

Cropping Patterns and its Determinants in the Greenhouses in the Northern Governorates of the West Bank, Palestine

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Greenhouses constitute an integral part of the Palestinian agricultural structure. Nonetheless, farming multiple crops on the same farm during the same season is still hard and a risky decision that farmers seek to avoid, despite the recent tendency to attempt diversifying. The aim of this study is to identify the cropping patterns prevalent among the northern Palestinian greenhouse farmers and the diversification decision affecting factors. A survey study was conducted in the northern regions of the West Bank of Palestine. The study area included three governorates, Jenin, Tubas and Tulkarm, with a geographical coordination between 35° 13' to 35° 16' east longitudes and 32° 06' to 32° 32' north latitude. Quantitative methods depending on PCBS (Palestinian Central Bureau of Statistics) issues regarding agricultural production and a questionnaire of the crops cultivated by the farmers were adopted. Data were analyzed using SPSS software package. The Herfindahl Index was used to assess diversification level. The results indicated that the diversification level was low in Jenin (0.33965) and Tubas (0.466525), but Tulkarm (0.25965) showed high diversification patterns. The crops mostly cultivated were cucumber, tomato and pepper, forming 35%, 34.88% and 9.75% of the total cultivated greenhouses in the three governorates respectively. The diversification decision was mostly influenced by the farmer's educational level, monthly income and years of experience. The fear of risk common among the farmers can be minimized by a collaboration between the agricultural associations, NGOs and ministries of agriculture and national economy to compensate farmers' loss.

Keywords: diversification, cropping patterns, West Bank, greenhouse, agriculture, Palestine

Introduction

Agriculture is considered one of the most important economic activities in resident people's lives in the study area (northern part of West Bank, Palestine)¹ the contributions of the agricultural sector to the GDP in 1999 was 9%, while in recent years this decreased to only 4%. In the last few years it was noticed that there was increasing use of greenhouses in farmed areas in the West Bank, especially for vegetable crops. The planted area in 1995 was 4 970 dunum,² (Palestinian Central Bureau of Statistics (PCBS)1997), however, in 2017 the area increased to more than 11 000 dunum.

During past decades, the agricultural sector in the West Bank evolved dramatically in the amount of production, with a recent tendency among the farmers to try new crops; however, this inclination is barely observable as few farmers decide to risk and grow new crops.

Previous studies on agricultural patterns in South Asia have shown a gradual shift in agricultural patterns, with the shift to high-value crops such as vegetable and fruit production, as well as fish and animal wealth (Joshi et al. 2004; Dorjee et al. 2003). Studies in India indicated a radical change in agricultural patterns, such as the shift from the cultivation of legumes to commercial crops, while others revealed a radical shift in the agricultural patterns of rice and grain crops to more valuable crops such as vegetables and fruits, as well as some legumes such as gram, horse, and commercial crops like sugar cane between 1970 and 2005 (Acharya 2003; Mohan 2017).

The change in the nature of agricultural patterns is the result of a combination of changing socio-economic and technological factors that have led farmers to develop specific and rather stable agricultural patterns within a climate-specific agricultural area. The major reasons for changing agricultural patterns are the productivity of crops, the use of new technology, and the use of more efficient agricultural inputs (seeds, fertilizers, chemicals). Therefore, such adoption of new methods led to an increase in products (Meena et al. 2016; Abro 2012; Islam and Rahman 2012; Kannan and Sundaram 2011; Joshi et al. 2004; Dorjee, et al. 2003).

Diversification of agricultural crops in the developing world has been largely been applied to reducing the problems associated with the agricultural economy and to reach a state of food security for all members of society, especially the poor. Diversity of crops is the creation of a range of crops that are competitive among other crops, whether land is actually planted or cultivable. There is a real need to move to the diversity of crops rather than to specialize in cultivation (Meena et al. 2016); it was also found that the size of the farm and the total area of irrigation depends positively on the diversity of agricultural crops (Mishra et al. 2004).

