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Research on image quality in decision management system and information system framework ☆

Jui-Chan Huang [a], Hao-Chen Huang [b], Su-Hui Chu [c],*

[a] Yango University, Fuzhou 350015, China

[b] Department of Public Finance and Taxation, National Kaohsiung University of Science and Technology, Kaohsiung City 80778, Taiwan

[c] Department of International Business, National Kaohsiung University of Science and Technology, Kaohsiung City 80778, Taiwan

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ABSTRACT

With the continuous development of society and the rapid advancement of science and technology, all walks of life are increasingly required to effectively manage their projects or affairs. Decision-making is the basis of project management, and the formation of decisions determines the formulation of corresponding programs, organizations and businesses. Decision-making is generated by decision makers based on the multi-faceted information they have, so decision management systems and information systems are inseparable in the management of projects and transactions. At present, research on decision management systems emphasizes management and decisions, and few researchers combine decision management and related information. In view of the current research deficiencies, and taking into account the needs of various industries for image applications, this paper introduces image quality evaluation methods, and systematically studies the decision management system and information system framework. The experiment part takes the intelligent image recognition and prevention system of citrus pests and diseases as an example, and the role of image quality in decision management system and information system from the perspective of practice. The results show that through the image quality evaluation system, in the identification and prevention of citrus pests and diseases, it can combine various aspects of information to make effective prevention and control decisions. The results show that the introduction of image quality evaluation can improve the comprehensiveness of information system. On this basis, decision-making system can help decision makers make correct decisions quickly and effectively.

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1. Introduction

Decision-making refers to the decision-making system of individual or collective, in order to achieve or achieve a certain goal, with certain scientific means and methods, choose or integrate a number of alternatives into a satisfactory and reasonable plan, and put it into the whole process of implementation. It refers to the entire system of various levels or departments of decision-making in this process [1]. Whether it is social economic development, environmental resource protection, disaster recovery, anti-terrorism, etc., crisis management for various emergencies requires decision makers to make correct decisions more quickly. With the development of science and technology, in the modern information environment, decision management becomes more complicated and difficult. A decision often requires the support of multiple information and knowledge. The current methods and institutional mechanisms are difficult to mobilize in the short term. All aspects of information and knowledge to achieve information sharing. Improving the understanding of decision-making information and accurately and timely processing and utilizing information are of great significance for improving the quality of decision-making [2].

In the 1940s, Paul C. Nutt, a professor of American management, found that decision-making took up almost half of the time for decision makers, and entrepreneurs and government officials often faced various decision-making problems. Further research shows that half of the decisions in various decisions fail. Since then, decision management has been studied as a discipline by management researchers, and management science and operations research have been used to model the decision-making [3]. With the development of society, the problems that need to be solved are more and more complicated, and the models involved are more and more. To solve a big problem, more than ten, dozens, and even

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* Corresponding author.
E-mail addresses: haochen@nkust.edu.tw (H.-C. Huang), chu889856@gmail.com (S.-H. Chu).

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hundreds of models are needed. For the problem that requires multiple model-assisted decision-making, before the emergence of the decision support system, people must rely on the connection and combination between models. When the number of models is relatively large, especially when it is necessary to repeatedly call the relevant models and exchange data between models, the decision becomes very inconvenient [4]. By the 1970s, decision support systems were used in the field of decision management due to the effective improvement of computer computing power. The decision support system is a computer technology solution to support complex decision making and problem solving [5]. The emergence of decision support system solves the problem of automatically organizing and invoking multiple models by computer and accessing and processing large amounts of data in the database, achieving a higher level of decision-making ability. In 1975, Brandaid developed a decision support system for a mixed market model of product marketing, pricing, and advertising decisions. In this system, Brandaid specifies a guideline for designing models based on which the user prefers the model or links the model to other information resources. Such criteria include robustness, ease of control, simplicity, and completeness of detail. The system provides a structure that links merchandise sales and profits with the actions of managers, allowing managers and managers to quickly and easily analyze market conditions and make sound decisions [6]. In 1980, Sprague proposed a three-part structure of decision support systems, namely, dialog components, data components [database (DB) and database management system (DBMS)], model components [model library (MB) and model library management system (MBMS)]. This structure clarifies the composition of the decision support system, and indirectly reflects the key technologies of the decision support system, namely the model library management, the component interface and the comprehensive integration of the system, which has greatly promoted the development of the decision support system [7]. In 1981, Bonczak et al. proposed the three-system structure of decision support system, namely language system (LS), problem processing system (PPS) and knowledge system (KS). The structure is characterized by "problem handling systems" and "knowledge systems" and has many similarities with current artificial intelligence and expert systems (ES) [8]. From the early 1990s to the end of the 1990s, research on decision support systems mainly included network technologies, next-generation database technologies, multimedia technologies, simulation (including distributed interactive simulation) technologies, and virtual reality technologies. At this stage, decision support systems have also adopted new technologies such as multimedia technology and object-oriented technology, from systems that mainly support individual decision-making to systems that support group decision-making activities and new systems that provide flexible support capabilities [9]. After entering the 21st century, most of the topics of decision support system research are related to network, big data and cloud computing. The application of online network services and various social media and social networks is a research hotspot in recent years [10]. In addition, the decision support system is integrated with the recommendation system, applied to market users and services, analyzes user preferences, conducts satisfaction surveys, and is closely integrated with online shopping, online shopping malls, and related big data analytics. In the decision support system modeling method, more emphasis is placed on big data modeling of complex systems, such as big data-based correlation analysis, prediction, data mining and machine learning, which can give decision results more quickly, intuitively and rationally [11].

