

Market Information System for Farmers*

نظام معلومات السوق للمزارعين

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ABSTRACT

Today, Palestinian farmers in small to medium-sized farms and multifunctional farms are rare to use market information systems for various reasons, like cost, scarcity of these systems, lack of experience and knowledge, the user interface language, and the complexity of the available such systems. The development of a MISF that uses new technologies, such as web-based and smart devices, is based on the initial information related to the local agricultural community, a questionnaire about the role of market information systems for Palestinian farmers was used, different statistical methods were used to analyze the data collected by the questionnaire for this study. Different users or stakeholders in the agricultural sectors can use the system. The application of MISF was successfully implemented using web technology and smart devices and tested, where all different scenarios were recorded. In this research, a descriptive approach was used to analyze the agricultural information marketing system. First, data related to our system was gathered using a literature review of research, reports, questionnaires, and site visits. This paper aims to address some of the problems facing the farmer markets. The proposed system will facilitate trade by creating a capacity for sellers to contact individual buyers. This system will provide information on what agricultural products are in demand by analyzing consumer consumption and market trends. The system will collect demographic details such as the types of crops grown, crop size, prices, cost, and maybe access to the type of irrigation, soil, and fertilizers as inputs from the farmers as well as other information about crops consumption. The data gathered by the proposed system can be used to advise farmers about needed crops and suggest ways to help them lower costs and improve productivity by using data mining techniques. Survey results indicated the need of farmers and other stakeholders in the agricultural sector for an efficient, easy-to-use MISF. In general, the system will track farmers' daily activities, businesses and provide ongoing support in areas such as labor, costs, yields management, crops consumption, harvest management, and market price discovery. This, in turn, will help to create strong relationships with buyers.

Keywords: Market Information Systems for Farmers, Data Analysis, Agriculture Information System, Web based Application.

الملخص

في يومنا هذا، نادراً ما يستخدم المزارعون الفلسطينيون من أصحاب المزارع الصغيرة والمتوسطة والمزارع متعددة الاستعمال أنظمة معلومات السوق لأسباب مختلفة مثل: التكلفة، وندرة هذه الأنظمة، وقلة الخبرة والمعرفة في التعامل معها، وصعوبة التعامل مع الأنظمة المتوفرة. يعتمد تطوير نظام معلومات السوق للمزارعين الذي يستخدم تقنيات جديدة مثل التطبيقات القائمة على (الويب) والأجهزة الذكية، على المعلومات الأولية المتعلقة بالمجتمع الزراعي المحلي، تم استخدام استبيانة حول دور أنظمة معلومات السوق للمزارعين الفلسطينيين، وتم استخدام الأساليب الإحصائية المختلفة لتحليل البيانات التي تم جمعها بواسطة الاستبيانة في هذه الدراسة. يمكن لمختلف المستخدمين أو أصحاب المصلحة في القطاعات الزراعية استخدام النظام. تم تنفيذ تطبيق نظام معلومات السوق للمزارعين بنجاح باستخدام تقنية الويب والأجهزة الذكية، كما وتم اختياره، حيث تم تسجيل جميع (السيناريوهات) المختلفة. في هذا البحث تم استخدام المنهج الوصفي لتحليل نظام تسويق المعلومات الزراعية. أولاًً، تم جمع البيانات المتعلقة بنظامنا عن طريق مراجعة الأدبيات للأبحاث والتقارير والاستبيانات، وزيارة الموقع الزراعية. هذه الورقة، تحاول معالجة بعض المشاكل التي تواجه أسواق المزارعين. سيسهل النظام المقترن التجارة من خلال خلق قدرة للبائعين على الاتصال بالمشترين بشكل فردي. سيوفر هذا النظام معلومات حول المنتجات الزراعية المطلوبة من خلال تحليل استهلاك المستهلك واتجاهات السوق. سيقوم النظام بجمع التفاصيل (الديموغرافية) مثل أنواع المحاصيل المزروعة وحجم المحاصيل والأسعار والتكلفة وربما الوصول إلى نوع الري والتربة والأسمدة كمدخلات من المزارعين. سيضاف إلى ذلك معلومات أخرى حول استهلاك المحاصيل. يمكن استخدام البيانات التي تم جمعها بواسطة النظام المقترن لتقديم المشورة للمزارعين حول المحاصيل المطلوبة واقتراح طرق لمساعدتهم على خفض التكاليف وتحسين الإنتاجية، باستخدام تقنيات استخراج البيانات. أظهرت نتائج الاستطلاع ان المزارعين والأطراف المختلفة في القطاع الزراعي بحاجة الى نظام معلومات فعال وسهل الاستخدام. بشكل عام، سيتبع النظام الأنشطة اليومية للمزارعين، والأعمال التجارية، ويتوفر الدعم المستمر في مجالات، مثل: العمالة والتكاليف وإدارة الغلة واستهلاك المحاصيل وإدارة الحصاد واكتشاف أسعار السوق والعلاقة القوية مع المشترين.

الكلمات المفتاحية: نظم معلومات السوق- للمزارع، نظم المعلومات الزراعية، تحليل البيانات، التطبيق القائم على الويب.

INTRODUCTION

An Overview

The importance of the agricultural sector in Palestine stems from its contribution to the food security of Palestinian households and the creation of job opportunities in the local Palestinian market. Furthermore, the agricultural sector is an important driver in the Palestinian economy since it creates job opportunities in the local Palestinian market. In recent years, new business models have emerged for the agricultural markets. However, there is a need for a new advanced market information system to facilitate transactions. Both sides, the consumers and the farmers, need certain information from the markets about agricultural products. For example, consumers may place requests regarding accurate agricultural product information or safety, while farmers may wish to display their products.

The main objective of the study is to develop a market information system for farmers (MISF) and digitize it using web applications and smart devices. This step helps and strengthens the local agricultural system, improves productivity, improves lives, and provides jobs for farmers in Palestine. It also helps provide and create new markets and value chains, bring together a wide range of local and regional stakeholders, and strengthen relationships between farmers and trusted consumers.

The problem of the study lies in the limited applications of information systems in the field of agriculture in general and agricultural marketing in particular. This comes despite the need of the different agricultural sectors for mechanisms by which market information can be exchanged for support in treating disconnected marketing groups such as retailers, wholesalers, consumers, factories, etc., dealing with agricultural products; strengthening supply chains that suffer from disintegration, and limiting mediators and monopolists' control on agricultural markets in light of the farmer's lack to effective communication with traditional markets, whether for agricultural products or production requirements.