The diversification of agricultural crops depends on a range of social and economic factors, based on the results of the study, including the years of experience of the farmer, the location of the farm in terms of access to basic inputs or the marketing of agricultural production, the overall size of the farm, and access to agricultural extension services. The study also showed that diversification has a positive effect on increasing the productivity of agricultural crops, increasing the income of farmers and achieving a percentage of food security (Makate et al. 2016). Other factors were identified by Ojo et al. (2014); they stated that experience in agriculture, extension communication, farm size and land ownership had a significant impact on diversification among farmers in the study area.

Moreover, the characteristics of the population, such as the educational level of the youth and the age of household, have a clear effect on the diversification of a particular type of grain. The study also showed that there is no specific policy that has the complete effect on the diversification of agricultural crops. Policy has a negative impact on another crop. On the other hand, the impact of the market and the increase in the population has had a negative impact on diversity, while the educational level has had a positive impact on agricultural diversity (Benin et al. 2003).

There is a clear difference in the distribution of agricultural patterns in the study area (Ali Al-Sharqi), near Maysan, Iraq. The reason for this is due to a number of natural factors that have a clear effect on the selection of the appropriate agricultural pattern for each region. Soil and climate elements have the most prominent role in selecting the agricultural pattern (Tawfiq and Ahmad 2016).

In the West Bank of Palestine, many crops have been cultivated over time, including vegetables, fruits and grains. However, with the introduction of greenhouses, the farmers choose to grow high value crops, focusing on the mostly consumed crops that include cucumber, tomato and capsicum, which constitute the highest amount of production (Harb et al. 2016). Such a pattern seems to be typical in the Levant (Fertile Crescent) area, for example, Al-Abady (2003) found that Iraqi farmers mostly cultivate cucumber, tomato, aubergine and pepper. These crops also appear to be popular among farmers in the Gulf as well; according to Al-Nasser and Bhat (1998), cucumber and tomato are the main crops grown in greenhouses in Kuwait, followed by eggplant and capsicum. The same trend was almost followed by Turkish peasants who focus mainly on tomato, cucumber, pepper and eggplant (Tüzel and Öztekin 2015).

According to a literature survey, agricultural patterns and crop diversification in the West Bank have not to date been studied. Therefore, the main objective of our study is to investigate the change in agricultural cropping under greenhouse use in the West Bank and what main factors have spurred such diversification.

Methodology

This study is based on the primary and secondary data. The secondary data was obtained from the (PCBS) and the Ministry of Agriculture. The study covered a period from 1994-2018. Secondary data were used to analyze data of crop diversification from 1994-2008; however, for the period 2008 until 2013 no data are available, while the data from 2014-2018 was obtained from the primary data collected through a questionnaire distributed in three governorates (Jenin, Tubas, Tulkarm) in the West Bank.

The descriptive analytical method was utilized using the questionnaire as data collection tool. The format of the questionnaire included two main segments, demographic information about the respondents, namely, number of family members laboring on the farm, farm size, farmer age, and farmer education level, number of family members, monthly income and years of experience. The subsequent section involved an evaluation of the cropping pattern adopted by farmers of the West Bank, more precisely, farmers located in Jenin, Tulkarm and Tubas (see Figure 1). The minimum sample size equation was utilized to determine the sample respondents distributed to the three governorates. The participants' locations were assigned employing GIS using the spatial random distribution (SRD), distributing the respondents following the area size of the greenhouses. The participants were a representative sample of the farm population, forming 10% of the whole population, so the total population of the study was (3 010) farmers, from which a randomly stratified sample of (300) farmers was selected.

$$HI = \beta_0 + \beta_1 Age + \beta_2 Edu + \beta_3 Fammem. + \beta_4 Famworker + \beta_5 income + \beta_6 exp + \beta_7 farmsize$$

The analysis was carried out in terms of changes in the proportion of area for every single crop compared to the total crops area, at the study area for each governorate. Thirteen crops were considered under protected agriculture. To define the effect of various factors on crops diversification, a linear regression equation was used. The Herfindahl Index (HI) data computed for measuring crop diversification were taken as the dependent variable while the other various factors which affect diversification were taken as independent variables.

