SOCIO-ECONOMIC ASSESSMENT OF GREENHOUSE AGRICULTURAL MANAGEMENT PRACTICES IN NORTH WEST BANK, PALESTINE

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ABSTRACT

Agricultural management practices increase the quality and quantity of food to cope with the growing population. This study aims to evaluate the agricultural practices adopted by greenhouse farmers in the northern governorates of the West Bank. A descriptive analytical approach was implemented utilizing a questionnaire designed by the researcher to explore the farmers' ratings of the availability of the basic practices and their significance to them. Eighty-seven farmers, chosen using SRD, participated in the study. The results revealed significant variation in the management practices among farmers. The farmers reported low levels of implementation of some practices including providing the greenhouse with high openings, safety procedures, record keeping, and technology use. In addition, the farmers showed differences regarding the greenhouse practices related to age, years of experience, family members working on the farm, and members of agricultural associations but not to gender.

Keywords: *management, greenhouse, practices, protected agriculture, West Bank*

INTRODUCTION

The high population growth rate in Palestine over the last 20 years has resulted in an increased demand for food (PCBS, 2018). Thus, the greenhouse agriculture system has been extended to match the high food requirement demand. The cultivated area in 1997 was 18,344 dunums, and it was increased up to 29,952 dunums in 2007 (PCBS, 1997-2007). Greenhouse agriculture is associated with a high use of pesticides and chemical fertilizers (Abdulrazzaq, 2017) and, as a protected, controlled environment, is characterized by its intensive productivity and out-of-season production (Reddy, 2016; Baudoin et al., 2013). The greenhouse management practices also involve the proper and safe utilization of chemicals and fertilizers (Baudoin et al., 2013). The selection of both fertilizers and pesticides relies on the farmers' experience and resources in addition to the availability of the necessary chemicals. The safety measures for using these chemicals are a significant point (Reddy, 2016); access to and use of chemicals associated with this agricultural system have led in many cases to high residual levels of these substances in plants and the soil, including nitrogen, phosphorus, and other minerals. Therefore, a negative impact on the environment is inevitable in addition to less revenue from this system (De Pascale & Maggio, 2004; Reddy, 2016; Huang & Chou, 2014).

Different studies have shown a gloomy image of the greenhouse agriculture practices adopted by the farmers. Alhadithy (2014) found that 47% of the Iraqi farmers asserted having weak levels of knowledge about the methods of soil sterilization compared to only 8% who had a good level of knowledge. Chemical sterilization was among the methods most used by Palestinian greenhouse farmers; it involves using chemicals to remove plant residue and double their use of solarization, which raises the level of monosodium methyl arsenate (CH4AsNaO3) followed by Candor (HarbShoaibi & Qadous, 2016). However, the majority (64%) of Saudi farmers depend on solarization, while 16% use it irregularly (Abdulrazzaq, 2017). Meanwhile, about 93% of the Ethiopian farmers in Mekonnen and Agonafir's study (2002) adopted careful working practices when using the pesticide, while 7% suggested using personal protective equipment. The lack of financial and administrative records in agricultural farming can adversely affect the net returns of the farm, as farm ownership and the availability of administrative and financial records is an important agricultural practice. In addition, having financial records enables farmers to know the economic feasibility of the farm and allows them to determine expenditures as much as possible to achieve the greatest possible return from the farm. According to the study by HarbShoaibi and Qadous (2016), more than 70% of the respondents did not work according to any written plan, 33% did not have any administrative or financial records, and the remainder had only partial records.

A study conducted by Alhadithy (2014) indicated that about 31% of the farmers interviewed were very weak in terms of follow-up agricultural operations through agricultural records, while 42% of respondents were weak and those who were well accounted for only about 5%, As for the records related to agricultural inputs and outputs, 39.19% of respondents were very poor at record keeping,

and 8.11% of respondents were good. Some of the important agricultural practices that affect production are cooling, heating, and ventilation systems. The cooling technology is of great importance in hot regions (summer temperature exceeds 45°C); for instance, more than 70% of the greenhouses in Saudi Arabia use a cooling system (Ganguly & Ghosh, 2011; Dayioglu & Silleli, 2015).