Agriculture Sector in Palestine

The agricultural sector is an important driver in the Palestinian economy since it creates job opportunities in the local Palestinian market. The agricultural sector and its activities show that the sector faces many challenges and obstacles and weak agricultural advising and scientific research. The political conflict in Palestine is the most critical of these challenges, characterized by the Israeli practices of land confiscation, control over natural resources, especially water, and restrictions on the mobility of products between Palestinian areas on the one hand; and with international markets on the other, thus increasing the cost of agro production and marketing.

Central markets for crops are spread throughout the West Bank, and there is hardly a governorate devoid of central markets. Up to this date, there are 11 central markets spread in all the governorates of the West Bank, with the exception of Jerusalem and Salfit governorates. However, the market is still under operating procedures, bringing the number of markets to 11 central markets. The central markets are considered one of the pillars of the marketing process for agricultural products from the farmers to every final consumer type. Central markets provide different types of vegetables, fruits, and fresh field crops according to the needs of each governorate. There are also many shops, wholesalers, and mediators working in these markets under the supervision of the municipalities of the city in which the market is located. In late years, the central markets have suffered several problems, the most important of which is the Israeli occupation policy undermining the Palestinian crops; add to this the absence of organization and surveillance from the responsible authorities of these markets.

The agricultural sector is considered a basic pillar in economic activity and plays a fundamental role in economic development. The agricultural sector's main role in developing economic resources is supplying food and other products necessary to the life of the individual and society alike. It also plays an important role in its contribution rate to meet the Palestinian people's food needs.

Study Approach

The study aimed to identify the role of MISF in order to establish and automate a system to improve the reality of markets and manage

products and the agricultural food supply chain to benefit the marketing circles in partnership with the Ministry of Agriculture, the Central Statistics Department, and the Ministry of Higher Education and Scientific Research. The study focused on the marketing, presentation, and utilization of an integrated information that provides valuable data to the farmer about the crops he cultivates. It also provides data that helps promote these crops to the concerned authorities in several governorates (Ramallah, Nablus, and Salfit). This was achieved by considering the agro-dealers, agro-industrialization, and extension workers' perspectives in relation to the variable of gender, business, academic qualifications, and practical experience. To realize the objectives of the study, the researchers prepared and developed a final draft questionnaire consisting of 46 items, applied on a sample of 35 stakeholders in Ramallah and Al-Bireh, Nablus, and Salfit governorates, selected via the available method. The questionnaire enjoyed a high degree of credibility and reliability, as the reliability coefficient reached a value of 0.82 on the Cronbach alpha scale. The data were collected, classified, analyzed, and interpreted to reach the desired results. The results showed that the role of the MISF in improving the performance of agricultural marketing, product management, and the agri-food supply chain is beneficial to the marketing groups in the form of partnership.

The study results revealed that MISF would provide a computerized information system used to collect, analyze, and disseminate information on agricultural production, prices, and other information related to farmers, traders, manufacturers, and others involved in dealing with agricultural products. It will also help address some of the problems facing the farmers' markets. The researchers undertook a new approach that makes both farmers and buyers responsible for uploading their agricultural products and price information via the Internet and mobile data availability. The system will facilitate trade by providing options for sellers to communicate with buyers. This system will provide information on needed agricultural products by analyzing consumer consumption and market trends.

In light of the findings of this study, the researchers concluded a set of recommendations, including: Consolidating the relationship between the Ministry of Agriculture with the farmers and

traders, increasing the number of scientific research that deals with and is interested in market information systems as there were very few researches conducted on this topic, and providing the infrastructure for the central markets.

THE STUDY PROBLEM AND QUESTION

The Palestinian government worked to establish a new institutional phase in building the Palestinian ministries and institutions on professional grounds, relying on employing information technology systems in various sectors in Palestine.

The Ministry of Higher Education, in 2019, launched an initiative to support implementing research projects in various sectors in Palestine. In light of the Palestinian government's increasing interest to employ technology in relation to improving the quality of services provided to farmers and citizens, approval for this project was granted. This project aims at realizing ambitions in building electronic markets that serve the beneficiaries of agricultural production from the citizen to the farmers and commercial markets, in addition to the industrial production sector to transform into e-government at the national level, which allows the citizen to obtain various services remotely, regardless of location. The project contributes to improving the performance, quality of services and enhancing the beneficiaries' revenues from the agricultural sector. Based on this approach, the researchers will try to elucidate the research problem by answering the following questions:

1. Are there statistically significant differences at the level of significance $\alpha \leq 0.05$ in the role of MISF in improving the agricultural marketing performance from the farmers' and extension workers' viewpoint, attributed to the variables of gender, years of working experience, educational qualification, years of work in the market, and the business field?
2. What are the problems that may arise when developing and programming MISF?
3. How can these problems be addressed by developing web and mobile applications?
4. What are the problems and limitations that arise with the use of the MISF?
5. Do the study sample responses differ from the problems facing MISF according to the different variables of gender, academic

qualification, years of work in the market, and the business sector?

Study Hypotheses

This study relied on a set of hypotheses that aim to address the problems of the study and achieve its objectives, as follows:

1. There are no statistically significant differences at the level of significance $\alpha \leq 0.05$ in the role of MISF in improving the performance of agricultural marketing from the viewpoint of the farmers, agricultural extension agents, and traders due to the variables of gender, years of working experience, and educational qualification.
2. There are no statistically significant differences at the level of significance $\alpha \leq 0.05$ in the role of MISF in improving the performance of agricultural marketing from the viewpoint of the farmers, agricultural extension agents, and traders due to the variables of educational qualification, years of work in the market, and business sector.

Study Importance

The study's importance lies in the establishment of the electronic network for agricultural marketing to create a pioneering content for the use of information systems and smartphone applications to develop an electronic market for agricultural crops in Palestine. It will gain such importance by being one of the first studies to analyze mobile information systems' uses in promoting agricultural products through the smart application of information systems.

The importance of this study from the theoretical and practical sides lies in the following aspects:

1. Providing information about the required agricultural products by analyzing consumer consumption and market trends using data mining techniques.
2. A stable supply and demand relationship will prevent the decline in agricultural product prices and help stabilize market prices. The market information system will play an important role in industrial manufacturing and food supply chains.
3. The system will facilitate the marketing of agricultural products by providing sellers with capabilities to communicate with buyers. The

system will provide information on needed agricultural products by analyzing consumer consumption and market trends.

