International Journal on Advanced Science Engineering Information Technology

Vol.14 (2024) No. 2
ISSN: 2088-5334

Sustainable Organic Farming Maturity Model

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***Abstract*—Organic farming is of the utmost importance in promoting environmentally sustainable agricultural practices, minimizing environmental contamination, and avoiding using chemical fertilizers and genetically modified organisms (GMOs). Even inexperienced and seasoned farmers frequently encounter formidable obstacles when attempting to authenticate their organic farming status by acquiring organic agriculture certification. The current level of agricultural land maturity is accurately assessed by a comprehensive model presented in this study, which also provides a framework for the transition to organic farming standards. These maturity models were formulated through an exhaustive analysis of agricultural standards, an extensive review of pertinent literature, and expert interviews conducted in 15 distinct locations, with each expert holding certification in a minimum of three organic agricultural standards. Identifying characteristics germane to organic standards, integrating them into maturity models, and establishing maturity items and dimensions are also components of the study. The outcome of our investigation is the Sustainable Organic Farming Maturity (SOFaM) model, which consists of five levels and eight dimensions, as well as a standard operating procedure manual for organic agricultural standard certification applications. This model's potential as an assessment instrument for determining the maturity level of agricultural land has been validated by experts who hold credentials in three distinct domains and three locations. The SOFaM model has the potential to function as a paradigm shift in the agricultural sector, streamline the certification process following organic farming standards, and guarantee adherence to predetermined criteria.**

***Keywords*— Organic farming; sustainable agriculture; maturity model; certification; agriculture standards.**

Manuscript received 12 Sep. 2023; revised 9 Jan. 2024; accepted 23 Mar. 2024. Date of publication 30 Apr. 2024.

I. INTRODUCTION

Throughout the 21st century, aspects like hygiene, health, and the environment have been garnering attention worldwide. Eating food tainted with toxins or chemicals can lead to over 200 diseases, with ailments ranging from gastrointestinal infections to more serious ones like cancer. Shockingly, it is estimated that around one-twelfth of the world's population, nearly 600 million, suffer from such illnesses, contributing to over 420,000 deaths each year [1], [2]. These alarming health issues directly affect economic, social, and public utility growth. They have also increased consumers' health consciousness, even more so in groups with dietary restrictions [3]. Considering these challenges, having consistent access to safe and nutritious food in sufficient quantities has become a vital aspect of today's society.

As per the World of Organic Agriculture Statistics & Emerging trends 2022 report by the esteemed Research Institute of Organic Agriculture (FiBL) and the International Federation of Organic Agriculture Movements (IFOAMs), the United States tops the global market for organic products with a whopping value of 49.5 billion euros. Germany and France closely follow it. In Asia, India boasts the largest production area, with Thailand ranking fourth, thanks to the commendable health-conscious behavior of its consumers [4]. Consequently, the demand for organic agricultural products has witnessed a significant surge.

Organic agriculture is synonymous with sustainable farming. This approach prioritizes soil, ecosystem, and human sustainability by leveraging local resources efficiently [5], [6]. It relies heavily on natural processes, nature's cycles, and biodiversity, conforming to the unique traits of each area rather than resorting to production factors that harm organisms, productivity, and the environment.

Moreover, organic agriculture melds scientific knowledge with innovative methods to safeguard natural resources and the environment. It provides a secure system for food production [7] and maintains nutritional integrity [8]. With the awareness of the detrimental effects of chemicals on resources and the environment among farmers, producers, and consumers [9], organic farming eliminates the need for pesticides, antibiotics, and chemical residues. Hence, it is gaining popularity and support from farmers as a production system that addresses sanitation, health [10], and environmental concerns (illustrated in Fig. 1).

However, transitioning from conventional farming to organic farming for certification under organic agriculture standards poses a challenge for farmers [11], [12]. Certification is necessary for farmers to garner acceptance, refine farming methods, and enhance consumer product reliability. The standards encompass a range of aspects, from the transition to organic farming, the types and diversity of plants grown, soil management, fertilization, plant disease and weed control, catalyst use, and pest prevention to contamination prevention and adherence to organic agricultural standards [13]. Therefore, to achieve certification in organic agriculture, farmers need clear guidelines that meet the standard requirements.