METHODOLOGY

Data sources

A descriptive analytical method was utilized using a questionnaire as a tool for data collection. The questionnaire includes two main segments. The first section asks for demographic information such as gender, age, experience, family members working on the farm, and membership of associations. The second section is about the evaluation of the greenhouse agricultural management practices adopted by Jenin, Tulkarm, and Tubas farmers on the West Bank. A Likert scale was utilized to define the farmers' attitude towards management practices. Figure 1 show the prevalence of greenhouses in the study area.

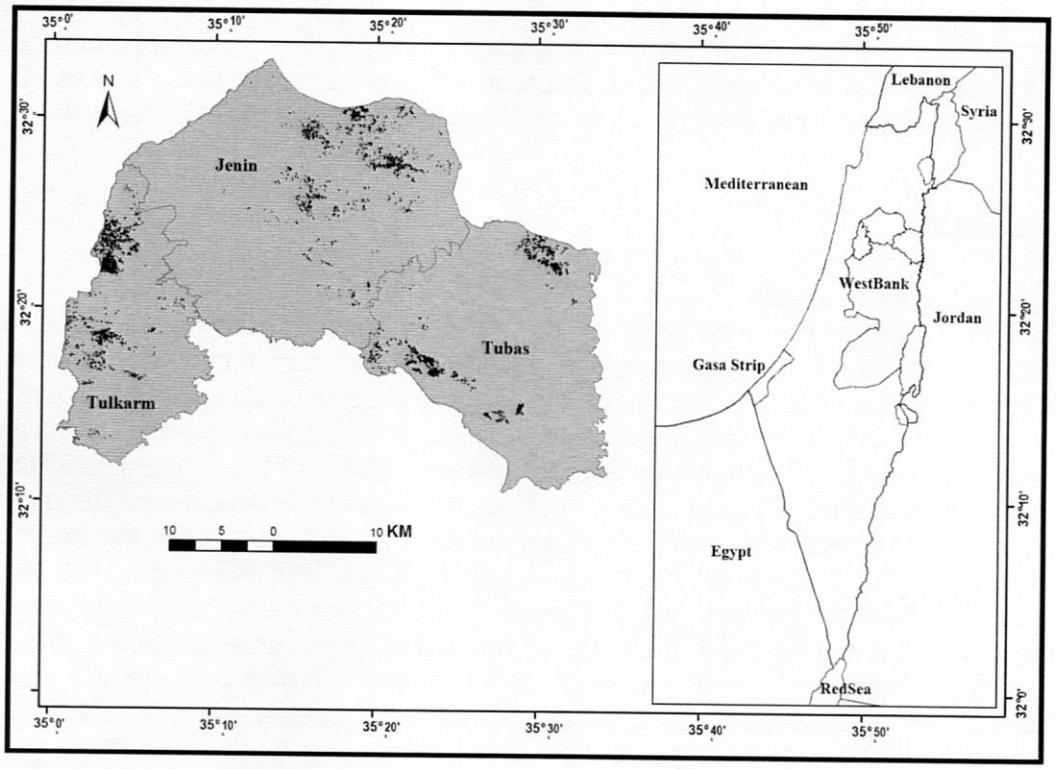

Figure 1: The prevalence of greenhouses in the study area.

Sampling

The minimum sample size equation was utilized to determine the sample of respondents distributed to the three governorates. The locations were selected using spatial random distribution (SRD) of the GIS. The total number of greenhouse farmers in the study area was (3,010) farmers, from which a randomly stratified sample of (87) farmers was chosen as shown in the following Table 1.

Table 1: Sample distribution to the governorates

Governorate	Total	Percentage
Jenin	19	21.84
Tulkarm	40	45.98
Tubas	28	32.18
Total	**87**	**100%**

Data Analysis

The collected data was analyzed using SPSS Version 23. Descriptive analysis was performed to find out the means and standard deviations. An independent sample T-test and one-way Anova analysis was used to identify the significant differences between the farmers' attitudes towards greenhouse management practices. The Least Significant Difference (LSD) was applied to assess the mean separation.