The research on China's decision support system began in the mid-1980s, and the initial application area was regional development planning [12]. Dalian University of Technology, Shanxi Institute of Automation and International Institute of Applied Systems Analysis have completed the decision-making support system for the overall development planning of Shanxi Province. This is a large-scale decision support system that has a large impact in early Chinese DDS research [13]. Subsequently, Dalian University of Technology, National University of Defense Technology and other units have developed a number of regional development planning decision support systems [14]. The "Decision and Decision Support System" publication, established by the Institute of Information and Control of Tianjin University, has greatly promoted the development of China's decision support system. Many domestic units have also made remarkable achievements in the development of intelligent decision support systems. For example, the "Intelligent Decision System Development Platform IDSDP" developed and completed by the Institute of Computing Technology of the Chinese Academy of Sciences is a typical representative [15].

In the case where image information technology is widely used, the evaluation of image quality becomes a broad and fundamental problem. Since image information has unparalleled advantages over other information, reasonable processing of image information has become an indispensable tool in various fields [16]. In the process of image acquisition, processing, transmission and recording, due to imperfect imaging system, processing method, transmission medium and recording equipment, combined with object motion, noise pollution, etc., some image distortion and degradation are inevitable. This brings great difficulties to people's understanding of the objective world and research and solving problems. In this case, image quality evaluation has been widely used [17]. In image recognition, the image quality is evaluated on the acquired image, and the image information is filtered according to the evaluation result, which significantly improves the accuracy and reliability of the recognition result; in the use of systems such as remote conference and video on demand, The application of online real-time image quality evaluation reduces the influence of unfavorable factors such as transmission errors and network delays, and provides convenience for service providers to dynamically adjust the source location strategy to meet the requirements of service quality [18]; In terms of applications, the effects of battlefield surveillance and strike assessment also depend on the quality of the images or video captured by aerial equipment such as drones. Therefore, the reasonable evaluation of image quality has very important application value [19]. It can be seen from these application examples that image quality evaluation can be applied to the research of decision management system and information system framework.

Through the review of historical literature and the related research, we can see the importance of information systems to the decision management system. Whether decision information is effective and comprehensive has a great impact on decision-making. At present, the research on decision management system, although combining emerging technologies such as big data, multimedia and cloud computing, is more intelligent, but it ignores the comprehensiveness of information systems to varying degrees. Through the analysis of industry information requirements, this paper finds that the demand for image applications in various industries is increasing. Therefore, the research on the role of image quality system in decision management system and information system framework is carried out, and the research in this area is improved.

2. Method

2.1. Decision management system

The decision management system refers to the whole system in which all departments at all levels of decision-making are connected and mutually restricted in decision-making activities throughout the decision-making process. The decision management system consists of five parts: decision system, staff system, information system, implementation system and supervision system. The decision management system is a unified, systematic whole [20].