Fig. 1 Benefits of organic farming

A maturity model evaluates, compares, describes, or sets plans [14]. It consists of elements with structures representing a path or the evolution of improvement from the beginning to the goal effectively and with good quality. The maturity model can be assessed qualitatively, continuously, or discretely [15]. In our study, we have crafted a maturity model that evaluates the current state and forms guidelines for organic agriculture, keeping these crucial issues in mind. This model highlights the strengths and drawbacks of the procedure, and it helps prioritize the development and enhancement of operations for obtaining organic certification. The maturity model integrates elements and characteristics necessary for evaluating the status and critical practices for transitioning from traditional farming to organic agriculture. This model serves as a valuable tool to gauge the readiness of agricultural land for transformation, assisting farmers in their application for organic farming certification and meeting the requisite standards.

II. Materials and Method

The literature review on the sustainable organic farming maturity model includes the following materials and methods.

A. Sustainable Agriculture

Sustainable agriculture [16], Alternative agriculture, Permanent agriculture [17], and Permaculture are all agricultural systems with similar principles. The principal values represent the importance of ecological balance [18], [19]. These systems also value product quality, produce sufficiency for farmers and consumers, self-reliance, and a focus on local communities.

Sustainable Agriculture aims to produce food and necessities for life rather than export. Sustainable Agriculture uses natural resources for maximum benefit without adversely affecting the environment. There is a balance in local resource production, consumption, and use. The food produced is of good quality and is safe from pesticide residues. It also enables family members to work together and to live in harmony with nature. As a result, these agricultural systems are maintained for as long as possible without negative impacts on the ecosystem, and they do not cause health, social, or economic problems [19], [20], [21].

The fundamental concepts for sustainable agriculture [22], [23], [24] are as follows: 1) The integration of biological and ecological mechanisms within food production, encompassing processes such as nutrient cycling, nitrogen fixation, soil regeneration, allelopathy, competition, predation, and parasitism. 2) The reduction of non-renewable inputs that adversely affect the environment or the well-being of farmers and consumers. 3) Utilising the farmer's knowledge and expertise enhances self-sufficiency and substituting costly external inputs with human capital. 4) The utilization of collective human capacity to address shared agricultural and natural resource challenges, including but not limited to pest management, watershed management, irrigation practices, forest management, and credit management. Various sustainable agricultural models encompass integrated farming, organic farming, natural farming, new theory agriculture, and agroforestry.

B. Agricultural standards

1) Good Agricultural Practices for Food Crops: Good Agricultural Practices (GAP) are a global agriculture approach farmers use to ensure food safety [25]. GAP refers to on-farm practices that address environmental, economic, and social sustainability while producing safe, high-quality food [26]. GAP guidelines for agricultural product management include seed preparation, planting, maintenance, harvest, and post-harvest practices, as listed in Table 1. The objective is to develop national and worldwide market safety standards while reducing the environmental impact [25]. GAP encourages farmers to develop safe agricultural products for consumers. It has become a minimal standard for agricultural transactions worldwide to ensure food safety; however, farmers have been incentivized to practice conservation with cash and advancement opportunities.

TABLE I
GAP's Requirements

Items	Requirements
1. Water	The water used in manufacturing originates from sources with no risk of danger for food contamination and has no negative environmental impact. Furthermore, there are ways to get products that are both safe and of high quality.
2. Planting area	Choose a planting area that does not pose a risk for food contamination, has a common environmental effect, and applies operational management techniques to ensure the production of safe and high-quality goods.
3. Pesticides	Using pesticides in agriculture requires methods that ensure the production of safe products that do not affect the health and safety of farmers and the environment.
4. Pre-harvest quality management	Crops are well-managed, including inputs, tools equipment and waste disposal to ensure efficient in-field operations resulting in safe and quality products suitable for consumption—no negative impact on the environment or the health and safety of farmers.
5. Harvest and post-harvest handling	Appropriate harvesting methods and post-harvest measures are in place to ensure safety and quality products that are safe for eating and do not harm the environment.
6. Holding, moving produce in planting plot and storage	Appropriate handling and storage protocols are in place to ensure safety and quality products are suitable for consumption.
7. Personal hygiene	Farmers have knowledge and understanding of production and good hygiene to ensure product safety and operators as well as facilities for the welfare of farmers.
8. Record keeping and traceability	It records every production process as a guideline for product improvement and traceability.

2) Participatory Guarantee Systems: Participatory guarantee systems (PGS) are quality assurance systems focused on quality assurance in the local area. Farmer certification is based on participation in the activities of those involved. According to Table 2, the system was constructed based on trust, social networks, and knowledge exchange. This system is presently acknowledged by the European Union for organic food, albeit without official recognition [27]. In recent years, PGS has been the focus of increasing, albeit nascent, research output. Several studies have examined its mechanism of action[28], advantages [28], [29] shortcomings, and problems [30], [31].