The questionnaire-collected data were analyzed using SPSS V. 23. The percentages were computed to identify the percentages of crops diversity across the last five years, while the linear regression was performed to examine the effect of the farmer's demographic information on the diversification patterns.

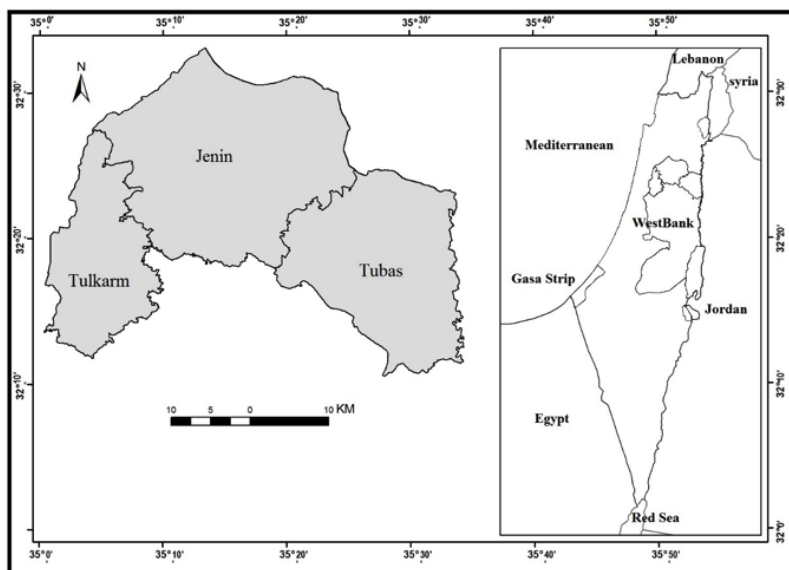


FIGURE 1

The map shows the study area in Northern Part of West Bank in Palestine

Results

Crop Diversification

The assessment of diversifications among farmers in the three governorates, Jenin, Tubas and Tulkarm, was done using the Herfindahl Index. When the Herfindahl Index value ranges from 0-0.33, it is considered as broad diversification; however, when the value is 0.34-0.66, it asserts moderate diversification, and when the value is 0.67-1.0 it expresses crop concentration. The Herfindahl Index values calculated for the three governorates are shown in Table 1. The values indicate moderate diversification attitudes among the farmers in Jenin from 1994 and 2018, with broad diversification attitudes emerging during the last ten years. In contrast, Tubas Governorate showed crop concentration since 1994 up to the present. Tulkarm Governorate, contrastively, demonstrated a strong tendency towards crop diversification during the past ten years; this was contrary to the farmers' attitudes during the period between 1994 and 2008, where the governorate was cropping-concentrated.

The Palestinian markets are restricted and relatively small ones, considering the low rate of population compared to the neighboring countries, aside from the effect of the restrictions on traveling which limit the knowledge transfer of agricultural diversification. However, the introduction of the internet and new technological communication has caused a change in the Palestinian cultural knowledge of the vegetables and fruits, as well as the

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TABLE 1
Herfindahl Index outcomes

Districts	1994-1998	1999-2003	2004-2008	2014-2018
Jenin	*0.366246	*0.342799	*0.478445	*0.33965
Tubas	*0.442214	*0.410907	*0.455013	*0.466525
Tulkarm	*0.480501	*0.52562	*0.64383	**0.25965
Study area	*0.454401	*0.450021	*0.513902	**0.319416

*Indicates that there is moderate diversification, **Indicates complete diversification in agriculture.

developments occurring on the local markets where the merchants export small amounts of some unfamiliar crops from the Israeli markets as an experimental trial of the buyers' attitudes toward it. Also, the new generation of young citizens longing towards experimenting even in food, along with the culture of openness to the world, have left their mark on the stakeholders to finance farmers who agree to grow new crops to the markets.