RESULTS

Descriptive Analysis

Table 2 shows the responses of the farmers toward greenhouse structure, agricultural input, safety procedure, record keeping and technology domains. Regarding the structure, 51.7% of the farmers asserted having double doors in their greenhouses, 81.6% utilized side curtains, while 51.7% indicated not having high windows as a ventilation method. However, 89.7% of the farmers took good care of the type of greenhouse roof as a major protective step. Regarding agricultural inputs, the response of the farmers was high except for the question regarding the amount of water consumption, which was moderate. The table shows that all the farmers participating in the study chose a suitable crop to grow in the greenhouse. As for their use of fertilizers, 96.6% asserted using organic fertilizers compared to 88.5% who used chemical fertilizers. As shown in the table, the farmers also used sterilization in their greenhouses; 55.2% of the farmers utilized heat sterilization, while 88.5% of them used chemical sterilization. For crop protection, the study revealed that 96% of the farmers adopted crop protection during cultivation, 86.2% of them utilized pesticides, while 11.5% applied biological controls.

Table 2: Farmers' answers regarding the domain of greenhouse structure, agricultural input, safety procedure, record keeping and technology

Domain	Items	Availability				Importance		
		Yes (%)	No (%)	Mean	SD	Mean	SD	Attitude
Greenhouse Structure	The greenhouse contains double doors.	51.7	48.3	1.48	0.502	2.52	0.712	High
	The greenhouse contains side curtains.	81.6	18.4	1.18	0.389	2.70	0.592	High
	The greenhouse contains high windows for ventilation.	48.3	51.7	1.51	0.502	2.50	0.679	High
	I have knowledge about types of plastic roofs.	89.7	10.3	1.10	0.303	2.68	0.576	High
Agricultural Input	I choose the suitable crops to grow in the greenhouse.	100	0.0	1.00	0.000	2.89	0.306	High
	I add initial organic fertilizer.	96.6	3.4	1.03	0.183	2.81	0.470	High
	I add initial chemical fertilizer.	88.5	11.5	1.11	0.320	2.68	0.556	High
	I use heat sterilization.	55.2	44.8	1.44	0.500	2.55	0.694	High
	I use chemical sterilization.	88.5	11.5	1.11	0.320	2.75	0.549	High
	I use appropriate plant treatments.	96.6	3.4	1.03	0.183	2.78	0.537	High
	I use pesticides.	86.2	13.8	1.13	0.346	2.68	0.576	High
	I use biological control against pests.	11.5	88.5	1.88	0.320	2.32	0.814	High
	I have knowledge about quantity of water consumption.	75.9	24.1	1.02	0.150	2.82	0.436	Moderate

Table 2: (continieued)

Safety procedures	I follow public safety measures during farming practices (use pesticides, fertilizers).	48.3	51.7	1.51	0.502	2.57	0.640	High
	I follow the instructions when using pesticides and fertilizers.	69	31	1.31	0.465	2.64	0.570	Moderate
	I have sufficient monitoring experience to detect greenhouse planting diseases.	83.9	16.1	1.16	0.369	2.74	0.463	High
Records keeping	I have an agricultural administrative record.	36.8	63.2	1.63	0.485	2.32	0.814	High
	I have an agricultural finance record.	44.8	55.2	1.55	0.500	2.39	0.812	High
Technology	I use the new technology methods (computers).	14.9	85.1	1.85	0.358	2.31	0.825	Moderate
	I use packaging and labeling for production.	37.9	62.1	1.62	0.488	2.39	0.767	High

The study showed that only 48.3% of the farmers followed the public safety measures during farming practices, yet, they ranked it as highly important. The table shows that 69% of the farmers followed the instructions when using pesticides and fertilizers. Moreover, 83.9% of the farmers had experience of detecting plant diseases. Keeping records of the farm is an important measure for tracking and observing the production stages. Nonetheless, although the farmers rated keeping agricultural administrative and financial records as highly important, only 36.8% of them kept administrative records while 44.8% of them had financial records of their farms.

Regarding the implementation of new technology, the farmers rated using the computer moderately; only 14.9% of them utilized it on their farms, but they rated implementing packaging and labelling techniques as high whereas only 37.9% of them package and label their production.