(1) Decision system

In the decision management system, the decision system consists of leaders who are directly responsible for the decision-making. The decision-making methods are generally divided into two methods: single leader and collective decision. In the actual decision-making management process, for the conventional decision-making problem, the single-leader decision-making method is often adopted, and the decision-making speed is fast and the responsibility is clear. However, for complex, large-scale and creative decision-making problems, collective decision-making is often adopted, because a single decision-making method is prone to one-sidedness and causes mistakes, while collective decision-making can integrate group wisdom and reduce mistakes. The main task of the decision-making system is to make decisions on the decision-making problems that are responsible. In each system of the decision-making system, only the decision-making system has the power to make decisions, while other systems cannot be responsible for the decisions. Through careful analysis and evaluation of each decision-making option, the decision-making system will take the overall situation from a strategic perspective. Finally, the decision-making system can either choose a solution from the alternatives or integrate a solution that is satisfactory to all parties to ensure the scientificity and accuracy of the decision-making and implement the decision-making. The decision-making system also undertakes the task of tracking and checking in the implementation of decision-making [21].

(2) Staff system

Since decision-making issues often involve multi-disciplinary knowledge, the staff system is often composed of multi-disciplinary experts and individuals and is a comprehensive decision-making body. In the practice of decision management, application development research is often carried out to study the application of new theoretical methods and new methods in decision-making practice. The main task of the staff system is to provide alternatives for decision-making problems, to evaluate and analyze decision-making plans. For new problems and new situations that arise during the implementation of decision-making programs, the staff system needs to objectively and effectively feed relevant information back to the decision-making system. It needs to be clear that the staff system can only provide decision-making opinions and suggestions for the decision-making system, and cannot replace the decision-making system to make decisions and implement decisions. Therefore, the staff system is not responsible for decision-making and is only responsible for the scientific nature of the decision-making program.

(3) Information system

Decision making information is critical in the decision making process. The completeness, accuracy and timeliness of decision information will directly affect the quality and speed of decision making. The information system in the decision system is the system directly related to the decision information. The information systems in the decision management system can be divided into decision information systems and decision support systems. The decision information system uses modern and advanced information technology such as computers and networks to provide decision-making systems with all kinds of information needed for decision-making. The decision support system is based on the decision information system, which determines data, models, knowledge, rules, etc., and constitutes a decision-making plan to support decision-making.

(4) Implementation system

The purpose of the decision is to implement. The implementation system refers to the system that implements the decision-making system and implements it. The implementation system is a system that guarantees decision execution from the bottom of the organization to the top. The main task of the implementation system is to implement the decision-making made by the decision-making system. The implementation system collects and reports the information of the implementation of the decision-making and its implementation process to the decision-making system and other related systems, and then is tracked by the decision-making system.

(5) Supervision system

The supervision system is to inspect and supervise the process of implementing the decision-making system of the system implementation decision system. The main task of the oversight system is to examine and monitor all aspects of the decision-making process. By checking and supervising the implementation of decision-making, we help decision-making systems to improve themselves to ensure the smooth implementation of decision-making and the achievement of decision-making goals.

2.2. Information system

An information system is a man-made composite system consisting of people, hardware, software, and data resources. The purpose is to collect, process, store, deliver, and provide information in a timely and correct manner to achieve management, regulation, and control of activities in the organization [22]. From the perspective of information processing functions and auxiliary management, information systems can be divided into the following categories:

(1) Transaction processing system

When the computer first entered the management of the city, it was first used as a computing tool. People use it to calculate the wages, accounting, statistics, etc., and partially replace the manual labor of people. The user of the computer takes a single user or batch process for a relatively long period of time [23]. With the development of electronic computer software and hardware systems, especially peripheral devices and communication technologies, the ability of computer information processing has improved, and the use of computers has gradually transitioned to the multi-user terminal mode of time-sharing systems. In the management information processing, in addition to the calculation work, the business of documents and file processing, and various report generations are gradually computerized [24]. This computer-aided management work is called electronic data processing. At this stage, since the relevant management business is carried out according to the project on the computer, different projects are carried out separately, and there is no connection between the different projects on the computer, so it is also called the single information processing stage [25]. The use of electronic data processing has improved the efficiency of managers in handling daily affairs, and has also improved the accuracy and timeliness of management.

(2) Management analysis system

The main goal of the transaction processing system is to improve the efficiency of managers in handling daily tasks and save manpower. However, this way of processing each management information item separately is far from meeting the needs of enterprise management decision-making [26]. Management information system is a unified system of computer hardware, software, communication equipment and related personnel to realize the overall goal of the enterprise, systematically and comprehensively analyze and process management information, and assist management decision-making at all levels, it is a typical management analysis system. Both management information systems and transaction processing systems use computer as the main means to process information [27]. However, management information systems emphasize the systematic and comprehensive information processing analysis, which not only requires high efficiency in transaction processing, but also emphasizes management decisions at all levels. Effective support [28]. This kind of support is mainly reflected in the analysis, classification and aggregation of a large amount of management data generated in the system to form useful information for decision makers. Therefore, the Management Information System emphasizes the timely and accurate provision of analytical and analytical information for those who make and implement decisions at all levels.

