University of Thi-Qar Journal of agricultural research

Thi-Qar Journal of agricultural research

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 12-19

https://jam.utq.edu.iq/index.php/main *https://doi.org/10.54174/utjagr.v13i1.323*

Applying digitalization techniques in managing agricultural facilities and detecting agricultural pests - a review

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Abstract

Innovations are one of the most important technical factors that lead to the growth and development of agricultural production and help in achieving sustainable development goals by reducing environmental pollution. In this research, a review of previous studies it conducted that dealt with the study of employing digital technologies to influence the management of agricultural facilities, as well as detecting and diagnosing fungal and insect plant diseases. It has become clear that these techniques help in reducing the use of chemical pesticides and help in reducing production costs and thus increasing the level of revenues generated from the sale of crops and then maximizing economic profits. This means achieving economic and technical efficiency in agricultural production and management of agricultural facilities. It recommended that digital applications used in farm management and plant disease detection to reduce the use of chemical pesticides, as well as the need to train farmers to apply these techniques to achieve efficient productivity and preserve the environment.

Keywords: Digitalization techniques, Plant diseases. Production efficiency. Economic profit.

I. Introduction

Plants are the source of most of the food we eat. Therefore, maintaining plant health is crucial to ensuring sustainable agriculture and food systems and protecting the environment and ecosystems. The world loses (40%) of its plant crops annually due to agricultural pests and diseases, and this leads to millions of people losing their healthy food. (F. A. O. 2020: 3) Digital technologies have become part of the daily activities of society. They it used to transfer digital data in various forms. Technical development has reached its peak in the field of communications. These technologies have played a fundamental role in the field of transferring and storing data to reach various parts of the world. Among the institutions that have benefited from these technologies are research institutions. Scientific. (Abbas, 2004: 28) Digital agriculture is the integration of modern technologies and reliance on available digital data to conduct agricultural practices, starting with the application of GPS and field analysis of agricultural sites, all the way to the use of digitalization techniques in agricultural production management, predictive analytics, and monitoring plant and crop health. Digital agriculture can help confront expected risks, as the sustainable development goals aim to achieve sustainability between food, water, energy and climate and employ them to produce healthy food for the consumer through many factors, including supporting farmers and providing a degree of knowledge to the consumer about how food it produced. (Brini, 2023: 8) Many technical means have employed in agricultural production, the aim of which is the optimal exploitation of productive resources, as this is possible if technical expertise is available among those working in the field of agricultural production. (Maurel, et all, 2022: 12) One of the advantages of employing digital technologies is managing and improving agricultural operations by monitoring various environmental indicators using remote sensing technology and GPS technology via satellite. As well as

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detecting plant diseases by adopting digitalization techniques, thus reducing the use of chemical pesticides by accessing accurate data as quickly as possible and then taking appropriate action as quickly as possible. (Arab Vision for the Digital Economy, 2020: 19-98) Plant diseases cause great damage to agriculture, causing production to decline in quantity and quality. An example of this is the outbreak of early blight on potatoes in the years (1845 - 1847), which caused a major famine in Europe, leading to the death of many of the European population and the migration of other numbers. There are other diseases that lead to the death of parts of trees and thus the death of the tree that is years old. (Abu Bakr, 2003: 17)

II. Research problem:

The innovations achieved by the modern technical revolution are the most widely used means in the fields of economic and social life now. These technologies have shortened the path for many industrial projects to reach their goals by integrating digitization processes in production and marketing, In addition to storing data for establishments. As for agricultural production, which is a basic pillar for economic development, digitalization techniques are still of limited use, so the research problem lies in the reasons that prevent the widespread application of employing modern technologies in agricultural production, especially to detect plant diseases, reduce the use of chemical pesticides, and reduce environmental pollution. The results of previous studies and their findings it read in the field of employing digital techniques to detect plant diseases and maximize producers' profits.

Search goal:

In light of the specific problem, the research aims to draw conclusions from previous studies on the use of digitalization techniques in diagnosing plant diseases and the impact of this on reducing production costs and maximizing profits in agricultural production.

Research Methodology:

The research relied on two approaches through the results of studies that focused on employing digital transformation techniques in diagnosing plant diseases and reducing their losses:

Inductive approach: It consists of extracting the results reached by studies interested in employing digitalization techniques in diagnosing plant diseases and the impact of these techniques in reducing the spread of diseases on farms and thus maintaining the level of economic profits.

Deductive approach: This approach it based on benefiting from the results of previous studies on employing digital transformation techniques and their role in identifying plant diseases and drawing the most important conclusions that are useful in achieving the research objectives to contribute to encouraging the introduction of digitalization techniques in agricultural production.