The relation between the management practices and the farmers' socio-economic characteristics:

a) The role of gender in agricultural management practices.

Table 3 shows no statistically significant differences in the domain of availability and its sub domains, as the significance level is higher than 0.05. Also, the table shows no statistically significant differences in the domain of importance and its sub domains, as the significance level is higher than (0.05) too.

b) The role of farmers' age in agricultural management practices

Table 4 shows no statistically significant relation between farmers' age and availability; however, no relation was found with structure and technology, where there are differences between the farmers' age groups in the sub-domain structure (0.01) in favor of farmers aged less than 20 years old. In addition, there are differences in the sub-domain of technology (α=0.03) in favor of farmers aged 31 – 40 years old. The table also shows no statistically significant difference in the domain of importance and its sub domains as the significance level is higher than 0.05.

c) The role of farmers' experience in agricultural management practices

The results in Table 5 indicate that there are no statistically significant differences between the level of experience (years) in the domain of availability except for the sub domains of structure and technology, where there are differences between the farmers' experience in the sub-domain structure (0.006) of less than 5 years. Besides, there are differences in the sub-domain of technology (α=0.008) in favor of farmers' experience of between (16-20) years. The table also shows no statistical significance in the domain of importance and its sub domain (0.05) except for the sub domains of structure importance, and safety importance, where there are differences between the farmers' years of experience in the sub-domain structure (0.004) in favor of farmers' experience of between (16-20) years. Also, there are differences in the sub-domain of importance (α=0.050) in favor of farmers' experience of between (16-20) years.

Table 3: The differences between the farmers' answers to the dimensions of the management practices related to gender

Main Dimension	Sub-Dimension	Gender	Number	Mean	SD	F	Sig.
Availability	Structure	Male	84	1.324	0.232	0.249	0.619
		Female	3	1.250	0.2500		
	Input	Male	84	1.179	0.0847	0.308	0.580
		Female	3	1.166	0.0577		
	Safety	Male	84	1.333	0.3061	1.164	0.284
		Female	3	1.222	0.0924		
	Records practices	Male	84	1.595	0.5000	0.229	0.633
		Female	3	1.500	0.2953		
	Technology	Male	84	1.738	0.2886	0.718	0.399
		Female	3	1.666	0.3886		
Importance	Structure	Male	84	2.601	0.3883	1.470	0.229
		Female	3	2.750	0.2500		
	Input	Male	84	2.727	0.2441	0.745	0.391
		Female	3	2.666	0.1527		
	Safety	Male	84	2.658	0.4202	0.075	0.785
		Female	3	2.555	0.5091		
	Records practices	Male	84	2.363	0.7813	0.202	0.654
		Female	3	2.166	1.040		
	Technology	Male	84	2.360	0.6166	0.077	0.782
		Female	3	1.833	0.5773		

Table 4: Analysis of variance between management practices and farmers age

Main Dimension	Sub-Dimension	Mean					F	Sig.
		≥20	21-30	31-40	41-50	≤51		
Availability	Structure	1.50	1.46	1.16	1.27	1.28	3.185	.017
	Input	1.20	1.16	1.16	1.20	1.19	1.24	.310
	Safety	1.33	1.134	1.29	1.35	1.30	.181	.948
	Records	1.00	1.64	1.56	1.61	1.57	.593	.669
	Technology	1.50	1.57	1.82	1.75	1.80	2.67	.033
Importance	Structure	2.25	2.48	2.67	2.59	2.73	1.24	.298
	Input	2.80	2.46	2.74	2.74	2.77	.860	.491
	Safety	3.00	2.53	2.46	2.67	2.79	.950	.439
	Records	3.00	2.21	2.42	2.38	2.34	.382	.821
	Technology	2.50	2.40	2.36	2.29	2.34	.103	.981

Table 5: The differences between the farmers' answers to the dimensions of the management practices related to years of experience