Study Objectives

The study aims to identify the uses of information systems in web applications and smart mobile devices in agricultural crop supply chains in Palestine through a case study of the smart network for agricultural marketing aimed at directly linking the community of small farmers in their markets. Among the other objectives of the study is to conduct an analysis of the strengths, weaknesses, opportunities, and threats of implementing the smart system as one of the agricultural information systems, to reach improvements in the performance of the current application and make room for other applications that contribute effectively to the transition in agricultural marketing from traditional to modern approaches.

The main objectives of the study can be summarized as follows:

1. To identify the role of MISF using web-based applications and mobile smartphones in regulating the flow of agricultural products and finding optimal ways to distribute agricultural productions and assist farmers.
2. To employ technology to promote the local agricultural system and improve productivity for those working in the agricultural value chain, including small farmers' businesses.
3. To improve the livelihoods of farmers in Palestine.
4. To reach new markets, value chains, and business models.
5. To reinforce the relationship between farmers and consumers in the most potent way.
6. To identify the main problems of implementing MISF.

Study Limitations

The study comprised the following limitations:

- Spatial limitation: This study was conducted on a sample of local community institutions in Nablus, Salfit, and Ramallah governorates.
- Time limitation: The study was conducted between 9/2019-2/2020.

- Human limitation: The study population solely included extension agents, farmers, traders, and factories.

Study Approach and Process

In this study, the Quasi-experimental and analytical approaches to the data were adopted. The system needs to program and examine the outputs, compare them with the results to include modifications to the inputs, and observe the desired results to harmonize them with the study's nature. This approach enhanced the understanding of the problem, identified the study variables to design the questionnaire, and formulated the study problem and questions. After completing the questionnaire, which includes the study sample, data analysis was conducted using SPSS to reach the needed statistics and results.

LITERATURE REREVIEW

Arabic Studies

The study of **Marzin J. et al. (2019)** showed the reality and problems of agricultural marketing in the Palestinian Territories (PT). The study focused on the impact of the Israeli measures on this sector, as it considered the agricultural sector the most prominent victim of Israeli economic policies. The study clarified the Israeli impediments to exporting through Israeli crossings, ports, and airports, as well as the Israeli restrictions to Palestinian agricultural marketing, which greatly limited its development. The study also addressed the absence of governmental marketing sovereignty.

Hrimat and Isaac, (2017) conducted a study that reviewed some of the obstacles that obstructed marketing services in the OPT. The study divided these obstacles into obstacles related to production and market requirements and obstacles related to marketing services and export. Concerning the production constraints and market requirements, the study indicated that the Palestinian agricultural production had undergone remarkable changes due to changes in the traditional Arab consumers' tastes, as each agricultural pattern attempts to respond to the specific environmental conditions, marketing, and planning processes, which thus prevent laying the foundations for successful marketing alternatives. As for the obstacles related to marketing services, quality requirements, and specifications, the study

refers to the sensitive nature of the vegetable and fruit trade in light of the difficult Israeli procedures, the weak application of the standards and quality system on exported agricultural products, the lack of refrigerated transport means for transporting the agricultural products, and the lack of supporting marketing service facilities (Monitor 2020a).

FAO (2013) conducted a study that highlighted the problems and obstacles facing agricultural marketing in Palestine. These problems included Israeli practices, in addition to the technical and institutional obstacles. The study put forth some appropriate marketing strategies and proposals for the advancement of the agricultural sector, some technical and production proposals, other proposals for institutional building, finally, proposals for the role of the government and the private sector, whether in the scope of local marketing or external marketing. Specifically, the proposals included: Establishing an efficient marketing information system, improving quality specifications for agricultural production, conducting the necessary studies related to agricultural production costs, participating in holding local and international exhibitions, examining all systems and instructions set by importing agencies for agricultural production, and following up on the changes that occur to them, and working to reduce high production costs relatively speaking in Palestine, in order to maximize the competitive advantage of the Palestinian production and maximize efforts towards high-value crops in international markets (Monitor 2020b).

Srouji (2009) conducted a study that reviews the local marketing of irrigated cash crops in Palestine. The importance of this study lies in its targeting of the farmers who are usually considered among the most vulnerable groups of society due to their exposure to risks. The study also focuses on the problems they suffer from, taking into account the farmers' views in solving these problems, by distributing a special questionnaire to farmers.

The study also clarified that other groups, other than farmers, such as mediators, could benefit from the final consumer and the government. Regarding the mediators, the researcher interviewed a number of them to find out the problems that the Palestinian agricultural

marketing sector suffers from. In terms of the consumer, a mediator can benefit by reducing the marketing cost, which leads to lower prices at the retail level.

Foreign Studies

As for foreign studies, the current study referred to the following:

(Nisansala, 2019), FAO (2017) and (COMCEC, 2018), in their review, present background introduction, theories, literature review, and analysis of information systems in agriculture.

Studies conducted by different teams of researchers, such as Shepherd (2011), and David-Benz et al. (2011; 2016), indicated that the first-generation market information systems were mostly based on a single model, regardless of the market being studied, the type of product, and the country. Other systems often focused exclusively on price information, relied on project-based financing, and were imperatively implemented by public bodies, such as marketing boards and ministries (Rubio, 2020), (Nwafor et al. 2020), (Muto, 2009), (Aker, 2010), (Belakeri et al. 2017), (Chikuni et al. 2019), (Roslin et al. 2020), and (Ezinne et al. 2020).

Several studies by David-Benz et al. (2011; 2012), (Galtier, 2014), and Mukhebi and Kundu (2014), showed the importance of the spread of mobile phones and the Internet, which paved the way to the rise of a new generation of Management Information Systems (MIS). The Information and Communications Technology (ICT) sector developments have made it possible to minimize the lag in transferring price data from collection points to Central Processing Units (CPUs) and disseminating information to the intended recipients. MIS that uses ICT has become known as the “second generation” MIS, or the 2GMIS “Second Generation of Management Information Systems”.

Several studies were conducted on MIS all over the world; among the most important of these studies are Mendoza (2006) and MIOA (2006), David-Benz et al. (2016), and Zoltner and Steffen (2012). Although some of these studies are now considered out of date, they still provide useful information and practical indications for those who wish to create new MIS or improve existing ones.

ICT presents unprecedented opportunities to empower smallholder farmers by strengthening their capabilities in marketing their products (Langat et al. 2016), (Rubio et al. 2020), and (Nisansala, 2019).