Digitization technology in agricultural facility management:

Facility management is the process of making decisions to achieve goals that other people work to implement. The management of the agricultural facility it considered one of the basic elements of production, as it is responsible for planning and organizing production, directing and coordinating labor. (Zayed & Saleem, 2008: 7) Through farm management, it is possible to ensure high-efficiency production and economic revenues, and this requires the development of human capital, especially in rural areas, optimally employ digitalization technology. (Ashalatha, & Rao, 2023: 627 - 633) Advanced planning depends on digital data in facility management, taking into account the expansion of advanced

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facility management activity by employing digitization technology. (Larysa, et all. 2020) One of the techniques that can applied in managing an agricultural facility is agricultural mechanization management through digitalization technology by connecting agricultural equipment to technical software platforms, in addition to monitoring soil moisture and climate conditions. (Padhy, et all, 2022: 40288 – 40290)

Production costs:

Production costs mean that they are the expenses incurred by the producer for producing the commodity, such as Labor wages, fuel expenses, raw materials, and the cost of transportation and insurance. It divided into apparent costs, which are the price of production requirements, and implicit costs that do not entail spending, such as the cost of using the land and tractors owned by the farmer. (Al-Hasnawi, 2011: 133) Studying production costs is one of the important topics in all agricultural production projects, as it helps determine the selling prices of the final product in the market. (Debertin 2012: 62) Costs are considered a determining factor for the behavior of the producer, which aims to maximize production, as the conditions for determining costs are based on the level of prices of production inputs, based on which the producer's decision is based. (Jehle & Reny, 2011: 135)

Digitization technology and economic profits:

Technology it considered part of the productive factors, so it considered part of production costs. Technology affects economic profits because costs include the prices of all productive inputs. (Al-Hasnawi, 2011: 128) Production costs are a major factor influencing the level of revenue. These costs must be minimized and economic efficiency achieved in addition to combating agricultural pests, which it considered a factor influencing production to achieve technical efficiency in order to maximize revenue. It became clear that revenues increased in an experiment that it controlled with an integrated program compared to another experiment with a lower control level, which led to an increase in production. (Abdullah, 2021: 1061 – 1082) Agricultural pests cause economic losses not only at the expense of the producer, but also among workers in the stages of the agricultural value chain. The decline in agricultural productivity affects the market in general, and thus its impact appears on prices as well. (Alam & Rolfe, 2006: 133 – 146) Technology is one of the most important factors for the growth of farm revenue for farmers, and this means achieving profitable efficiency despite the high prices of some production requirements. (Al-Tamimi, 2018, 42 – 51) Plowing operations, by adopting modern mechanization and regular irrigation techniques, also increase productivity, thus achieving technical efficiency in production. (Al-Timimi, 2020: 4827 – 4834) Producer profits decrease because of reluctance to use modern technologies in production processes, and this means an increase in the total cost borne by the farmer. Digital illiteracy is one of the most important reasons for farmers' reluctance to use modern technology in agricultural production. (Shehata, et all, 2022: 298 – 314) One of the factors that achieve the goals of integrating digitalization technology into agricultural production is the presence of knowledge in using and applying this technology. In addition to the presence of the appropriate infrastructure, which plays an essential role in achieving the goal of digitalization technology in agricultural production. (Tang, & Chen, 2022) Employing digitalization technology in agriculture is a good tool to achieve a boom in agricultural production, which in turn leads to maximizing farm revenues, especially in rural areas. (Kashapov, et all, 2019) Technical integration in agricultural production and management on a regular basis leads to the growth of profits and helps to take a larger market share in the world of agricultural production. (Kostomakhin, et all, 2023) Agricultural production workers rely on detecting some plant diseases through visible signs such as leaf discoloration, plant stunting, and leaf deformation, but without diagnosing the type of pathogen, so we need digital technology to know the

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type of pathogen before it spreads. (F. A. O. 2022: 70) Adopting the use of digitalization techniques in detecting plant diseases is possible through multiple techniques that have found in many Arab and foreign studies, as shown in the following table (1):

Table (1) Development of results of previous studies on employing digital technology in detecting plant diseases.

Researchers	year	Description	conclusion
Barbedo, J. G. A.	2013	The researcher used digital image processing techniques to detect and classify plant diseases through digital images and the visible spectrum according to the technical solution in the algorithm.	Detect diseases that appear on the plant in the leaves and stem, determine the severity of the infection, then classify the disease and determine the affected tissue.
Martinelli, et all.	2015	Reviewing the results of previous studies that investigated innovations for detecting plant diseases and determining the mechanism of action of the innovative technology.	Classification of innovative sensor technology for detecting plant diseases based on the detection mechanism: sensors that rely on analyzing host plant responses, then detecting the spread of the disease in the field, and biosensors that rely on instantly detecting mites and biophotonics based on spectroscopic analysis methods.
Al-Qudsi, Yanal Ahmed	2018	The researcher describes Microarray technology, its relationship with (DNA) chips. Moreover, how it can used to detect plant diseases.	The researcher concluded the possibility of the activity of plant genes. Microarray technology adopted using robots, which help in early detection of plant diseases and then treat them.
Khan, U. & Oberoi A.	2019	The researchers adopted a review of previous studies that used different techniques to detect plant diseases by dividing the work into two stages: detecting the infection and then identifying it accurately.	In this study, the researchers found that there are two stages in using technology to detect plant diseases. In the first stage, the digital image it segmented, and in the second stage, diseases it identified and classified according to the nature of the infection.
Sandhu, G. K. & . Kaur, R.	2019	The researcher relied on the findings of previous studies to obtain a conclusion that would shorten the time to detect plant diseases and gradually abandon the traditional methods used in detecting agricultural pests.	Plant diseases can detected by monitoring and classifying the disease, then applying the (K-Mean) technique to segment the image, and applying the (SVM) classification technique to detect the name of the disease, and then the disease is classified accurately.
Guiam, A. C. et all.	2021	Researchers have adopted (Spidtch) technology on mobile tablets to detect agricultural pests using mobile phone cameras.	The researchers concluded that it is possible to detect (71) diseases on plants at one time and then classify them by adopting the (Spidtch) application technology, through which the classification of insects and their life stages can be revealed based on the database available on the