Participatory guarantee systems serve the same function as third-party certification systems or IFOAM in establishing smallholder standards' credibility. To determine whether the production process adheres to organic standards, they must participate in the regular inspection of the farm throughout the year and control according to the recommendations or suggestions. They must also prepare the assessment report as a standard to help farmers reduce the assessment cost for organic agriculture certification.

TABLE II
PGS'S PROCESS

Process	Details
Participation	Villager organizations that are suitable for their way of life Measures, rules, and regulations that are mutually accepted
Discussion	Schedule meetings and ongoing events
Transparency	Document management system and field visit process. Consumers take part in field visits.
Reliability	Joint vow
Horizontal relationship	There is a standard logo and a verification mechanism. Producer Support Mechanism
Learning process	Exchange of experience during field visits Summing up the results

3) International Federation of Organic Agriculture Movements: The IFOAM Standard is a globally applicable organic standard that may be directly used for certification. The implementation of organic agricultural standards is a production approach that prioritizes enhancing soil quality, preserving ecosystems, and safeguarding human well-being. Rather than utilizing inputs that have adverse effects, the approach prioritizes biological processes, biodiversity, and cycles that are specifically adapted to the local environment. Organic agriculture integrates traditional practices, innovative techniques, and scientific knowledge to enhance environmental sustainability while fostering fair relationships and ensuring a superior quality of life for all stakeholders. Organic agriculture is essential to the overall atmosphere, is safe for farmers and consumers, and has positive ecological, social, and environmental aspects. It is an alternative to safe farming. It also builds a country's competitiveness. There are four main principles of organic agriculture: health, ecology, fairness, and care [32], based on the concepts listed in Table 3 under organic agriculture standards.

TABLE III
IFOAM'S COMPONENTS

Subject	Details
Nutrient Cycle	It is based on natural principles involving plant nutrients in the form of organic matter that microorganisms can decompose, making the nutrient cycle circulate continuously.
The abundance of soil nutrients	It is considered the heart of organic agriculture. Farmers must always find organic matter, such as straw or leaves, to mulch plants during organic agriculture. This organic matter becomes food for living creatures and soil microorganisms and helps to revive the soil.
Enhancing biodiversity	Organic agriculture necessitates a balance in the cultivation of various crops, whether many types are grown simultaneously or overlap, as well as crop rotation, including animal husbandry.
Agricultural ecosystem conservation and restoration	By refusing to use synthetic chemicals, synthetic chemical inputs disrupt the ecological balance of agriculture and affect. various organisms on the surface and underground, including animals, insects, and microorganisms. These organisms play an A vital role in creating a balance of agricultural ecology.
Dependence on natural mechanisms in agriculture	Organic agriculture is based on the philosophy that sustainable agriculture must follow the natural course.
Self-reliance on production factors	The goal for farmers is to produce inputs, such as organic fertilizers or seeds, and to use locally available inputs consistent with the local ecosystem.

C. Maturity Model

The term 'maturity' refers to a 'state of being complete, perfect, or ready [33], [34]. A maturity model is a technique used to assess, contrast, define, or choose a course of action. An evolutionary route from ineffective, immature processes to mature, efficient, and qualitatively superior techniques is achieved using a maturity model, an organized set of elements. Discrete or continuous methods can quantify or measure maturity [15].

The maturity model is used to assess the state of a company or a production organization under one of the states indicated by such models. This concept could include business process management [35], [36], inventory management [37], supply chain management [38], [39], new product development [40], R&D projects [41], project management [42], quality management [43], sustainability [44], [45], [46], service innovation [47] and service management [48], [49]. They may be used to obtain helpful information regarding the point of departure for improving the processes of extant organizations [50] or to compare different organizations [33].

