calculated according to Coates et al. (2007) as follows:

$$\text{HFIAS (0 to 27)} = \text{Q1xF1 + Q2xF2 + Q3xF3 + Q4xF4 + Q5xF5 + Q6xF6 + Q7xF7 + Q8xF8 + Q9xF9}$$

Explanatory variables

Table 1 presents a description of the variables used in the empirical model. The selection of explanatory variables was based on previous empirical findings on food security, which were mentioned in the Food Security section. The variables were classified into four groups: (1) household head factors, (2) household factors, (3) biophysical factors, and (4) exogenous factors. Household head variables included gender, age, education level, marital status, and farming experience; household factors included household size, remittances, and off-farm income; farm factors included land ownership and farm size; and exogenous factors included access to credit and agricultural cooperatives.

Data analysis

The analysis was performed by Statistical Package for Social Sciences IBM (SPSS). The household dietary diversity score (HDDS) and household food insecurity access score (HFIAS) were determined and the associations of these indicators with socioeconomic and demographic variables were assessed. Descriptive statistics such as frequencies, percentages, mean, and standard deviations were used to

analyses the data. Finally, variables related to the household dietary diversity score (HDDS) and household food insecurity access score (HFIAS) were entered into a regression analysis (the Multiple Regression Model) to identify the independent factors of food security.

Results and Discussion

Characteristics of the surveyed households

A summary of statistics of the sampled households is presented in **Table 2** and shows that of the total 211 sampled households in the study, 204 households were headed by a male with the remaining 7 households headed by a female, accounting for 96.7%, due to a common trend that the farming profession is only suitable for men. The average age of the household head is 45.61 years, while the distribution of household size ranges from 2 to 12 with an average household size of 6.55. On matters of education, most household heads in the Jordan valley are educated, with 53.1% having attained secondary education,

2.4% having attained primary level education, 23.2% basic, 17.5% university level education, and only 3.8% of the household heads do not have any form of education.

Household heads had considerable farming experience as the average years of farming experience was 15.4 years. The majority of the households did not have off-farm income, with a percentage of 66%. It is evident from the results that remittance is not a popular strategy for livelihoods diversification among the Jordan valley smallholder households as a meager 5.2% received remittances from relatives household.

Agricultural land tenure was categorized as an ownership and leasehold system. The average land size of smallholder farmers was 11.7 dunum. Access to credit was constrained somewhat, where the percentage did not exceed 20%. Finally, less than 7% of the smallholder farmers were indicated as participating in agricultural cooperatives.

Table (2): Characteristics of the surveyed households.

| Variable | Mean or proportion | Standard deviation |
|--|--------------------|--------------------|
| Gender of household head(proportion) | .97 | - |
| Age of household head | 45.61 | 12.710 |
| Education level of household head (% with secondary) | 53.10 | - |
| Marital status of household head(proportion) | .88 | - |
| Farming experience | 15.39 | 9.0012 |
| Household size | 6.63 | 2.4305 |
| Off- farm | 37.40 | - |
| Remittances(proportion) | 5.20 | - |
| Land ownership(proportion) | 49.30 | - |
| farm size | 11.66 | 6.0622 |
| Access to credit (proportion) | 19.4 | - |
| agricultural cooperatives(proportion) | 6.6 | - |

The measurement of household dietary diversity score (HDDS) and household food insecurity access score (HFIAS)

Data for the HDDS considered in the study are presented in **Table 3**. The HDDS for households ranges between 2 and 9. The mean HDDS was 6.06, which signifies a household consumption per day that is less than half of the different food groups available. When the HDDS results were divided into terciles based on the responses generated from the households,

the lowest HDDS was represented by 1–4 food groups and the highest HDDS by 9 or more food groups. The number of households in the medium tercile (food groups total between 5 and 8) was higher than the other two terciles as nearly (81%) of the households fall under the tercile. The proportion of households in the lower (food groups total between 1 and 4) and upper tercile (food groups total between 9 and 12) were 13.8% and 5.7% respectively. Thus, based on a 24-hour recall, most households consume between five and eight food groups.

Table (3): Household Dietary Diversity (HDDS) grouping in terciles in the past [24-hour].

| Household Dietary Diversity Score | Frequency | Proportion of households (%) |
|--|------------|------------------------------|
| 1st tercile (Low, scores between 1-4) | 29 | 13.8 |
| 2nd tercile (Medium, scores between 5-8) | 170 | 80.5 |
| 3rd tercile (High, scores between 9-12) | 12 | 5.7 |
| Total | 211 | 100 |

Mean = 6.061; SD = 1.5769; Minimum = 2; Maximum = 9.

Data for the HFIAS considered in the study are presented in **Table 4**. The results show that, based on the food experiences of the last 30 days for households, a high proportion of households in the Jordan valley had been dependent only limited variety of food (73.8%), their inability to eat their preferred food (73%), and even their inability to eat less-preferred food (58.3%).