(3) Decision support system

Since the concept of decision support systems was born, relevant researchers have defined them from different angles. This paper refers to the definition of S.S.Mittra: The decision support system finds the necessary data from the database and uses the mathematical model function to generate the required information for the user [29]. The framework of the decision support system can be divided into "multi-library structure" and "3S structure" from the perspective of information, and can be divided into three levels from the technical point of view: dedicated decision support system, decision support system generator and decision support system development tools.

The "multi-library structure" is the division of the decision support system framework structure from the perspective of information distribution, and the "3S structure" is the division of the decision support system framework structure from the perspective of information application. "Multi-library structure" means that the decision support system is composed of a problem library, a database, a model library, a method library, a knowledge base, a media library, a text library, and related management systems, a human-machine system, and a problem processing system [30], and "3S" Structure means that the decision support system consists of a language system, a problem processing system, and a knowledge system.

The dedicated decision support system is the computer application system that actually completes the decision support; the decision support system generator is integrated, based on the computer software and hardware decision support system development environment, for the rapid development of the dedicated decision support system: the development of the decision support system Tools are unit technologies used in decision support system development. Reasonable configuration and integration of decision support system development tools can build decision support system generators or dedicated systems that meet the needs of an application [31], and decision support system generators can be combined with specific decision processes and decision environments for rapid and convenient development. A dedicated decision support system that meets the needs of decision makers.

2.3. Image quality evaluation

Image is an important source of information for human perception and machine pattern recognition, and its quality plays a decisive role in the adequacy and accuracy of the acquired information. The image will have a certain degree of distortion during acquisition, compression, display, and the like [32]. Establishing an effective image quality evaluation system is critical to measuring the quality of images and assessing whether images meet certain specific requirements. At present, the image quality evaluation can be divided into a subjective evaluation method and an objective evaluation method. The former relies on the subjective perception of the experimenter to evaluate the quality of the object; the latter measures the human visual system perception mechanism based on the quantitative indicators given by the model. Image Quality [33]. The subjective evaluation method of the image can truly reflect the visual quality of the image, and the evaluation result is reliable and without technical obstacles. However, there are many deficiencies in the subjective evaluation method. For example, it is necessary to repeat the experiment on the image several times, and it is impossible to describe it by using the mathematical model. From the perspective of engineering application, it takes time and cost, and it is difficult to realize real-time quality evaluation. In time applications, subjective evaluation results are also affected by factors such as the observer's knowledge background, observational motivation, and observational environment. The objective evaluation of image quality is to establish a mathematical model based on the subjective visual system of the human eye [34], and calculate the quality of the image through a specific formula. Compared with subjective evaluation, objective evaluation has the characteristics of batch processing and reproducible results, and there is no deviation due to human factors. The objective evaluation algorithm can be divided into the following three categories according to its dependence on the reference image:

$$MSE = \frac{\sum_{m=1}^{M}\sum_{n=1}^{N}[R(m,n) - I(m,n)]^2}{M \times N}$$

$$PSNR = 10\ln\frac{L^2}{MSE}$$

(1) Full reference: a one-to-one comparison with the pixels on the reference image is required;
(2) Semi-reference: only need to compare with some statistical features on the reference image;
(3) No reference: No specific reference image is required.

The full reference algorithm is the longest and most mature part of the research. Therefore, this paper uses the full reference algorithm in objective evaluation to construct an image quality evaluation system.

The quality of the image signal to be evaluated can be subjected to quality analysis by an error signal obtained after comparison with the original image signal. The degradation of image quality is related to the strength of the error signal [35]. Based on this, the simplest quality evaluation algorithm is evaluated using mean square error (MSE) and peak signal-to-noise ratio (PSNR). The expression is as follows:

Where R(m,n) represents the gray value of the reference image at spatial position (m,n), and I(m,n) represents the gray value of the (m,n) of the distorted image at the spatial position; Peak signal, for 8-bit grayscale image, L = 255. Mean variance (MSE) and peak signal-to-noise ratio (PSNR) are simple in calculation form, and the physical meaning is also very clear, but it is not considered in essence. The characteristics of human visual system are introduced into the image quality evaluation [36]. It is only from the mathematical point of view that the difference is not necessarily related to the perceived quality of the image, and the evaluation result is not ideal.