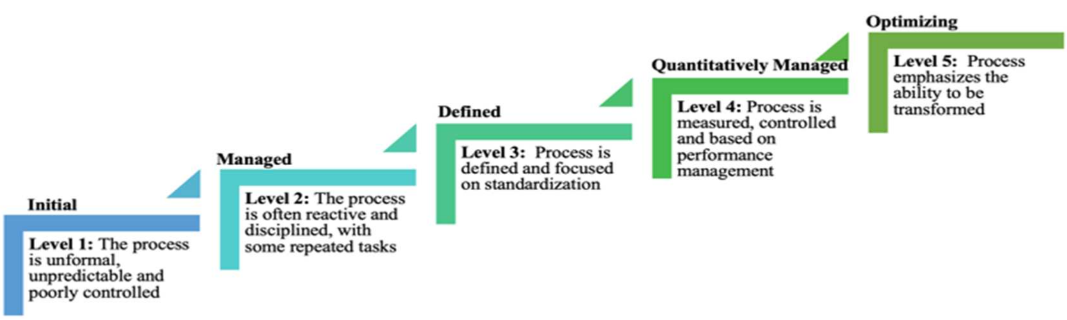

Fig. 2 Maturity level definition

The successful completion of a level signifies the attainment of the necessary level of maturity needed for progression to the subsequent level, as illustrated in Figure 2. The categorization of maturity levels is as follows: Level 1–Initial: Processes exhibit an absence of established norms and, in specific circumstances, may undergo a state of 'chaotic development.' A limited number of procedures are sufficiently defined, and the achievement of project success is contingent upon human initiative. The primary processes are typically well-defined at the managed level, effectively managing cost, time, and function. Furthermore, the outcomes of the process exhibit a high degree of repeatability. At Level 3, the software process is thoroughly documented and standardized, encompassing organizational and production aspects. Company processes and standards regulate software development and maintenance initiatives. Level 4–Quantitatively Managed: The software process at this level involves collecting and analyzing comprehensive metrics. Various techniques and products undergo scrutiny and regulation. Level 5–Optimization: The continuous enhancement of processes is facilitated through analyzing measurement outcomes and integrating innovative concepts and technology.

Given the limited resources and experience, Sustainable Organic Farming would benefit significantly from assessing its current status and emerging gaps, which the maturity model can provide [51]. As a result, maturity models appear appropriate to address the gaps in research defining and prescribing [52] and the need for more focus on the difficulties facing Sustainable Organic Farming along the servitisation journey.

D. Proposed Research Methodology

In their literature review on maturity model development procedures, Becker et al. [53] presented a seven-step development process. In addition, Neff et al. [48], Hausladen, and Schosser [54] have proposed a four-step development procedure, which is consistent with Becker et al. [53]'s framework. Under the model's four-stage development procedure, Becker et al. [53], Neff et al. [48], and Hausladen and Schosser [54] are summarized and depicted in Fig. 3.

Seven research steps proposed by Becker et al.[53]	Four research steps proposed by Neff et al.,[48] and Hausladen and Schosser[55]	Sustainable Organic Farming Maturity (SOFaM) Model			Building and using maturity model	
1.Problem definition	1.Problem identification	Understand Standard of GAPs, PGSs and IFOAM concept	Literature review and research	Expert's in-depth interview		
2.Comparison of existing maturity models	2.Comparison of existing maturity models	GAPs, PGSs and IFOAM feature and characteristics	Review and compare existing maturity model	Collect information, analysis and integration		
3.Determination of development strategy	3.Iterative maturity model development	Identify involved maturity model and organic farming			1.Determine the propose of the model and its component	Building a maturity model
					2.Determine the scale	
4.Iterative maturity model development		Verify SOFaM Model dimensions and items as well as determine underlying problems in SOFaM adoption			3.Develop the expectation for each component level	
					4.Set a target for each component	Using a maturity model
5.Conception of transfer and evaluation	4.Maturity model evaluation	Transitions conception of SOFaM model			5.Assess the level of maturity by component	
6.Implementation of transfer media		Transitions of SOFaM Model			6.Consider what the model may have missed	
7.Evaluation		Case study research with participants interviews			7.Report on conclusions	
					8.Revisit the model regularly	

Fig. 3 Research steps of the proposed model

1) Literature review and research: Beginning with a study and understanding of agricultural standards, a structured literature review based on Becker et al. [53] simultaneously interviewed producers certified to international organic standards. The interview began with the concept of maturity and asked general questions about the main obstacles to obtaining organic certification. In addition, the maturity model was used to identify the scope and requirements appropriate to well-established organic standards. The literature was reviewed to determine a maturity model to solve research problems.

2) Review and compare existing maturity model: The process compares the maturity model with existing models that support the requirements for generating maturity.

3) Identify the involved maturity model and organic farming: This process is a strategy formulation based on literature reviews, studies, collection of agricultural standards, and in-depth interviews with a group of 15 experts who have certified at least three organic standards and consisted of academics, farmers and farmers with experience as auditors of organic certification. Eighty percent had more than six years of experience identifying the most influential factors for creating a maturity model. In addition to evaluating the factors affecting the maturity model, the eight domains covered the goals, including three agricultural standards (GAP, PGS, and IFOAM) in Fig. 4 involved in constructing the maturity model and defining sub-domains, concepts, and definitions. A maturity model is created to accommodate the appropriate boundaries.