Main Dimension	Sub-Dimension	Mean					F	Sig.
		< 5	5-10	11-15	16-20	> 20		
Availability	Structure	1.51	1.31	1.29	1.21	1.30	3.86	0.006
	Input	1.16	1.15	1.21	1.16	1.18	1.55	0.194
	Safety	1.30	1.33	1.25	1.39	1.36	0.598	0.665
	Records	1.60	1.56	1.66	1.46	1.62	0.532	0.712
	Technology	1.60	1.59	1.71	1.87	1.85	3.70	0.008
Importance	Structure	2.37	2.51	2.53	2.84	2.72	4.22	0.004
	Input	2.64	2.66	2.67	2.82	2.80	2.24	0.050
	Safety	2.50	2.60	2.66	2.72	2.73	0.829	0.510
	Records	2.21	2.15	2.30	2.59	2.47	0.869	0.486
	Technology	2.42	2.25	2.23	2.34	2.50	0.613	0.654

d) Family members working on the farm in agricultural management practices

The results in Table 6 indicate that there are no statistically significant differences between the family members working on the farm in the domain of availability, except for the sub domains of input and safety, where there are differences between the family members working on the farm in the sub-domain input (0.021) in favour of wives. Moreover, there are differences in the sub-domain of safety (α=0.055) in favour of wives. Also, the table shows no statistically significant differences in the domain of importance sub domains as the significance level is higher than 0.05.

e) The role of association membership in agricultural management practices

The findings presented in Table 7 show that there are no statistically significant differences between being a member of an association in the domain of availability, except for the sub domains of input, where there are differences between the farmers' association membership in the sub-domain input (0.004). Moreover, the table shows no statistical significance in the domain of importance and its sub domains, except for the sub domain of records (0.003).

DISCUSSION

The study found that the greenhouse structure is generally available on a large scale and is considered important in terms of the Palestinian farmers' income. However, more than half of them asserted the lack of high windows for ventilation, which is consistent, to some extent, with Alhadithy's (2014), study, which asserted the existence of a good level of knowledge of basic practices of greenhouse management.

As for the agricultural input, a high percentage of the farmers, as seen above in Table (2), indicated they followed the standardized measures related to their rotation beginning with choosing a suitable crop to grow through to water consumption and pest control. However, only (11.5) of the farmers utilized biological controls against pests, compared to those relying on pesticides, preferring chemical controls. This is in accordance with Rijal et al. (2018), who found that chemical controls are the preferable method of pest control for 80% of the farmers. Also, chemical sterilization is more common among farmers in comparison to heat sterilization; this is in contrast to the Iraqi farmers, who prefer heat sterilization (Abdulrazzaq, 2017).

Table 6: The differences between the farmers' answers to the dimensions of the management practices related to family members working on the farm.

Main dimension	Sub-Dimension	Mean					F	Sig.
		Non	Wife	Males	Females	All members of family		
Availability	Structure	1.28	1.37	1.33	1.25	1.30	0.20	0.935
	Input	1.15	1.35	1.18	1.25	1.16	3.07	0.021
	Safety	1.04	1.50	1.33	1.16	1.40	2.30	0.055
	Records	1.35	2.00	1.62	1.50	1.56	1.15	0.355
	Technology	1.64	2.00	1.70	2.00	1.79	1.40	0.241
Importance	Structure	2.71	2.37	2.53	3.00	2.70	1.72	0.152
	Input	2.80	2.50	2.71	2.85	2.74	0.80	0.529
	Safety	2.90	2.83	2.64	3.00	2.56	1.32	0.267
	Records	2.71	2.00	2.20	3.00	2.56	1.78	0.140
	Technology	2.57	2.50	2.27	2.25	2.43	0.544	0.704

Table 7: The differences between the farmers' answers to the dimensions of management practices related to farmers' association membership

Main Dimension	Sub-Dimension	Yes/No	Mean	SD	F	Sig.
Availability	Structure	Yes	1.26	0.214	1.45	0.310
		No	1.36	0.238		
	Input	Yes	1.18	0.105	8.66	0.004
		No	1.17	0.060		
	Safety	Yes	1.37	0.330	2.21	0.140
		No	1.29	0.274		
	Records practices	Yes	1.62	0.404	1.79	0.184
		No	1.56	0.449		
	Technology	Yes	1.75	0.299	0.03	0.850
		No	1.72	0.291		
Importance	Structure	Yes	2.67	0.358	2.80	0.098
		No	2.54	0.399		
	Input	Yes	2.77	0.212	0.72	0.398
		No	2.68	0.258		
	Safety	Yes	2.78	0.307	13.57	0.00001
		No	2.54	0.473		
	Records practices	Yes	2.61	0.635	9.20	0.003
		No	2.13	0.838		
	Technology	Yes	2.50	0.554	2.99	0.089
		No	2.22	0.649		