Based on the HVS related image quality evaluation method, according to the different emphasis of the HVS model description, the image quality evaluation model can be summarized as two types based on the error sensitivity evaluation algorithm and the structural similarity evaluation algorithm.

(1) Image quality evaluation based on error sensitivity

The main characteristics of the HVS model include visual nonlinearity, multi-channel, contrast sensitivity bandpass, masking effect, interaction of different excitations between multiple channels, and visual psychological characteristics. These algorithms mainly mathematically model the underlying features of HVS to simulate HVS characteristics for objective image quality evaluation. HVS is a highly complex and non-linear system, and its current understanding is still limited. Each of the above methods is based on certain assumptions and has achieved certain effects, but there are also some problems.

(2) Image quality evaluation based on structural similarity

Natural images have a specific structure, and there is a strong affiliation between pixels. These affiliations reflect the structural information in the visual scene. An image quality evaluation method based on structural distortion is called a structural similarity method [37]. The method considers that illumination is independent of the structure of the object, and the illumination change mainly comes from brightness and contrast; therefore, it separates the brightness and contrast from the structural information of the image, and combines the structural information to evaluate the image quality.

The error sensitivity is based evaluation method is a bottom-up method, which first simulates the functions of each part of HVS, and then combines them to realize the whole HVS. The structural similarity evaluation method directly simulates the HVS extracted object structure from the whole. Human visual function. Therefore, this paper selects the image quality evaluation method based on structural similarity.

3. Experiment

3.1. Data source

Compared with other industries, agriculture has a greater demand for image applications, especially in terms of pest control, plant characteristics detection, and soil monitoring. The advantages of image processing are obvious. Therefore, this paper selects the citrus forest in a certain area of Sichuan, deploys a monitoring system, and monitors it in real time during the period of frequent pests and diseases. When the citrus encounters pests and diseases, the citrus pest image is uploaded to the server through the terminal device, and after the image quality evaluation by the image recognition server, the type of pests and diseases to which the uploaded image belongs is analyzed and determined, and a countermeasure is prepared.

3.2. Experimental evaluation criteria

In order to contrast with the research method proposed in this paper, a control experiment was set up, that is, under the same conditions, a set of image acquisition equipments that did not use the image quality evaluation system was set up, and the two sets of experimental results were compared. This paper mainly evaluates the experimental results from the following three aspects:

(1) Image quality evaluation effect;
(2) Whether the collected image information can be used as pest control decision information;
(3) Effect after implementation of pest control decision.

4. Results and discussion

4.1. Image quality evaluation effect

In the quality-evaluated image, select a set of images containing different growth stages of citrus, as shown in Fig. 1. The distortion after magnifying the image 10 times is used as a criterion for evaluating the image quality evaluation effect, and at this magnification, almost all citrus insect pests can be found. After the image with quality evaluation was magnified by 10 times, except for Fig. 1(b), the other images showed no significant distortion. This shows that the image quality evaluation system used in this paper has a good effect.

4.2. Collected image information

According to the image information collected by the monitoring system, it is processed by the image quality evaluation system and transmitted to the database of the decision support system in the decision management system. After analyzing these image information, decision making is made.

Therefore, whether this information can be used as decision information is crucial. In the decision support system, the knowledge base of pests and diseases in the whole growth cycle of citrus is established, and the pest species can be correctly distinguished according to the image information of pests and diseases, so as to be the decision information for the prevention and control plan. As shown in Fig. 2 and Fig. 3, respectively, the image of pests and

Fig. 1. Image quality evaluation effect.

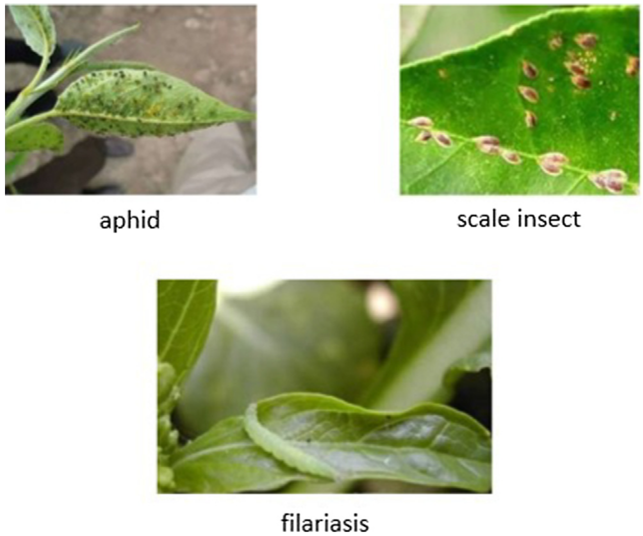

Fig. 2. Image of pests and diseases evaluated by image quality.