In the agricultural industry, Artificial Intelligence (AI) and Data Mining (Abuzir, 2018) are expected to report significant growth in the near future. Farmers can track their livestock in real-time by making use of AI. Dairy farms can now individually monitor the behavioral aspects of animals with AI solutions, including picture classification with body condition score and feeding patterns and facial recognition for livestock. Furthermore, farmers use machine vision that allows them to identify facial features (Global, 2020).

Study Tool

The researchers developed a study tool (questionnaire) for the purpose of gathering information to answer the study's questions and hypotheses after reviewing a number of previous studies related to the reality of sales markets and market information systems. The tool, in its final form, consisted of two parts:

First: Initial information related to local community institutions' managers such as:

1. Gender: Male and female.
2. Educational Level: High school, diploma, B.A., M.A., and more.
3. Years of your work in the market: 5 years or less, 5 years to less than 10 years, 10 years and more.
4. The business sector you work in: Industrial sector, commercial sector, agricultural sector, and the service sector.

Second: A questionnaire about the role of market information systems for Palestinian farmers. The questionnaire was designed based on the five-dimensional Likert scale where items were constructed in a positive direction and weights were given, as shown in Table 4.

After the data collection process, the questionnaires were coded and entered into the computer, using the statistical packages program (SPSS) to process the data, extract the results, answer the study questions and test its hypotheses. The following statistical processes were used:

- Likert scale to measure the degree of importance and the role of market information systems for Palestinian farmers.
- Frequencies and percentages to identify the study sample distributions.
- Descriptive statistics to answer the study questions.
- Cronbach's alpha to measure the degree of reliability of the study scale.
- Pearson correlation coefficient to measure the degree of consistency in the study scale.
- Independent sample t-test, to test the significance of the differences between the study sample members in reference to the variables that contain two independent samples, such as gender.
- One-way ANOVA test, to test the significance of the mean differences between the study sample.

To measure the responses of the sample members to the study items, a Likert scale was used, as shown in Table 1.

In order to determine the degree of approval (scale of correction), five levels were defined, as in Table 2.

It was obtained using the range for the scale options, which is the upper class of the scale-the lower class $5-1=4$, and to extract the length of the average category, the range was divided by the upper class of the scale, i.e., $5 \div 4=0.8$, which is the length of the mean category.

Tool Validity

The validity of the tool was verified. It was presented to a peer-reviewers group who suggested the need to make some amendments to its items. The number of items of the questionnaire, which represented the overall field of research, reached 46 items in its final form.

Table 1 Likert 5th Scale

Response	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Degree	5	4	3	2	1

Table 2 :Correction Scale Levels for the Study Scale

Arithmetic Mean Category*	Approval Category	Approval Percentage	Approval Degree
1-1.8	Strongly disagree	36 % and less	Very low
1.81-2.6	Disagree	36.1% - 52.9%	Low
2.61-3.4	Neutral	53% - 68.9%	Moderate
3.41-4.2	Agree	69% - 84.9%	High
4.21-5	Strongly agree	85% -100%	Very high

Tool Reliability

The reliability of the statistical tool for the items was verified using the Cronbach alpha test. The reliability of the study tool reached 82.4%, which is the appropriate stability factor that meets the purpose of the study.

Statistical Processing

SPSS was employed to process the following statistics:

7. Arithmetic means
8. T-test for independent samples
9. One way analysis of variance
10. The Cronbach alpha equation to measure reliability
11. Scientific results

Reliability scale of the study tool: It is used to give the scale the same results if re-applied to the same sample under the same conditions. The tool was measured using Cronbach's alpha stability coefficient. The stability factor was calculated using the SPSS program, through which the discrimination coefficient is calculated for each question, and omit the question of which discrimination coefficient is weak or negative. The following are the results of the Cronbach alpha test for the scale, as they appear in Table 3.

Table 3 Results of the Cronbach Alpha Test to Examine the Internal Consistency of the Scale used in the Study.

Scale	No. of Items	Cronbach's Alpha
Total score of the scale	46	82.4

It is noted from the results in Table 1 that the value of the reliability coefficient for the study scale was high and reached 82.4%, which indicates good consistency and stability between the items of the scale used in the data collection tool.

Validity scale of the internal consistency of the study tool: The internal consistency of the questionnaire questions means the strength of the correlation between the scores of each scale and the degrees of the overall questionnaire represented in the scale axes, as shown in Table 4.

*The correlation coefficients in Table 4 are considered statistically significant internal stability coefficients at a significant level of 0.05.

** The correlation coefficients in Table 4 are considered as statistically significant internal

consistency coefficients at a significant level of 0.01.

Table 4: The Results of the Pearson Correlation Test to Examine the Validity of the Internal Consistency Between the Items of the Questionnaire.

Axis	No. of Views	Total scale	Significance Level
		Pearson Correlation Coefficient	
The reality of sales markets in Palestine	35	0.344*	0.043
Difficulties and problems facing the distribution systems currently in effect	35	0.091	0.602
The market information system role in achieving an efficient system	35	0.919**	0.000
Availability of technological requirements for market information systems	35	0.702**	0.000

It appears from the results in Table 4 that the value of the Pearson correlation coefficient between the total score of the study scale and the first axis was significant, and the correlation was significant and moderate. In contrast, the value of the Pearson correlation coefficient between the total score of the study scale and the second axis was non-significant, and the correlation was non-significant and very weak. Whereas, the division of Pearson's coefficient between the total score of the scale and each of the third and fourth axes was statistically significant, and the correlation is strong (significant correlation at a significant scale of 0.01), which indicates a high consistency between the items of the scale used in the data collection tool.

Study methodology: The researchers used the experimental as well as the descriptive approach due to its relevance to the nature of this study. The survey was conducted on farmers, traders, factories, extension agents, and local community institutions and their relationship to some demographic variables.

Study population and sample: The study population consisted of farmers, merchants, extension workers, and factories in the governorates of Nablus, Ramallah and Al-Bireh, and Salfit. The researchers selected 50 of them using the available method as a sample to represent the study community. Table 5 shows the

distribution of the study sample according to the study variables.

The features of the study sample:

The distribution of the study sample was done according to the qualitative variables in the questionnaire: Gender, academic qualification, years of work in the market, the business sector in which you work, as shown in Table 5.

It is evident from the results in Table 5 that the study sample consisted mostly of males at 85.7%, as well as holders of high school and bachelor's degrees at 37.1% each. Moreover, the majority of the sample had 10 years of working experience or more, at 48.6%. In addition, the majority of the sample members worked in the agricultural sector at 62.9%.