Cropping patterns

The tendency toward crop diversify between 1994 and 2018 did not evince remarkable change; nonetheless, new crops has been introduced for various reasons. The top common crops among the Palestinian farmers are cucumber, tomato and bell pepper, respectively. Since the community consumes high amounts of these crops, other crops are less popular, including bean, eggplant, cowpea, Borago, Jews melo. These crops show a steady consumption pattern over the years since 1994, which is matched by a stable pattern of crop production and growing as shown in Figure 2. The period between 2014 and 2018 did not display a huge difference in the crop growing patterns, where the farmers concentrated on the crops principally consumed, including cucumber, tomato and bell pepper. However, the farmers are responding to the markets needs regarding the crops most in demand based on the changing consumption patterns of the Palestinian community (Figure 3). New crops have been introduced to the Palestinian consumers, including strawberries that have witnessed a rising consumption pattern among the Palestinians. Other crops are more diversified in the category of vegetables, where the farmers are growing spinach, eggplant, Rocca, cabbage, cauliflower, potato, Borago, kidney beans and medicinal herbs.

Comparing the crop diversification and production between 1994-2008 and 2014-2018, it is obvious that a change has taken place in the plants and crops grown in the agricultural ownerships in Jenin, Tubas and Tulkarm, but the level of diversification is evidently dissimilar, due to the geographical and climate characteristics of each of the governorates. This plays a major role in determining the type of crop the farmers choose to grow in addition to other factors.

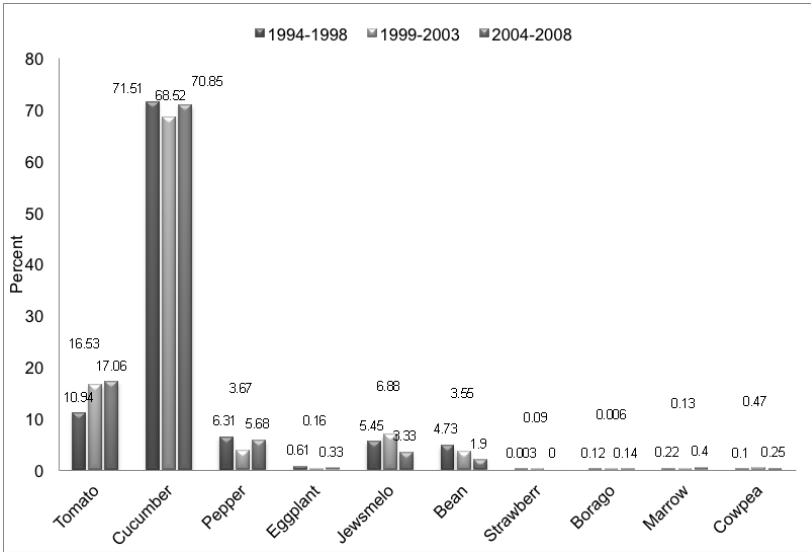


FIGURE 2
Percentage of greenhouse agriculture crops in the northern west Bank, from 1994-2008

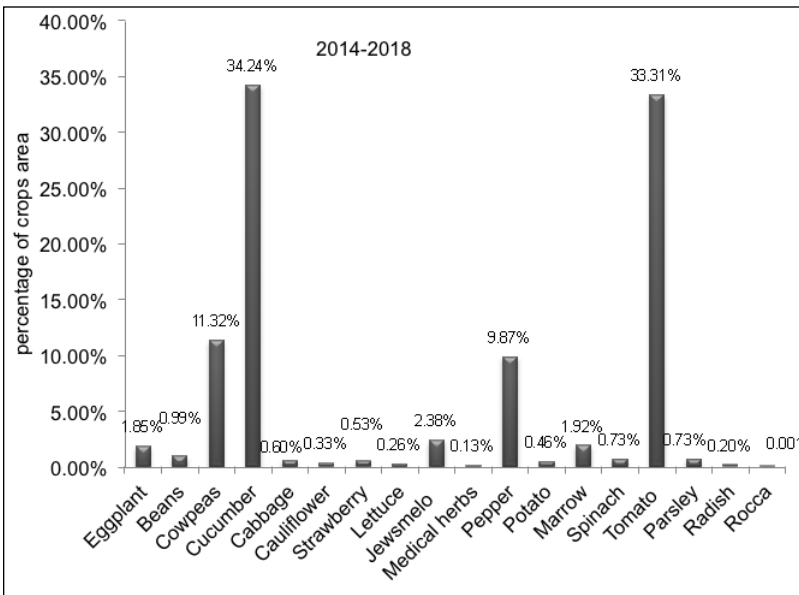


FIGURE 3
Percentage of greenhouse agriculture crops in the northern west Bank, from 2014-2018