A fairly high proportion of households in the Jordan valley had been anxious about food insecurity (43.1%). However, only (23.7%) had been completely without food in the house, (13.2%) had gone to bed without eating, and (4.7%) had spent at least a day and night without eating any food at all.

Table (4): Household food insecurity access score (HFIAS) in the past [4 weeks].

| Indicator | Proportion of affirmative response (%) |
|---|--|
| Anxiety about food insecurity | 43.1 |
| Inability to eat preferred foods | 73 |
| Availability of only a limited variety owing to a lack of resources | 73.8 |
| Inability to eat even less-preferred food | 58.3 |
| Availability of only smaller amounts of food | 54.4 |
| Reduced number of meals | 52.1 |
| Having no food in the house | 23.7 |
| Going to bed without having eaten any food | 13.2 |
| Spending the day and night without any food | 4.7 |

Determinants of household dietary diversity score (HDDS) and household food insecurity access score (HFIAS)

To determine the factors influencing food security, a regression analysis (the Multiple Regression Model) with entre method was conducted. The regression model integrated all of the independent variables which had significant correlations with the (HDDS) and (HFIAS).

Regression analysis results in **Table 5** indicate that four variables – namely the education level of household head, the marital status of household head, farm size, and access to credit – have a positive influence on HDDS. The results of the regression analysis do not show negative effects for any variable.

Table (5): The multiple regression analysis results for the determinants of household dietary diversity in the Jordan valley.

| Variables | Coefficient | Standard error | T-Statistics | P-value |
|-----------------------------------|-------------|----------------|--------------|---------|
| (Constant) | 3.076 | .820 | 3.751 | .000 |
| Gender of household head | 0.501 | .595 | .842 | .401 |
| Age of household head | -0.002 | .011 | -.211 | .833 |
| Education level of household head | 0.366 | .122 | 2.998 | .003*** |
| Marital status of household head | 0.620 | .348 | 1.783 | .076* |
| Farming experience | 0.019 | .014 | 1.318 | .189 |
| Household size | -0.053 | .043 | -1.234 | .219 |
| Off- farm | 0.331 | .231 | 1.436 | .152 |
| Remittances | 0.726 | .466 | 1.559 | .121 |
| Land ownership | 0.162 | .237 | .683 | .495 |
| farm size | 0.082 | .019 | 4.215 | .000*** |
| Access to credit | -0.552 | .263 | -2.095 | .037** |
| agricultural cooperatives | 0.104 | .414 | .251 | .802 |

N = 211; F= 4.266; R²= .205

***significance at 1% level; **significance at 5%level; * significance at 10%level.

Table 6 shows that married household head, household head with more agricultural experience, and households with off-

farm income and a large size farm are less likely to be food insecure than their counterparts.

Table (6): The multiple regression analysis results for the determinants of household food insecurity access in the Jordan valley.

| Variables | Coefficient | Standard error | T-Statistics | P-value |
|-----------------------------------|-------------|----------------|--------------|---------|
| (Constant) | 12.719 | 1.955 | 6.504 | .000 |
| Gender of household head | -1.120 | 1.419 | -.789 | .431 |
| Age of household head | 0.016 | .026 | .625 | .533 |
| Education level of household head | 0.159 | .291 | .547 | .585 |
| Marital status of household head | -1.416 | .829 | -1.707 | .089* |
| Farming experience | -0.064 | .034 | -1.876 | .062* |
| Household size | 0.017 | .102 | .165 | .869 |
| Off- farm | -.0953 | .550 | -1.731 | .085* |
| Remittances | 0.195 | 1.110 | .175 | .861 |

| Variables | Coefficient | Standard error | T-Statistics | P-value |
|---------------------------|-------------|----------------|--------------|---------|
| Land ownership | -0.809 | .566 | -1.430 | .154 |
| farm size | -0.328- | .046 | -7.076 | .000*** |
| Access to credit | 0.571 | .628 | .910 | .364 |
| agricultural cooperatives | -1.036- | .988 | -1.049- | .296 |

N = 211; F= 7.044; R²=.299

***significance at 1% level; **significance at 5%level; * significance at 10%level.

Discussion

The results show that household food security in the Jordan valley is influenced by the education level of household head, the marital status of household head, farming experience of household head, farm size, household off- farm income, and household access to credit.

Household head characteristics

The results show that the level of education of the head of the household has a positive influence on the dietary diversity of the household, while it does not appear to influence its food insecurity. That means that households with literate heads are less likely to be food insecure or anxious about food security than their counterparts. This can be explained by the fact that household head education largely contributes on working efficiency, competency, and adopting technologies with a long-term target to ensure better living conditions. This finding is consistent with the findings of Joshi and Joshi (2016) and Bashir et al. (2013).