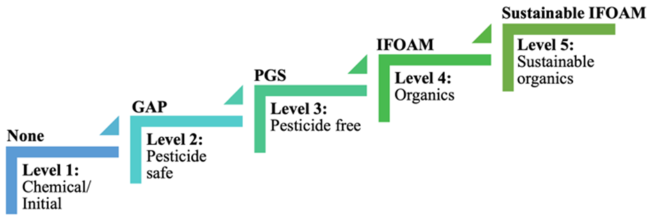

Fig. 4 SOFaM 's maturity level definition

4) Transitions conception of SOFaM model: Modelling maturity requires several research approaches. These must be well-founded and carefully adapted to highlight the challenges of conducting rigorous research and introducing an ontological approach. This problem is solved by taking action to change the model of agriculture from the SOFaM Model.

5) Transitions of SOFaM Model: The presentation of a mature model must be adapted to the conditions of use, and user needs by introducing the model of agricultural transformation into a farmer standard request guideline certificate of approval.

6) Case study research with participant interviews: All concepts and premises for developing a maturity model and the artifact's usefulness, quality, and effectiveness must be reviewed repeatedly (for the problem of delimiting the evaluation criteria). This case involves a research participant who wants to determine how to modify agriculture to discover ways to apply for organic certification.

III. Results and Discussions

The model structure is a matrix consisting of different levels and factors. Eight matrices are shown in Fig. 5 and are associated with agricultural operations to apply for organic agriculture standards certification, as listed in Table 4. The model understands the procedure and evolution. A range of levels of change are evaluated for each step. These are defined by corresponding quality to (1) set the current maturity level, (2) set the maturity level at a higher level, and (3) identify the characteristics needed to be done for maturity at a higher level. Eight factors are listed in the Table. Five influence the maturity model.

1) Knowledge: Knowledge in related sciences must be specific. It can be used to create, produce, develop, or obtain by accumulating a principle, method, or textbook for doing something efficiently and effectively. It is knowledge derived from a specific subject. For example, it may be obtained from transferring experience or data synthesis and analysis directly applicable to the situation or work. Therefore, this research is a body of knowledge related to organic agriculture to obtain certification. It will assist in operation planning and reduce errors resulting from various activities.

2) Ecosystem: Ecosystem is the relationship of organisms in a particular habitat. These relationships include between living and non-living things and between living things and living things. The ecosystem serves two critical functions: (1) energy flow: energy is transmitted sequentially by living organisms in the form of food chains and food webs. Therefore, any change in any living creature will affect that organism's homeostasis. (2) The Circulation Solution refers to how the organisms in the ecosystem bring minerals, nutrients, and matter into balance with nature for their livelihood. Therefore, it is considered one of the requirements under the organic agriculture standard that the applicant must plant in the organic agriculture area to create an ecosystem in the planting or agricultural area.

3) Framework: Framework is the management of organic farming operations according to a management concept and efficient operation under the integrated farming approach with various plants and animals that can be self-reliant concerning raw materials, preservation, and natural resources. It contributes to reducing the time required to implement organic agriculture standards. It also supports production process management that considers humanitarian principles, which have the most negligible impact on nature.

4) Production: Production is the most critical element. Other elements must be considered if production is missing to obtain organic certification. Production consists of preventing and using chemicals, seeds, production period, and management and protection within the farm to obtain organic agriculture certification.

5) Producer: Producers are an element that enables organic farming certification. It consists of the confidence and skills of being a researcher, such as being observant, recording and collecting data, and making conclusions, as a guideline for preventative planning in case there is an effect on the operation.

6) Period: A period is a standard criterion that must be satisfied to examine and consider the requirement based on an event or circumstance of the site where conversion to organic farming is required: Recovery and Sustainable Ecosystems.

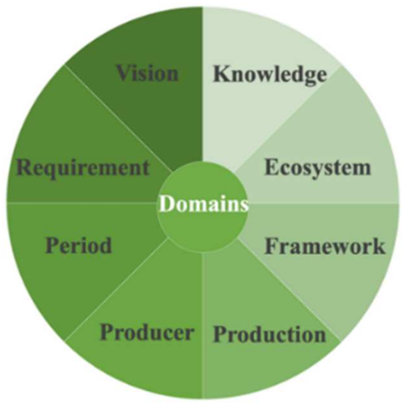

Fig. 5 Domains of SOFaM Model

7) Requirement: The requirement defines the agricultural level or standard. It is what enables the intended objective to be attained. Success is essential. Consequently, action, motivation to manage, and planning to obtain results achieve the established goals.