Table 5: The Proportional Distribution of the Study Sample According to the Demographic Variables

Independent Variables	Variable Levels	Repetition (#)	Percent (%)
Gender	Male	30	85.7
	Female	5	14.3
	Total	35	100.0
Educational Level	High school	13	37.1
	Diploma	7	20.0
	BA.	13	37.1
	MA. & higher	2	5.7
Years of working experience	Total	35	100.0
	Less than 5 years	6	17.1
	5-10 years	12	34.3
	More than 10years	17	48.6
The business sector in which you work	Total	35	100.0
	Industrial sector	1	2.9
	Commercial sector	9	25.7
	Agricultural sector	22	62.9
	Service sector	3	8.6
	Total	35	100.0

Results Related to the Research Questions

In this section, we will answer the research questions by conducting appropriate analysis and tests to each question separately, as follows:

The first sub-question: What is the reality of the markets in Palestine?

In order to explain the scores of the items of the first core area of the study's scale, the means, and standard deviations were calculated for each item, which answers the first sub-question, as shown in Table 6.

Table 6 Means, Standard Deviations, Percentages, and Ratings of the Study Sample's Responses to the Core Area of the Reality of the Markets in Palestine

Order	Item	Mean	SD	Percent %	Level of Agreement	Attitude
1	Lack of purchasing power among citizens due to hard economic conditions.	4.17	.891	83.4	1	High
2	Availability of Israeli products in the central markets in large quantities and at low prices.	3.94	1.305	78.9	4	High
3	Availability of a sufficient number of highly skilled labor in the central market.	3.17	1.124	63.4	5	Medium
4	Availability of a mechanism for selling damaged products in the market.	2.43	1.065	48.6	9	Low
5	The fluctuation of the quantities available in the markets due to the lack of coordination between farmers in the planting dates.	3.97	.954	79.4	3	High
6	The local bodies that oversee the markets are effective and efficient.	2.17	.985	43.4	12	Low
7	The lack of price control in the central market.	4.03	.954	80.6	2	High
8	The lack of corruption, bribery, mediation and favoritism.	2.40	1.397	48.0	10	Low
9	Availability of unified and integrated laws and legislations for collecting fees.	2.60	1.090	52.0	8	Low
10	Availability of electronic systems that record the quantities entering the market.	2.83	1.071	56.6	7	Medium
11	Availability of an effective market management system.	2.26	1.245	45.1	11	Low
12	Lack of infrastructure in most central markets.	2.89	1.207	57.7	6	Medium
Total Score of the Third Core Area		3.0714	0.37440	61.4%	---	Medium

The overall agreement score for the first core area was 61.4%, which is a moderate degree of satisfaction with the reality of the markets in Palestine. The highest level of agreement was for item No.1, the lack of purchasing power among citizens due to hard economic conditions, at 83.4% with a mean of 4.17, which is the highest among all other means of the reality of markets in Palestine. Item No. 6, the local bodies that supervise the markets are effective and efficient, scored the lowest level of agreement at 43.4%, with a mean of 2.17, which is the lowest value for the first core area.

The second sub-question: What are the levels of difficulties and problems facing the current distribution system?

To identify the level of the difficulties, the means and the standard deviations were calculated for each item in the core area: Difficulties and problems facing the current distribution system, which answers the second sub-question, as shown in Table 7.

Table 7 Means, Standard Deviations, Percentages, and Ratings of the Study Sample's Responses to the Core Area of the Difficulties and Problems Facing the Current Distribution System.

Order	Item	Mean	SD	Percent %	Level of Agreement	Attitude
1	Inefficient road networks that connect between production areas and markets as well as export outlets.	4.29	.572	85.7	1	Very High
2	Lack of incentives for the workers in the field of distribution.	4.17	.618	83.4	2	High
3	Lack of land and maritime transportation and distribution companies specialized in marketing and exporting agricultural products.	3.83	.954	76.6	7	High
4	The ongoing Israeli closures and barriers, which impact the availability of products in the central markets	3.86	1.004	77.1	6	High
5	Poor distribution and absorption capacities, as well as the high cost of the transportation process.	3.97	.822	79.4	5	High
6	Randomness in the distribution system and the lack of clear references in the Palestinian Territories.	4.11	1.078	82.3	3	High
7	Isolation of many areas due to the construction of the apartheid wall.	3.69	1.207	73.7	8	High
8	The lack of agreements that protect the Palestinian trader from fraud, in case he/she exports agricultural products.	3.97	1.043	79.4	4	High
9	The transport and communication sector is well developed.	2.37	1.114	47.4	10	Low
10	There are no logistical restrictions on exports to other countries.	2.60	1.265	52.0	9	Low
11	Administrative costs for import (insurance, transportation, freight, fees, etc.) are reasonable.	2.11	.758	42.3	12	Low
12	There is no complexity in the process and requirements for importing from other countries.	2.17	.891	43.4	11	Low
Total Score of the Third Core Area		3.4286	0.36444	68.6%	---	Medium

The overall agreement score for the second core area was 68.6%, which is a moderate degree

of satisfaction with the difficulties and problems facing the current distribution system. The highest

level of agreement was for item No.1, weakness of the road network linking production areas with markets and export outlets, at 85.7%, with a mean of 4.29, which is the highest among all other means of this core area. Item No. 11, administrative costs for import (insurance, transportation, freight, fees, etc.) are reasonable, scored the lowest level of

agreement at 42.3%, with a mean of 2.11, which is the lowest value in the second core area.

The third sub-question: To what extent does the market information system contribute to achieving an efficient system?