Safety is a major issue in agriculture, as farmers deal with multiple threats to their lives and to public safety. However, the research revealed that more than half of the Palestinian farmers did not strictly follow either personal or public safety measures. Such a finding is contradictory to Rijal et al. (2018), who indicated that in their study, over 84% used at least one form of personal protection against harmful pesticides. However, the study outcomes were inconsistent with the findings of Mekonnen and Agonafir (2002), who indicated that safety measurement practices are important but have low adoption percentages. Although the farmers may have good knowledge of the health risks associated with pesticide usage, this may not affect their behavior and practices related to safety measures; however, it can affect the farmers' tendency to control the impact, where education regarding safety practices can be effective in changing the farmers' attitude to control the effect (Arcury, Quandt & Russell, 2002).

One of the most significant indicators of successful agricultural practices is record keeping, both administrative and financial. Nonetheless, a high percentage (63.2%) of the northern Palestinian farmers indicated not keeping administrative records, and (55.2%) said they did not have financial records of their farms. Moreover, technological advances are now crucial to greenhouse production, yet, the majority of the Palestinian farmers indicated not having adopted such advances, either concerning the use of computers or the use of packaging and labeling techniques. This agrees with Alhadithy (2014), who indicated the lack of knowledge regarding record keeping among the farmers as well as the low adoption of technological methods.

The study found no significant differences between the gender of farmers regarding greenhouse management practices, but significant differences were shown in relation to structuring the greenhouse and farmers' use of technology due to age. This result is inconsistent with the findings of Omoro (2014) and Garcia-Martinez et al. (2010), indicating negative attitudes towards it, although the use of such technology is low among the farmers due to the high costs of its implementation (Van Der Spijk, n. a.; Dwasi, 2017).

The result showed that farmers' experience was mainly in greenhouse structure and technology adoption; level of experience also influenced the agricultural input. This corresponds with the results of Omoro (2014) and Garcia-Martinezetal (2010). The experience of the farmer, on the other hand, does not affect either practices or attitudes but it is an indicator of the greenhouse management practices among farmers (Viloria, 2010).

The number of family members working on the farm seems to be significantly important in the dimensions of input and safety practices. The study showed a positive effect for the wife, generally working side by side with their husbands; in addition, most women in the rural areas are housewives and have enough time to work in the greenhouses. This is in contrast to Broz and Ozcatalbas (2010), who found that the farmers rely on their personal experience regarding the input selection but count on family members and neighbors in other greenhouse practices.

Membership of agricultural associations has an impact on the agricultural input in favor of those who are not members. Being a member of an association affects the farmers' safety practices, record keeping, and use of technology; this is consistent with the outcomes presented by Abdelrahman (2017), where the farmers' experience influences their benefit from membership of an agricultural association.

CONCLUSION

The agriculture management practices adopted by the farmers are crucial to the production and an effective factor in the agricultural greenhouses' sector. The findings have revealed an underestimation of the value of using environmentally friendly pest management methods, such as biological controls, and the importance of safety for both the farmers and consumers regarding risks that threaten the lives of the general population. Other negative attitudes observed among the farmers were regarding keeping records of the farm, both administrative and financial, as well as the adoption of technological methods in all aspects of farm work and related practices due to the high costs of these technologies.

These underestimated practices should be re-evaluated among the farmers through education and with collective collaboration between the private and public sector organizations active in the agricultural field. Additional research on the management practices related to farming and production should be conducted to uncover the aspects of negative and harmful attitudes among the farmers.

REFERENCES

Abdelrahman, T. A. (2017). Factors affecting farmers' benefits from agricultural cooperatives services: The case of Kafrelsheikh Governorate, Egypt. *International Journal of Economic Research*, 14(10), 129-144.