8) Vision: Vision is the capacity to predict what will happen in the future and to determine the direction, trend, possibility, time, process, and general approach that can and will occur.

TABLE IV
DOMAINS AND ATTRIBUTES OF SOFAM

Domain	Sub-domain	Attribute	Domain	Sub-domain	Attribute
[KL] Knowledge	[KL1] Law	[KL1.1] Related law	[PD] Production	[PD1] Plan	[PD1.1] Planning to meet requirements [PD1.2] Production according to the framework
	[KL2] Agriculture Standard	[KL2.1] GAP [KL2.2] PGS [KL2.3] IFOAM		[PD2] Prepare	[PD2.1] Pre-production [PD2.2] Production [PD2.3] Post-production
	[KL3] Agriculture	[KL3.1] Production process [KL3.2] Production factors [KL3.3] Growing factors [KL3.4] Durability		[PD3] Production Sales	[PD3.1] Ability and management of sales
[ES] Ecosystem	[ES1] Quality	[ES1.1] Analysis and test acidity–alkalinity (pH) of soil* [ES1.2] Analysis and test acidity–alkalinity (pH) of water*		[PD4] Recording	[PD4.1] Recording all steps of the process*
	[ES2] Resources	[ES2.1] Preserving natural resources*	[PC] Producer	[PC1] Producer	[PC1.1] Practice [PC1.2] Learning [PC1.3] Researcher [PC1.4] Honest [PC1.5] Developer
	[ES3] Biodiversity	[ES3.1] 5% of Land*	[PR] Period	[PR1] Period	[PR1.1] 1 year* [PR1.2] 1–1.5 years* [PR1.3] 2–3 years*
[FW] Framework	[FW1] Chemical protection	[FW1.1] Soil* [FW1.2] Seeds* [FW1.3] Biological stimulants* [FW1.4] Tools*	[RQ] Requirement	[RQ1] Requirement	[RQ1.1] GAP [RQ1.2] PGS [RQ1.3] IFOAM [RQ1.4] Sustainability
	[FW2] Safety	[FW2.1] Producer and consumer safety* [FW2.2] Chemical and synthetic safety* [FW2.3] Inspection and verification*	[VS] Vision	[VS1] Vision	[VS1.1] Producer [VS1.2] Export Standard [VS1.3] Organic Standard [VS1.4] International Organic Standard
	[FW3] Buffer line	[FW3.1] The land has a buffer line*			

*Agricultural Standard Requirements

TABLE V
SUSTAINABLE ORGANIC FARMING MATURITY (SOFAM) MODEL

Domain	Level 1	2	3	4	5	Domain	Level 1	2	3	4	5
Knowledge	KL1.1	KL1.1 KL2.1 KL3.1 KL3.2 KL3.3	KL1.1 KL2.2 KL3.1 KL3.2 KL3.3	KL1.1 KL2.3 KL3.1 KL3.2 KL3.3	KL1.1 KL2.3 KL3.1 KL3.2 KL3.3 KL3.4	Production	None	PD1.2 PD4.1	PD1.1 PD1.2 PD2.1 PD2.2 PD2.3 PD3.1 PD4.1	PD1.1 PD1.2 PD2.1 PD2.2 PD2.3 PD3.1 PD4.1	PD1.1 PD1.2 PD2.1 PD2.2 PD2.3 PD3.1 PD4.1
Ecosystem	None	ES1.1 ES1.2 ES2.1	ES1.1 ES1.2 ES2.1	ES1.1 ES1.2 ES2.1 ES3.1	ES1.1 ES1.2 ES2.1 ES3.1	Producer	None	PC1.1	PC1.1 PC1.2 PC1.4	PC1.1 PC1.2 PC1.3 PC1.4	PC1.1 PC1.2 PC1.3 PC1.4 PC1.5
Framework	None	FW2.1	FW1.1 FW1.3 FW1.4 FW2.1 FW2.2 FW2.3	FW1.1 FW1.2 FW1.3 FW1.4 FW2.1 FW2.2 FW2.3 FW3.1	FW1.1 FW1.2 FW1.3 FW1.4 FW2.1 FW2.2 FW2.3 FW3.1	Period	None	PR1.1	PR1.1	PR1.2	PR1.3
						Vision	VS1.1	VS1.2	VS1.3	VS1.4	VS1.4
						Requirement	None	RQ1.1	RQ1.2	RQ1.3	RQ1.3 RQ1.4