Table 8 Means, Standard Deviations, Percentages, and Ratings of the Study Sample's Responses to the Core Area of Contribution of the Market Information System Towards Achieving an Efficient System

Order	Item	Mean	SD	Percent %	Level of Agreement	Attitude
1	The ability to have a direct access between farmers and their markets.	4.09	1.040	81.7	3	High
2	The ability to extract a wide range of information in a quick and automatic manner.	4.09	1.095	81.7	4	High
3	Availability of modern and effective marketing techniques that achieve sustainable development.	4.09	.951	81.7	5	High
4	Availability of an integrated mobile application for the agricultural sector.	3.77	1.239	75.4	11	High
5	Availability of an e-market for buying and selling agricultural products and agricultural production supplies.	3.63	1.374	72.6	15	High
6	The ability to update the farmer's data periodically.	3.71	1.100	74.3	12	High
7	The ability to publish all details of demand and supply.	3.91	.919	78.3	7	High
8	Communication between the seller and the buyer is established through SMS.	3.89	1.157	77.7	8	High
9	The information can be modified easily through the computer system.	3.71	1.152	74.3	13	High
10	The ability to provide contact information of subscribers upon request.	3.71	1.226	74.3	14	High
11	Agricultural crop prices are sent via text messages according to their importance.	3.83	1.150	76.6	9	High
12	The ability to provide crop price analysis for the last three years, including high and low prices.	4.09	1.040	81.7	6	High
13	Availability of an efficient system to enhance planning for the agricultural cycle.	3.80	.994	76.0	10	High
14	The ability to improve the quantity, quality and safety of agricultural products as well as follow up on the wholesale prices daily.	4.11	.867	82.3	2	High
15	The ability to promote efficient agricultural transactions and contact agricultural supplies' companies.	4.20	.964	84.0	1	High
Total Score of the Third Core Area		3.9086	.77427	78.2%	---	High

The overall agreement score for the third core area was 78.2%, which is a high degree of satisfaction with the contribution of the market information system towards achieving an efficient system. The highest level of agreement was for item No.15, the ability to promote efficient agricultural transactions and contact agricultural supplies' companies, at 84.0%, with a mean of 4.20, which is the highest among all other means of this core area. Item No. 5, availability of an e-

market for buying and selling agricultural products and agricultural production supplies, had the lowest level of agreement at 72.6%, with a mean of 3.63, which is the lowest value in the third core area.

The fourth sub-question: To what extent are the technological requirements available for the market information system?

Table 9 Means, Standard Deviations, Percentages, and Ratings of the study sample's Responses to the Core Area of the Extent of the Availability of Technological Requirements for the Market Information System

Order	Item	Mean	SD	Percent %	Level of Agreement	Attitude
1	Availability of a comprehensive and adequate database.	4.17	.785	83.4	3	High
2	Availability of advanced hardware and software to obtain information quickly.	3.94	.968	78.9	6	High
3	Ability to train workers on the use of special devices and software.	4.11	.932	82.3	4	High
4	Availability of a constant access to the internet at high speed and large capacity to learn about latest developments and products.	4.29	.987	85.7	1	High
5	Availability of a sufficient number of working programmers.	3.86	1.033	77.1	7	High
6	Availability of advanced competencies and skills	4.23	.731	84.6	2	High
7	Availability of an efficient and safe system.	4.09	.818	81.7	5	High
Total Score of the Third Core Area		4.0980	.69622	82.0	---	High

The overall agreement score for the fourth core area was 82.0%, which is a high degree of

agreement with the extent of the availability of the technological requirements for the market

information system. The highest level of agreement was for item No.4, availability of constant access to the internet at high speed and large capacity to learn about the latest developments and products, at 85.7%, with a mean of 4.29, which is the highest among all other means of this core area. Item No. 5, availability of a sufficient number of working programmers, had the lowest level of agreement at 77.1%, with a mean of 3.86, which is the lowest value in the fourth core area.

The fifth sub-question: Are there statistically significant differences in the respondents' opinions about the role of the market information system for farmers due to different variables: Gender, academic qualification, years of working experience in the market, and business sector?

To answer this question, we will conduct tests for each demographic variable separately to identify the presence of statistically significant differences in the opinions of the respondents on the role of market information system for farmers, as follows:

Gender variable:

In order to examine the presence of significant differences in the respondents' opinions about the role of the market information system for farmers due to the variable of gender, a T-test was performed for two independent samples, as shown in Table 10.

Table 10: The T-test for Two Independent Samples to Identify the Differences in the Respondents' Opinions about the Role of the MISF Due to the Variable of Gender

Gender	Descriptive Statistics			T-test		
	Number	Mean	Standard Deviation	T - value	Degree of Freedom	Sig.
Male	30	3.6036	0.35251	0.404	33	0.689
Female	5	3.5348	0.35675			

It appears from the results in Table 10 that the level of significance for both genders is 0.689, which is higher than $\alpha \leq 0.05$, after dividing it by two, because the test was conducted for both genders. Consequently, there were no statistically significant differences in the opinions of the study sample (respondents) on the role of MISF due to gender, meaning that the opinions of both are equal on average. There is no statistical value for the small differences in their averages.

Variables of academic qualification, years of working experience, and business sector:

In order to examine the significant differences in the respondents' opinions on the role of MISF due to the variables of academic qualification, years of working experience, and business sector, the one-way ANOVA test was conducted. The results of the test are shown in table 11.

Table 11: Results of the One-way ANOVA Test to Examine the Significance of the Differences in the Averages of the Sample's Responses on the Role of MISF Due to the Variables of Academic Qualification, Years of Working Experience, and Business Sector

Variable	Variance Source	Degree of Freedom	F-test	Sig.
Educational Level	Between Groups	3		
	Within Groups	31	1.022	.396
	Total	34		
Years of Working Experience	Between Groups	2		
	Within Groups	32	.301	.742
	Total	34		
Business Sector	Between Groups	3	1.755	.176

The results in Table 11 showed that the F test's level of significance for the variance analysis of the academic qualification variable was 0.396, which is higher than $\alpha \leq 0.05$. Based on this, we conclude that there were no statistically significant differences in the study sample (respondents) opinions on the role of MISF due to the academic qualification variable. This means that the respondents' opinions of all academic qualifications are equal on average, and there is no statistical value for the small differences in their averages.

The results in Table 11 also showed that the F test's level of significance for the variance analysis of the years of working experience variable was 0.742, which is higher than $\alpha \leq 0.05$. Based on this, we conclude that there were no statistically significant differences in the opinions of the study sample (respondents) on the role of MISF due to the years of working experience variable. This means that all opinions of the respondents who have different experiences are equal on average, and there is no statistical value for the small differences in their averages.

The results in Table 11 showed that the F test's level of significance for the variance analysis of the business sector variable was 0.176, which is higher than $\alpha \leq 0.05$. Based on this, we conclude that there were no statistically significant differences in the study sample (respondents)

opinions on the role of MISF due to the business sector variable. This means that all opinions of the respondents of the different business sectors are equal on average, and there is no statistical value for the small differences in their averages.

From the above results, there is a consensus that there is a role for MISF, as the demographic variables did not show any differences in the respondents' views on this matter. Consequently, we can now answer the study's main question: What is the role of MISF?

The previous analysis of the answers to the sub-questions shows that there is a role for MISF. The study scale results show a medium to a high degree of agreement on the existence of a role for MISF.