Abdulrazzaq, A. (2017). Attitudes of protected vegetable farmers in Wasit Province towards practicing of eco-friendly methods and its relation to some variables. *Al-Furat Agricultural Sciences Journal*, 4(appendix), 565-579.

Alhadithy, A. A. (2014). Study on plastic-houses farmers knowledge in the basics of under-cover cultivation in Heat district. *Al-Anbar Journal of Agr. Sci.*, 4th Scientific Conference researches, 12, special issue, 378-387.

Arcury, T. A., Quandt, S. A., & Russell, G. B. (2002). Pesticide safety among farmworkers: perceived risk and perceived control as factors reflecting environmental justice. *Environmental Health Perspectives*, 110(suppl 2), 233-240.

Baudoin, W., Nono-Womdim, R., Lutaladio, N., Hodder, A., Castilla, N., Leonardi, C. & Duffy, R. (2013). Good agricultural practices for greenhouse vegetable

crops: Principles for Mediterranean climate areas. FAO plant production and protection paper (FAO).

Boz, I., & Ozcatalbas, O. (2010). Determining information sources used by crop producers: A case study of Gaziantep province in Turkey. *African Journal of Agricultural Research*, 5(10), 980-987.

Dayioglu, M. A., & Silleli, H. H. (2015). Performance analysis of a greenhouse fan-pad cooling system: Gradients of horizontal temperature and relative humidity-Sera Fan-Pad SoğutmaSistemin in PerformansAnalizi: Yatay Sıcaklıkve Bağıl Nem Değişimleri. *Journal of Agricultural Sciences* Tarım Bilimleri Dergisi.

Depascale, S., & Maggio, A. (2004, September). Sustainable protected cultivation at a Mediterranean climate. Perspectives and challenges. In International Conference on Sustainable Greenhouse Systems-Greensys2004 691 (pp. 29-42).

Ganguly, A., &Ghosh, S. (2011). A review of ventilation and cooling technologies in agricultural greenhouse application. *Iranica Journal of Energy & Environment*, 2(1), 32-46.

Garcia-Martinez, M. C., Parisi, S. B., Fernandez-Zamudio, M. A., &Villar, P. C. (2010). Trends in the adoption of greenhouse technology in Mediterranean horticultural farms. *New Medit*, 9(3), 47-55.

Harb, Shoaibi & Qadous, 2016. Options for moving towards organic farming in Palestine territory infrastructure, institutional framework and legal perspectives. Palestine Economic Policy Research Institute (MAS) Jerusalem and Ramallah. ISBN 978-9950-374-71-3.

Huang, T. C., & Chou, H. P. (2014, November). Extension of good agricultural practices towards safety of fresh fruit and vegetables. In This publication includes papers prepared for presentation at the workshop subjected under FFTC's publication guidelines and miscellaneous information regarding the workshop such as the program, list of participants, and background notes. (p. 80).

Mekonnen, Y., &Agonafir, T. (2002). Pesticide sprayers' knowledge, attitude and practice of pesticide use on agricultural farms of Ethiopia. *Occupational Medicine*, 52(6), 311-315.

Omoro, P. A. (2014). Assessment of Selected Factors Affecting Performance of Greenhouse Technology in Small scale Farms in Gusii Highlands, Kenya (Doctoral dissertation, Kisii University).

Reddy, P. P. (2016). Greenhouse technology. *In Sustainable Crop Protection under Protected Cultivation* (pp. 13-22). Springer, Singapore.

Rijal, J., Regmi, R., Ghimire, R., Puri, K., Gyawaly, S., & Poudel, S. (2018). Farmers' knowledge on pesticide safety and pest management practices: A case study of vegetable growers in Chitwan, Nepal. *Agriculture*, 8(1), 16.

Van der Spijk, C. (n. a.). *Greenhouse technology adoption among small and medium-scale tomato farmers in Kenya*. Wageningen University & Research.

Viloria Carrillo, F. (2010). Two dimensions of farmers' decision making on record keeping. *Agroalimentaria*, 16(31), 87-99.