Crop Diversification Determinants

The diversification of crops is a fundamental practice for many farmers; however, others believe such a practice is highly risky. In order to explore the factors governing taking such a decision among Palestinian farmers, the researchers presumed a correlation between certain factors and the decision to diversify the crops and examined this presumption using regression, as shown in the following table (Table 2). The multiple regression was conducted to determine the impact of some demographic factors on the diversification decision. The results show that the farmer's educational level, monthly income and years of experience significantly affect the crop diversification decision. These factors indicate that the diversification is mostly chosen by farmers with a high educational level, income and experience, denoting awareness of the risks and fear of risk among the farmers without coverage for the expected loss margin.

TABLE 2

Regression estimates for effect of demographic factors on the agriculture crop diversification decision in northern West Bank

Model	Unstandardized Coefficients		Standardized Coefficients		Sig.
	B	Std. Error	Beta	t	
1 (Constant)	.511	.095		5.366	.000
Number of family laboring in the farm	.012	.008	.091	1.542	.124
Farm size	.002	.004	.029	.478	.633
Farmer age	-.018-	.019	-.066-	-.924-	.356
Farmer Education level	.056	.019	.167	2.917	.004
Number of family members	.009	.007	.083	1.303	.194
Monthly income	-.048-	.019	-.144-	-2.447-	.015
Years of experience	-.033-	.014	-.163-	-2.439-	.015

Discussion

The study explored the diversification of crops in three distinctive governorates in the northern West Bank, Palestine, namely: Jenin, Tubas and Tulkarm, in addition to investigating the factors influencing diversification of crops in the greenhouses of these governorates over a period of 24 years of changing agricultural sector patterns in the study area.

The findings showed moderate tendencies towards diversification of crops planted in the greenhouses in the three governorates; however, this orientation conserved its stability over the years in the governorates of Jenin and Tubas, but Tulkarm farmers showed more positive attitudes towards

diversification of crops, as they tended to plant new crops and plants. This is due to their closeness to the Israeli markets that introduce all new technological innovations and techniques in the agricultural sector and relative water abundance compared to Jenin and semi-dry Tubas.

Moreover, the crops planted in the three governorates showed constant attitudes towards growing cucumber, tomato and pepper since these crops are highly consumed as also indicated by Harb et al. (2016). However, the cultivated area of these three major crops showed wide variation during the past 24 years, where the cucumber cultivated area constituted an average of 70.29% of the planted area during 1994-2008, but the cultivated area increased to 35% of the total cultivated area during 2014-2018 in the three governorates. That is a notable shift in the cultivation area, with an average of 40% cultivated with cucumber between 2013 and 2016 (Harb et al. 2016). Likewise, the average cultivated area of tomato during 1994-2008 formed 14.84% of the total area, but notably showed a rise in the cultivation area to form 34.88% of the total area during 2014-2018.

Similarly, pepper cultivated area was 5.22% in average but rose to 9.75% during 2014-2018. Such variation in the cultivated areas of the cucumber, tomato and pepper was in a response to the growing demand for these crops by consumers, the initiation of food manufacturing firms and exporting some of the production, the transformation from open field to greenhouse for various factors, in particular risk of pathogens, in addition to the high quality of the greenhouse production of these crops.

The research revealed stable agricultural patterns in the study area, where cucumber, tomato and pepper were the most prevalent crops compared to other crops, to 35% %, 34.88%, and 9.75% respectively, in accordance with the study of Harb et al. (2016), and Al-Abady (2003), Al-Nasser and Bhat (1998) and Tüzel and Öztekin (2015) showing an identical pattern of cropping. Other crops cultivated by the northern governorate farmers included beans, Jews melo, squash, eggplant, Borago and cowpea; their average area of cultivation was 3.39%, 5.22%, 0.25%, 0.37%, 0.08% and 0.27%, respectively, during 1994-2008. Yet it rose notably for some crops like beans, Jews melo, squash and eggplant, where the average area of cultivation was 8.73%, 2.31%, 1.91%, 1.84 respectively, during the past five years. In the same context, other crops showed shrinkage in cultivation area, such as Borago and cowpea, which declined from 0.08% and 0.27%, to 0.0 due to crop replacement by other crops like potato, cauliflower, spinach, rocca and radish.