Farming experience also has a negative relationship with the food insecurity access score, suggesting that household food insecurity declines with an increase in years of experience of smallholder farmers. In other words, the higher the experience, the lower the risk of food insecurity. The importance of long experience is to improve farmers stock of farming knowledge, through leveraging on years of "learning by doing"; where more experienced farmers are possessed better knowledge of farming practices that could help improve yield and income earnings, therefore affecting household food security positively. This finding corroborates with the results of a study by Adeniyi and Dinbabo (2020).

A negative relationship was found between the marital status of a household head and household food insecurity, implying that households headed by married individuals have a lower chance of becoming food insecure. This result coincides with the theoretical evidence that this is related to the role marriage plays in access to resources such as land and water (Maziya et al., 2017).

Household characteristics

The result shows that higher rates of food security are associated with increased household off-farm income. This suggests that households without off-farm income have a higher risk of being food insecure. The result is consistent with some of the findings in literature where an inverse relationship between household off-farm income and food insecurity was observed in the study of Owusu et al. (2011). Furthermore, the result shows and confirms the critical role income plays in accessing food and in the achievement of food security in general.

Farm characteristics

The results show that the farm size has a significant positive influence on the dietary diversity among smallholder households and a significant negative influence on its food insecurity. This

means that households with large size farms are less likely to be food insecure or anxious about food security than their counterparts. This result coincides with the theoretical evidence that there is a greater likelihood that households with larger land size will engage in increased agricultural production, better crop diversification, they also have a higher quantity of crop product which could be consumed directly or indirectly by used to raise income that can be used to purchase other food products (Adeniyi and Dinbabo, 2020). The relation of farm size to food security highlighted in the study is in line with the findings of Uruguchi (2012) and Ramakrishna and Demeke (2002).

Institutional characteristics

Surprisingly, access to credit has a negative effect on household dietary diversity. It makes sense that the access to credit would improve household food security, since it should enable recipients to improve the scale of their enterprises. Although the result contradicts the findings of other studies, such as the study of Gebre (2012) and the study of Nkomoki et al (2019), the result in this study may be significant and bear other explanations. The plausible explanation for the result obtained in this study that the households who have access to credit struggle to pay back their high loans and find themselves in a poverty trap that leads to less spending on food.

Conclusions and Recommendations

The aim of this study was to investigate the association of the chosen socio-economic factors as influencers on food security. The study was conducted in 2020 in the Jordan Valley of Jordan. Food security was measured by the household dietary diversity score (HDDS) and the household food insecurity access score (HFAS) indicators. From our sample, both the HDDS and HFAS multiple regression findings revealed that the existence of families headed by married individuals and higher education levels of household head, increasing farming experience of household head, increasing off-farm income, and increasing land size increased the probability of household food security, while access to credit decreased the probability of household food security.

The effect of education on household food security confirms the significant role of the variable in consideration for the improvement of living conditions. So, strengthening both formal and informal education and vocational or skill training should be promoted to increase food security in the study area.

Farm experience tends to be negatively associated with food insecurity. As already mentioned, it is anticipated that as farmers become more experienced, their ability to make the best choices and the best use of resources, improves, which consequently enhances their food security status. The importance of experience begs the question of how to offset for experience in light of the fact that it cannot be substantially increased without due consideration of time. The solution could be in providing the training services and retraining of farmers as well as opportunities and spaces for knowledge transfer between them,

which could be promoted by initiatives that can be led by NGOs. In addition to agricultural extension services provided by the government directorates of agriculture.

Moreover, the results also imply that households headed by married individuals have a lower chance of becoming food insecure. Therefore, policies and strategies that involve providing allocations from the monthly aid program for needy households headed by divorced, widowed, separated, and single people who do not have access to resources are essential procedures.

The findings demonstrate a negative effect of off-farm income on food insecurity. Therefore, interventions to creating off-farm employment opportunities should be encouraged by private and government organizations, which may be in the shape of the establishment and promotion of small-scale agro-based industries in the study area.

The size of the land was found to have a significant negative relationship with food insecurity. Therefore, the pursuit of policies that help smallholder farmers with holdings of land, especially irrigated and arable land, must be promoted. This is done by expanding the distribution of agricultural units to the owners according to the registration documents of lands that have been seized for the purposes of agricultural projects and the professional farmer (who practice the profession of agriculture under a documented lease contract). The decreasing farm size may affect the agricultural productivity of and limit smallholder farms chance of achieving better food security.

Access to credit was found to have a negative relationship with food security. Therefore, the pursuit of bank and Agricultural credit institutions to implement a provision of credit to eligible households using targeting criterion that reflects actual characteristics of food insecure households must be promoted. And collateral requirements from borrowers should be avoided if there is a need to lift food insecure households from their current situation. Also, borrowers should be encouraged to save or contribute as matching funds to reach limited resources over a large number of needy people.

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