diseases that have been evaluated by image quality and without image quality evaluation, it can be seen that the image can be clearly identified by the image quality evaluation image without image quality evaluation. In the case of pest and disease images, there are cases where the system cannot recognize and identify errors. For example, in Fig. 3, the image clarity without image quality evaluation is low, which causes the system to recognize the mites as rust niches.

4.3. Effect of pest control decision-making after implementation

After obtaining effective decision information, it is provided to decision makers to make decisions on prevention and control plans. Three days after the implementation of the control plan, the pests were tested. The survey found that the decision-making system of image quality evaluation can provide effective decision-making information. On this basis, effective decision-making can be made, and the pests and diseases of citrus are effectively controlled. The decision-making system of image quality evaluation is not introduced. The information is not comprehensive enough and there is an error message, which leads to the timely prevention and control of rust wall mites.

5. Conclusion

With the development of the times, the factors that need to be considered in decision-making are becoming larger and more complex. Policymakers often want to analyze multiple factors to analyze problems. Which factors are most critical to decision-making, and what characteristics of these factors are required to be collected by the information system in the decision management system. Faced with the increasing demand for image applications in many industries, this paper studies the role of image quality evaluation in the decision management system and information system framework, and proves that image quality can improve the comprehensiveness of decision information systems and can assist decision makers. Make decisions quickly and efficiently. In the decision management system, each decision support system is a solution and a concrete embodiment of advanced decision-making ideas. It is necessary to combine the status of the decision-making entity itself, identify the main problems to be solved, provide decision-making entities with effective methods for analyzing and solving problems, and then analyze, design, develop and implement the decision support system to truly meet the needs of decision-making.

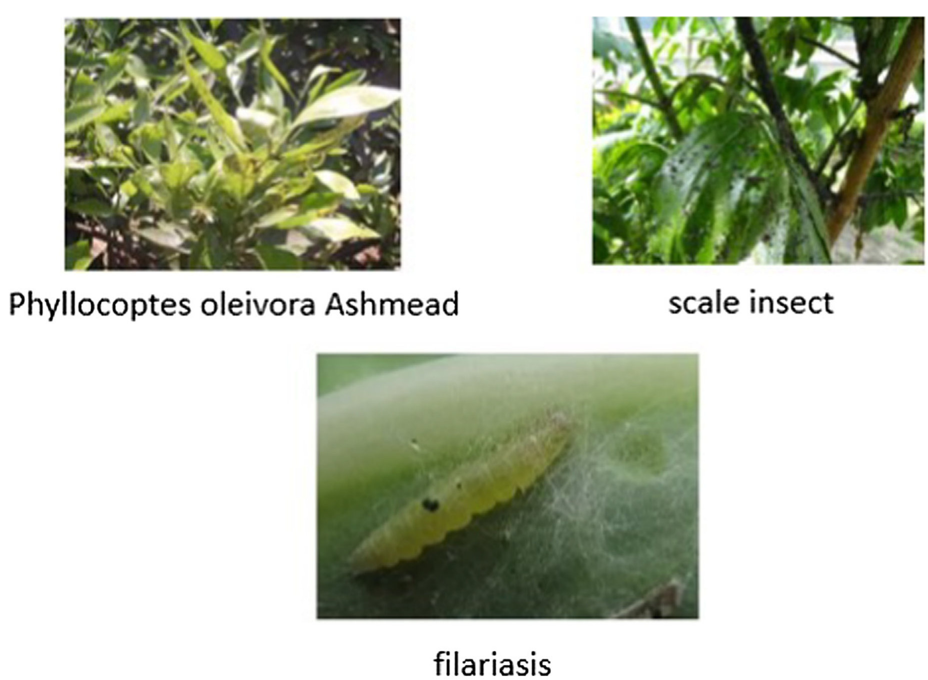

Fig. 3. Pest image without image quality evaluation.

Declaration of Competing Interest

There is no conflict of interest.

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