The Proposed System: MISF

The advance of information and communication technologies (ICTs) for development in Palestine and especially the availability of mobile data will mark the importance of providing information for the agricultural sector.

Farmers need to be empowered to allocate the scarce resources of the farms. Accordingly, the researchers will select different West Bank farmers as a case-study to apply a system analysis. The farm case study helps identify and analyze relevant material and information flows, production processes, and their interconnections and synergies.

Market Information Systems for Farmers (MISF) is a computerized information system used to gather, analyze, and disseminate information about agricultural yields, prices, and other information relevant to farmers, traders, manufacturers, and others involved in handling agricultural products.

In this study, we will try to address some of the problems facing the farmers' markets. We will develop a new approach that will enable farmers and buyers to take responsibility for uploading their agricultural products and price information via the internet and 3G technologies.

The system will facilitate trade by creating a capacity for sellers to contact individual buyers. This system will provide information on what agricultural products are in demand by analyzing consumer consumption and market trends.

The system will collect demographic details such as the types of crops grown, production size, prices, and cost and may provide access to the types of irrigation, soil and fertilizers as inputs from the farmers as well as other information on product consumption. The system will also advise farmers and find ways to help them lower costs and improve productivity using data mining techniques.

In general, the system will track farmers' businesses and provide ongoing support in areas such as labor, costs, yields management, product consumption, harvest management, market price discovery, and strong relation with buyers.

MISF was designed to target different users. Users create an account and select its type from a list managed by the system administrator, as in Figure 1.

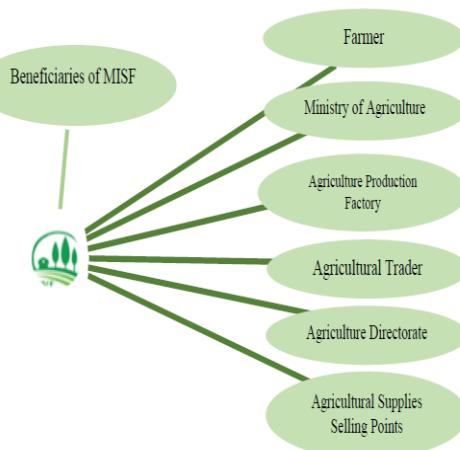


Figure 1. Users of MISF

The computerized system was developed and designed to be comprehensive to serve all sectors of agriculture in the governorates. The computerized agricultural system consists of two parts:

- The first part is the homepage of the system. It is accessed by the visitors through the website and the mobile application, as shown in Figure 2.
- The second part consists of a control panel secured with a username and password to set and manage the system's settings.



Figure 2. The homepage of the system

The system was developed for the different stakeholders, for the farmer, agricultural trader, agriculture production factory, Ministry of Agriculture, agriculture directorate, and agricultural supplies selling points. The system is accessible through smartphones and computers.

The following is a brief on how each user can utilize the system:

- System management: Through an account, the system can be managed by adding the system's constants, such as the names of crops and equipment. Moreover, the administrator can modify the status of the accounts and allow or block some accounts. The Ministry of Agriculture can be the administrator of the system.
- Farmers: The farmer can list his/her assets from agricultural lands, types of crops, dates of harvest, and operational expenses, to help with the pricing process.
- Agricultural facility: The agricultural trader can create orders on products through the system and be familiar with the current supply of agricultural products in the market and the location of certain products, as well as their marketing due date.
- Agricultural supplies selling points: These selling points can add, through the system, what they have available from agricultural equipment and supplies, such as fertilizers.
- Agriculture directorates: The directorates of agriculture in the governorates can communicate with farmers, merchants, and agricultural factories to provide assistance and guidance on agricultural work.

Stages of development

The system was developed based on the stages of computer systems' methods and design. The Object-Oriented Development Approach was adopted for developing the system. In this approach, the users of the system identified as "Actors" and the different functions for each user as "use cases". The system's input and output screens were designed and linked to the databases. The steps for developing the system can be summarized as follows:

- Databases of the agricultural system consisted of accounts tables, their types, Palestinian cities, communities, and more.
- The Palestinian cities and towns data were listed in a table to serve the agricultural system and the dimensions of the communities, which were also listed in electronic maps, accessed by the mobile application and, if necessary, by the computer.
- The types of accounts that use the dynamic control panel were included. The system administrator can add new types when necessary, as in Figure 3.

الصفحة / إدارة حسابات وتعديل بياناتك					
بيانات حسابك		تعديل بياناتك			
اسم المستخدم	كلمة المرور	النوع	العنوان	الرقم	البيانات
user1	password1	1	جبل المغارب	02-46-30 2019-08-23	admin
user2	password2	2	جبل المغارب	02-46-30 2019-08-23	user2
user3	password3	3	جبل المغارب	02-46-48 2019-08-23	user3
user4	password4	4	جبل المغارب	02-47-05 2019-08-23	user4
user5	password5	5	جبل المغارب	02-48-19 2019-08-23	user5
user6	password6	6	جبل المغارب	02-48-11 2019-08-23	user6

Figure 3. The page for managing accounts.

- Implementing security and protection options in the system to protect the system, secure access to the system and its data, identify the malicious use of the system, and the ability to delete or suspend his account.
- Privacy - building the system in such a way that preserves privacy for all system users by protecting their menus, privileges, and accessing their data. Prevent other system users or the system administrator from accessing their screens and data too.

The software application on smart devices allows the system user to manage all the different operations, such as following up orders and adding the number and quantity of crops from his account.

In this way, the merchant can search for and order agricultural products (Figure 4).



Figure 4. The page to list the available agricultural products and add a new gallery

DISCUSSION

Based on the selected data from the questionnaire and the statistical method analysis, first, we developed a general discussion of the results to answer the study's main question: What is the role of MISF? The analysis of the data in this study shows that there is a role for MISF. Later, we developed our MISF that suits the different stakeholders' needs, including an easy adaptation, user-friendliness, and accuracy in depicting the various production processes, management, and services.