The technological advances and opening to the world changed the demand of the market and paved the way for growing new crops in the greenhouses. These crops are not new, as they were grown in the open field, but the shift of their cultivation is considered new to the greenhouses. Such crops include aubergine (eggplant), potato, cauliflower, spinach, and rocca, which formed 1.84%, 0.46%, 0.33%, 0.72 and 0.26 of the crops cultivated in the

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greenhouses. The totally new crops brought to the Palestinian farmers and markets encouraged by the success of greenhouse production include strawberries and medicinal herbs, forming 0.92% and 0.13% of the total greenhouse agricultural areas.

The results show that the farmer's educational level has impact on the decision to vary the crops grown in the greenhouse, as high qualifications empower the farmer to engage in informative and training workshops that elevate his/her skills and abilities to manage the crops and follow a more scientific path when deciding which type of vegetable or crop to cultivate. This has a positive impact on the farmers' decisions to diversify, as affirmed by Benin et al. (2003). Monthly income is also an influencing factor for the diversification of crops according to the Palestinian farmers in the northern West Bank. The farmers depend on the farm's net profit to prepare for the next cropping rotation; therefore, risking their financial support in new crop is not expected, unless their monthly income has risen to a safe level that enables them to cover the losses.

In addition, years of experience significantly affect the crop diversification decision, as was also found by Ojo et al. (2014) and Makate et al. (2016). Experience in the greenhouse cultivation and markets empowers the farmer to anticipate the consumers' general attitudes towards specific crops; a farmer can thus decide, smartly and wisely, when and what to diversify.

However, contrary to Makate et al. (2016), Ojo et al. (2014) and Mishra et al. (2004), the study found that the diversification of crops is not affected by the size of the farm, despite the rational notion that the larger the land, the more diversified potentials are available. The Palestinian farmers continue not to risk their seasonal crop, preferring to stay on the safe side.

The diversification decision is a very influential one, taking such a decision requires a study of the market's needs, the new crop requirements and the potential problems and difficulties, even in the case of small size holdings — as in the case of the holdings of the Palestinian agricultural lands, where the risk is very high and costly, since the marketing options are very limited, and the financial compensations are highly incompatible with the losses these farmers might suffer. In addition, there are personal determinants shaping the diversification decisions, such as age and experience.

Conclusion

The Palestinian agricultural sector has witnessed a huge shift during the few past decades, as a response to changing circumstances, socially, economically and educationally. The shifting to greenhouse cultivation and the deterioration in open field cultivation have been caused by various factors. These factors include the rising demand for crops, the growing population, the advancement in agriculture in the neighboring countries, in addition to open-

ness to the world contributed to shifting many widely consumed crops to greenhouses, and these crops comprise vegetables and some fruits.

The most prevalent crops cultivated by the Palestinian farmers in the northern area of the West Bank were cucumber, tomato, pepper and green beans. The Herfindahl Index showed that there is some sort of stability in the cropping diversification in the three governorates of Jenin, Tubas and Tulkarm. However, Tulkarm farmers seem to diversify in their cultivation more than farmers in Jenin and Tubas. The diversification decision among the farmers is found to be affected by the farmer's educational level, farm size and years of experience.

The diversification is highly valued for production and income. Thus, farmers should be encouraged to diversify their production through providing the best seeds and seedlings and input resources, alongside extension for the best productivity. The farmers should be informed of the positive aspects of differentiating their cropping production and the new crops demanded by consumers. Moreover, the fear of risk common among the farmers can be minimized by a collaboration between the agricultural associations, NGOs and the ministries of agriculture and national economy to compensate for farmers' losses.

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