In this study, the researcher conducted a case study interview to assess the status of agricultural land using the SOFaM Model to bring it into compliance with international organic standards. This interview consisted of 15 cases, which were divided into three groups consisting of agriculturists (7 cases), instructors (7 cases), and agriculturists and an administrator (1 case) who had experience applying for organic certification and received at least three organic certification standards. Additionally, the case study has experienced at least three years of organic agricultural experience. The assessment will be evaluated based on the domain-specific requirements list of the SOFaM Model. Fig. 6 Exemplifies a case study of agriculturists and an administrator (Experienced in auditing organic farming areas), which indicates the farmer's implementation outcomes for the activities associated with each related element.

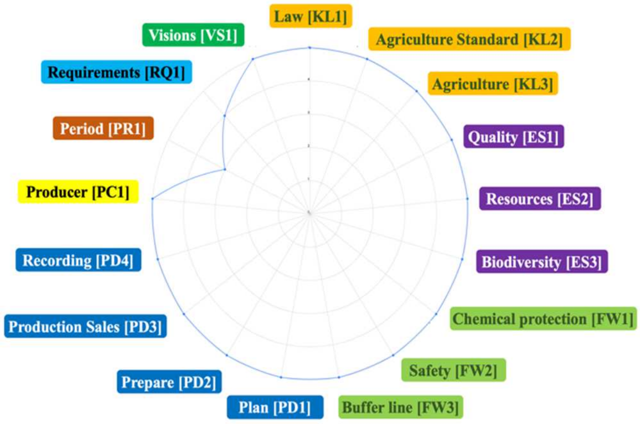

Fig. 6 A subdomain-level evaluation results of the case study

The status of agriculture in that area is known for its development in status modifications, which allow farmers to summarize the overall results of the operations for each element, as shown in Fig. 7. Agriculturists worked for 1 year in agricultural operations, were involved in PGS agriculture, and had begun the status check procedure in the SOFaM Model.

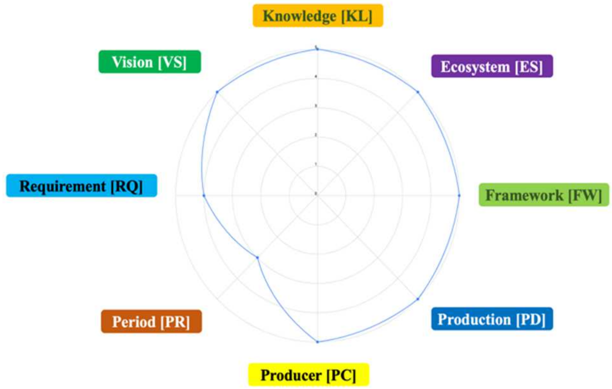

Fig. 7 A domain-level evaluation results of the case study

Table 6 shows the steps involved in the SOFaM to obtain a higher status and transition to an organic farming certification. Table 6 consists of three stages. (1) In pre-production, seeds must be organic, chemical-free, and meet international agricultural standards. Chemical usage must only be done following predetermined norms. (2) Production: The harvesting method must adhere to specific guidelines. The planting area must not be set on fire. The processing time must adhere to the established requirements. (3) Post-production: cleaning and chemical contamination prevention, as well as assessing the performance of each manufacturing cycle. The radar graphic depicts the case study, evaluates the findings in eight areas, and shows the maturity level results for the primary dimensions.

TABLE VI
SUGGESTED TRANSITION PLAN

	Relevance/ Standard	GAP (2)	PGS (3)	IFOAM (4)
Pre-production	Duration: At least one month -Related people: Farmer, Department of Agriculture (local level) and Certification Unit -Technology: Database, online service of Department of Agriculture, and quality inspection tool Forecast	1. For implementation, Soil and water analysis at least once a year (contaminated water resources and soil can be controlled).	1. For implementation, soil and water analysis should be carried out at least once a year (Uncontaminated water resources and soil can be carried out).	1. Soil and water analysis should be performed at least once a year for implementation (Uncontaminated water resources and soil can be carried out as per distance specified by the standards).
		2. Seeds	2. For seeds with chemical coating, the chemicals must be removed.	2. Seeds without chemical coating.
		3. Preparation, the body of knowledge and planning and organizing an excellent agricultural production system of practitioner	3. Preparation, the body of knowledge and planning and organizing the PGS agricultural production system (according to the group standards) of the practitioner	3. Preparation, the body of knowledge and planning and organizing the IFOAM agricultural production system of practitioner
			4. Bumper line that can prevent chemicals according to group standards	4. Bumper line that can prevent chemicals and have a safe distance from the risky area
			5. Plant nutrients according to group standards set	5. Plant nutrients according to group standards set
Productio	-Duration: As per the planting cycle -Related people: Farmers	1. Suitable water, nutrients, and chemicals according to the suggestion	1. Suitable water and nutrients according to the group standards	1. Suitable water and nutrients
		2. Recording steps and implementation details,	2. Recording steps and implementation details, along with	2. Recording plant species, steps, and implementation details, along