The most important findings of the study are:

- The overall degree of agreement for the core area of the reality of markets in Palestine was medium, which indicates a moderate degree of satisfaction. This shows the sample's desire to develop these markets.
- The overall degree of agreement for the core area of difficulties and problems facing the current distribution system was medium, which indicates a moderate degree of satisfaction. This shows the sample's recognition of the presence of problems in these markets and the need to solve them.
- The overall degree of agreement for the core area of the market information system's contribution to achieving an efficient system was high, which indicates a high degree of agreement on its status.
- The overall degree of agreement for the core area of the extent of the availability of the technological requirements for market information system was high, which indicates a high degree of agreement on this core area, and that the technological environment is available and can be invested in developing effective information systems.
- There were no statistically significant differences in the study sample's opinions (respondents) on the role of MISF due to gender. This means that both respondents' gender opinions are equal on average, and there is no statistical value for the small differences in their averages.
- There were no statistically significant differences in the study sample's opinions (respondents) on the role of MISF due to the academic qualification variable. This means that the opinions of the respondents of all academic qualifications are equal on average, and there is no statistical value for the small differences in their averages.
- There were no statistically significant differences in the study sample's opinions (respondents) on the role of MISF due to the years of working experience variable. This means that all opinions of the respondents who have different experiences are equal on average, and there is no statistical value for the small differences in their averages.
- There were no statistically significant differences in the study sample's opinions (respondents) on the role of MISF due to the

business sector variable. This means that all the opinions of the respondents of different business sectors are equal on average, and there is no statistical value for the small differences in their averages.

- There is a role for MIF, as the study results showed a medium to a high degree of agreement on it.

The scientific discussion of the results is carried out in light of the objectives of this study and the results of the previous studies in the field of research, as well as after considering what was accomplished from the required tasks for this research.

Challenges

Today, information technology and communication reshaped agricultural production management, process, and services and is entering a new era where computerized systems can support farmer's decisions to help them in their daily activities. These systems can work on simple record-keeping software or/and complex systems that can manipulate large amounts of data and provide decision support capabilities using artificial intelligence and data mining. In this paper, the development of MISF utilizes different technologies, such as web technology, smart devices, 3G, and Internet technology.

The main focus of MISF is to perform farm activities based on all farm transactions. Different users or stakeholders in the agricultural sectors can use the system. The application was successfully implemented using web technology and smart devices and tested where all different scenarios were recorded.

However, when it comes to programming the application, many issues may be considered to depict all processes accurately. This statement holds, in particular, true for our MISF with the following concerns or challenges:

- When we programmed the system, we encountered several problems, including technical problems, when writing the source code.
- Writing the source code took a long time because it needed to be tested by all users.
- The process of collecting data and distributing the questionnaire to farmers and traders took

much time because they did not send them back on time.

- The process of documenting, analyzing, and discussing the questionnaires' responses took a long time.
- The lack of the already-agreed-upon equipment that was to be used during the project by relevant parties.
- The lack of a database for central markets, and this required time in order to introduce the agricultural crops and their quantities.
- The randomness of the commercial markets.
- Most workers in markets need to be instructed and trained to use such systems.

CONCLUSIONS AND RECOMMENDATIONS

The following section summarized the main finding, conclusions, and recommendations based on the analysis of the data and interviews with the different groups.

Findings

- Developing a computerized market information system for the benefit and use of the concerned parties.
- Developing a mobile application for the market information system.
- Providing a database on agricultural crops, their prices, quantities, and orders for the benefit and use of the concerned parties.
- Establishing an electronic equipped lab for interested researchers in the field of Internet of Things (IoT) for scientific research purposes.
- Establishing a control system for crops and quantities offered in the local market by the Ministry of National Economy and the Ministry of Agriculture.
- Saving cost, time, and effort through the use of a mobile application, as the farmer and trader can compare agricultural crops and the available quantities online.
- Digitizing and organizing all operations in the central markets to achieve transparency.

Recommendations

The study concluded a number of recommendations as follows:

1. Consolidating the relations between the Ministry of Agriculture and farmers, traders as well as the Ministry of National Economy,

- to place all its capabilities and facilities at the service of the farmers.
2. Organizing seminars and distributing awareness leaflets on the market information system's role in improving the performance of the farmers' markets (Hisbah) in Palestine.
 3. Focusing on qualitative scientific research that targets the needs and problems of farmers. This can be done by networking with research centers and institutions in the community and using the University's scientific research to solve these problems.
 4. Organizing scientific conferences, workshops, and study days on serving farmers and their problems to propose appropriate solutions.
 5. Controlling the number and specializations of workers inside the central markets.
 6. Reconsidering the existing commercial markets infrastructure to make it compatible with the application of such systems.
 7. Providing a database for available agricultural crops, the needed quantities, and the quantities of crops imported from inside the green line.
 8. Establishing a clear mechanism for working and coordinating between all relevant parties with regard to marketing agricultural products, so it would be carried out in an organized and targeted way, as it is currently random.
 9. Supporting the Palestinian farmer with modern agricultural means that keep pace with technological developments, especially in terms of insecticides and their controlled use under the Ministry of Agriculture's supervision.
 10. Establishing a mechanism for the disposal of damaged goods retrieved from the central markets.
 11. Implementing a mechanism for calculating commissions and monitoring the internal system used by markets for pricing products that enter the central market.

Conclusion

The study aimed to identify the role of MISF in order to establish and automate a system to improve the reality of markets and manage products and the agricultural food supply chain to benefit the marketing circles in partnership with the Ministry of Agriculture, the Central Statistics

Department, and the Ministry of Higher Education and Scientific Research.

The study results revealed that MISF would provide a computerized information system used to collect, analyze, and disseminate information on agricultural production, prices, and other information related to farmers, traders, manufacturers, and others involved in dealing with agricultural products. It will also help address some of the problems facing the farmers' markets. The researchers undertook a new approach that makes both farmers and buyers responsible for uploading their agricultural products and price information via the Internet and mobile data availability. The system will facilitate trade by providing options for sellers to communicate with buyers. This system will provide information on needed agricultural products by analyzing consumer consumption and market trends.

Based on the study data and analysis, as well as the researchers' perspectives, it was concluded that ICT could play an important role in promoting and developing central markets in Palestine through organizing and saving time, effort, and money in all sectors. In light of this research's results, the researchers recommend that universities cooperate with the Ministry of Agriculture to support farmers and traders and provide an integrated information system to enhance the capacities and create a central system that serves the agricultural sector and the State. The researchers also recommend the need for holding workshops to raise awareness and enrich the knowledge of concerned parties (system users) on agricultural technologies, in addition to supporting them financially to use these technologies.

The researchers also recommend focusing on research that directly addresses the difficulties and problems facing Palestinian farmers in order to present appropriate solutions in cooperation with universities and research centers. Moreover, it is recommended to evaluate other successful market information technology applications in other countries and introduce good practices that help promote agriculture. The researchers believe that the system should be implemented and further developed to become an endorsed comprehensive system for the benefit of all.

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