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			aforementioned application and the experience of the users.
Preti, M. et all.	2021	An experiment conducted to monitor insects using digital cameras installed on traps designated for these insects. The cameras store high-resolution images of the insects and their behavior in dealing with the host plant, and these cameras operate on solar energy.	The researchers concluded that it is possible to calculate the number of insects that cause injuries within the range of the cameras and determine the type of insect through high-resolution photography. As this technology reduces repeated field visits as the farm can monitored through a mobile device via the Internet, in addition to the low cost of this technology because it depends on Solar energy does not require much labor.
Filho, F.H.I. et all.	2022	Conducting an isolated experiment under controlled conditions on plants infested with a type of mite to determine the ability of high-precision sensing techniques to detect the infestation.	The researchers concluded that using high-spectral resolution sensor technology could detect insect infestation with an accuracy rate of up to 70%. The researchers also concluded that it is possible to monitor plant behavior and the changes that occur because of the infestation for more than ten days by adopting this technology.
G. Thiele et all.	2022	In this study, the researcher relied extensively on the use of available digital technologies to identify plant diseases that affect roots and tubers. The technical tools include systems that operate on identification keys on mobile devices.	The researchers concluded that it is possible to use extension advisory services through communication technologies available, especially to small farmers in developing countries, by adopting mobile devices, and through the (Plant Village) and (Pest Dis Place) applications to detect plant diseases.
Das, et all,	2022	The researchers relied on a comparison between traditional methods and innovative digital techniques in detecting plant diseases based on high-resolution multi-spectral imaging.	The researchers concluded that the use of digitization technology by adopting the self-repetition (TL) algorithm and autoradiography (DL) technology, which works on high-resolution multi-spectral imaging, helps detect plant infection, reduces the use of chemical pesticides to preserve the environment and improve agricultural production.
Omer, et all.	2023	The researcher relied on the results of previous studies to detect plant diseases by relying on convolutional network techniques to classify images, and identified the gaps in this technique to address in the future to obtain the highest possible accuracy.	The researchers concluded that adopting the (CNN) algorithm is an accurate technique in diagnosing the infection and diagnosing the plant infection very quickly and with high accuracy by distinguishing and classifying the image, in addition to identifying the factors that affect the identification of the plant infection.

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Table (1) shows that previous studies on employing digitization techniques rely on inexpensive and environmentally friendly technical applications. In addition, it is possible to detect the type of pathogen in the plant accurately and quickly.

Conclusions: Through extensive reading of the results of previous studies, the following conclusions can reached:

1 - The possibility of employing digitization techniques in the management of the agricultural facility, such as monitoring weather conditions, soil moisture, and plant health through sensors and via the Internet. We conclude from this that the use of digitization techniques helps in achieving efficiency in farm management by reducing the effort, time, and costs in monitoring the agricultural facility and the performance of farm operations. In addition, monitoring agricultural machinery.

2 - The revenues of the agricultural facility can maximized by minimizing production costs, of which chemical control pesticides constitute a large part, as digitalization techniques are used to monitor and diagnose plant diseases early to treat them before they spread. We conclude from this that it is possible to reduce the use of chemical pesticides and achieve environmental efficiency, in addition to minimizing Production costs and thus maximizing profits.

3 - Different levels of digitalization techniques can used to diagnose plant diseases, whether insect or fungal, and thus accurately identify these infections and the possibility of treating them, which helps improve productivity and preserve fruits and plants, in addition to improving the farmer's knowledge.

Recommendations: Based on the conclusions reached, the following can recommended:

1 - The necessity of employing digitalization techniques in the management of agricultural facilities, such as devices for monitoring weather conditions and plant health, as well as monitoring agricultural mechanization machines, to reduce effort and time and lower production costs.

2 - The necessity of training farmers on how to detect plant diseases by adopting digitalization techniques, especially as they help reduce the use of pesticides to ensure a healthy and efficient environment.

3 - Benefiting from the results of recent studies that dealt with the application of digitalization techniques in farm management and detection of plant diseases in order to achieve technical efficiency in agricultural production and farm management, as well as achieving environmental efficiency.

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