	Relevance/ Standard	GAP (2)	PGS (3)	IFOAM (4)
	-Technology: Application, database, online service of Department of Agriculture, and quality inspection tool	along with ways of solving the problem entirely 3. Harvesting is hygienic	ways of solving the problem entirely according to the group standard 3. Harvesting is hygienic as per the specified group standards 4. Maintain biodiversity 5. The period of implementation as per the group standards set	with ways of solving problems entirely according to standards set 3. Harvesting is hygienic as per the specified standards 4. Maintain biodiversity at 5% of the production area 5. Do not burn in the farm area 6. The period of implementation as per the standards set
Post-Production	-Duration: After completing each cycle of cropping -Related people: Farmers -Technology: Application, database	1. Maintain soil and water quality 2. Clean, prevent, and store hazardous materials safely 3. Reduce waste from the production process 4. Review the implementation at least once a year	1. Maintain soil quality, prevent soil erosion, and maintain water quality 2. Clean, prevent, and store hazardous materials safely 3. Reduce waste from the production process 4. Review the operation as per group standards set	1. Maintain soil and water quality 2. Clean, prevent, and store hazardous materials safely 3. Reduce waste from the production process 4. Review the operation of each production cycle

The study and evaluation show that the body of knowledge (5), ecosystem (5), framework (5), production (5), producer (5), period (3), requirement (4), and visions (5) dimensions have a total maturity at level 3, indicating that the case study meets PGS standards. Moreover, it shows the process details of each dimension within the required standard level and the processes that need to be developed to reach the desired level. Nevertheless, various dimensions still need improvement to meet the standards. The body of knowledge dimension must meet the IFOAM requirements and standards.

In addition, guidelines for practice, pre-production preparation, production, and post-production related to each dimension must be developed to meet the standards. The maturity evaluation results will result in significant learning of various aspects that farmers need to improve. The current evaluation indicates that agriculture standards are at the 'PGS maturity level, and there is a better chance of moving to the next maturity level, 'IFOAM.' The maturity evaluation reveals the strengths of agriculture and agricultural areas; however, it shows that some processes need improvement. These processes must be developed and improved to meet the 'IFOAM' standard, enabling them to reach the organic agriculture standard.

IV. Conclusion

This scholarly investigation provides critical insights for agricultural practitioners transitioning from conventional farming methodologies to organic practices. This objective is pursued by engendering a deep understanding of the diverse standards that govern both traditional and organic farming, thereby discerning crucial attributes through an intensive series of interviews with recognized experts.

Sustainable Organic Farming Maturity Model (SoFaM) proposed by this study comprises eight distinctive dimensions, each corresponding to the diverse levels of compliance requisite for meeting the benchmarks of organic farming standards. This model presents an organized framework through which agricultural practitioners can evaluate their existing practices and identify potential improvement areas. The model serves as an instrumental guide for practitioners seeking international organic agriculture standard certifications. Its robustness is ensured through rigorous evaluation by at least three experts holding accreditations from a minimum of three international standards, suggesting appropriate modifications to achieve the desired certifications.

This investigation's initial findings underscore the proposed model's proficiency in verifying the progression toward an enhanced maturity level for organic agricultural standard certifications. Consequently, it is an essential decision-making tool for farming practitioners and entrepreneurs seeking to transition to organic farming. The model delineates a systematic approach to augment farming practices and achieve loftier certification standards. Specifically, our model equips agricultural practitioners to:

- Scrutinize their current agricultural practices.
- Identify potential advancements and future progression.
- Recognize the necessary qualities for actualizing the steps delineated within the model.

Despite its comprehensive nature, it is crucial to highlight that the insights from the expert interviews predominantly pertain to crop production and are thus situated within the broader production framework. Consequently, the applicability of our model's recommendations to organic farming practices within animal husbandry or food processing is limited. Thus, while the model exhibits versatility, its optimal utility remains primarily within the confines of crop and plant production sectors.

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