Jurnal Teknologi Industri Pertanian 35 (1): 8-22, April 2025
DOI: https://doi.org/10.24961/j.tek.ind.pert.2025.35.1.8
ISSN: 0216-3160 EISSN: 2252-3901

Terakreditasi Peringkat 2
SK Dirjen Pendidikan Tinggi, Riset, dan Teknologi No. 158/E/KPT/2021
Tersedia online http://journal.ipb.ac.id/index.php/jurnaltin

DESIGNING AN INSTITUTIONAL MODEL FOR THE SUNFLOWER AGRO- INDUSTRY SUPPLY CHAIN

RANCANG BANGUN MODEL KELEMBAGAAN RANTAI PASOK AGROINDUSTRI BUNGA MATAHARI

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Paper: Received October 25, 2024; Revised January 10, 2025; Accepted February 07, 2025

ABSTRAK

Penelitian ini bertujuan untuk merancang model kelembagaan dan sistem informasi untuk meningkatkan keberlanjutan rantai pasok agroindustri bunga matahari di Indonesia. Agroindustri bunga matahari di Indonesia. Agroindustri bunga matahari memiliki potensi besar, namun terkendala oleh belum terancangnya struktur kelembagaan yang optimal. Hal ini menyebabkan daya saing dan keberlanjutan rantai pasok agroindustri bunga matahari rendah. Berfokus pada agroindustri bunga matahari di Kabupaten Bandung dan sekitarnya, penelitian ini menggunakan pendekatan sistem untuk menganalisis kondisi situasional dan kebutuhan agroindustri bunga matahari. Kemudian, model kelembagaan dirancang menggunakan metode Interpretive Structural Modeling (ISM). Selanjutnya, model sistem informasi kelembagaan dirancang untuk menunjang operasional kelembagaan menggunakan pendekatan design system. Analisis dan perancangan sistem informasi ini terbatas hanya kepada perancangan graphical user interface, tidak sampai kepada perancangan database. Hasil penelitian menunjukkan bahwa kondisi situasional agroindustri bunga matahari belum optimal dan memerlukan adanya rancangan kelembagaan yang dapat meningkatkan keberlanjutan serta daya saing rantai pasok agroindustri tersebut. Berdasarkan hasil menggunakan ISM, dengan berpedoman kepada 9 (sembilan) elemen, terancangnya usulan model kelembagaaan yang disesuaikan dengan kepentingan unsur elemen. Tidak hanya itu, terancangnya juga model desain sistem penunjang informasi yang akan menunjang operasional dalam program kelembagaan. Penelitian ini diharapkan dapat memberikan kontribusi bagi perusahaan dengan luaran yang diberikan adalah usulan perancangan model kelembagaan dan dasar pembuatan sistem penunjang infomrasi kelembagaan. Penelitian dapat dilanjutkan dan dikembangkan lebih mendalam serta dapat diimplementasikan dengan optimal.

Kata kunci : model kelembagaan, sistem informasi, agroindustri bunga matahari, keberlanjutan, rantai pasok

ABSTRACT

This research aimed to design an institutional model and information system to improve the sustainability of the sunflower agro-industry supply chain in Indonesia. The sunflower agro-industry has great potential, but it is hampered by the lack of an optimal institutional structure. This causes the competitiveness and sustainability of the sunflower agro-industry supply chain to be low. Focusing on the sunflower agro-industry in Bandung Regency and its surroundings, this research used a systems approach to analyze the situational conditions and needs of the sunflower agro-industry. Then, the institutional model was designed using the Interpretive Structural Modeling (ISM) method. Furthermore, the institutional information system model was designed to support institutional operations using the design system approach. The analysis and design of this information system was limited to the design of the graphical user interface, not to the design of the database. The research results show that the situational condition of the sunflower agro-industry was not yet optimal and requires an institutional design that can improve the sustainability and competitiveness of the agro-industry supply chain. Based on the result using ISM, a proposed institutional model was designed. In addition, a design model for a supporting information system was also designed that would support operations in the institutional program. This research is expected to provide contributions to companies with output given in the form of a proposed institutional model design and the basis for creating an institutional information support system. Research can be continued and developed in more depth and can be implemented optimally.

Keywords : institutional model, information system, sunflower agro-industry, sustainability, supply chain

INTRODUCTION

Agro-industry can be defined as an industrial sector that substitutes raw materials from agricultural products, implements planning and provides relevant equipment and services for the production needs (Dewa Gede *et al.,* 2021). According to the Ministry of Industry of the Republic of Indonesia, this sector is a group of manufacturing sectors that make a significant contribution to the national economy. This

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statement is presented along with data on the significant contribution of the agricultural sector to the non-oil and gas processing sector GDP throughout the year 2020, amounting to 52.94%. This data indicates that the agro-industry in Indonesia is developing quite prospectively, supported by abundant agricultural resources as domestic agro-industrial raw materials. One of the agro-industries with potential prospects is the sunflower agro-industry (Kementerian Perindustrian RI, 2020).

Indonesia has 6,450.5 thousand hectares of agricultural land (BPS, 2024) According to FAO data, Indonesia has not yet become a producer of sunflower seed cooking oil (Pullen LC, 2017). The world's crude sunflower seed oil production data indicates an increase from 2017 to 2020. Ukraine and Russia emerged as the largest exporters of sunflower seed oil in 2022, averaging 3.675 million tons. Sunflower oil consumption rates have been trending upwards from 2022 to 2024 (Foreign Agricultural Service, 2024). In the statement, there appears to be a gap between sunflower seed oil production and consumption. The demand for sunflower oil in Indonesia exceeds domestic production, as evidenced by the high volume of imports. This high level of importation is driven by a lack of supply from domestic sources, inadequate quality, and unreliable continuity in production (Farida and Ardiarini, 2019). This opportunity serves as motivation for Indonesian farmers who can play a role as sunflower seed oil producers.

The sunflower (Helianthus annuus L.) is an annual plant with the potential for cultivation, besides being merely used as an ornamental plant (Audina *et al.*, 2017). The most utilized part is its seeds, used for cooking oil, herbal oil, animal feed, and biodiesel. Sunflower seeds are a leading oilseed, ranking second globally in cooking oil production after soybean oil (Nandha *et al.*, 2014). However, unfortunately, there are still few sunflower agro-industries that process sunflower seeds into value-added products. Based on previous research, sunflower agro- industries still receive relatively little attention in scientific literature or media compared to several other types of agro-industries. Most studies focus on sunflower cultivation (Adeleke *et al.*, 2020) and growth (Marshel *et al.*, 2015). This is due to several factors, including greater research focus on other agricultural commodities or the less significant level of sunflower production compared to major food crops. The competitiveness of this agro-industry is also questioned when compared to other agro-industries. Competitiveness is a factor that will affect the sustainability of the sunflower agro-industry supply chain. This is particularly relevant to the sunflower agro-industry managed by CV TLP the villages of Cihanjuang and Banjaran, Bandung Regency, as well as the surrounding agro-industries, which are the focus of this research.

An approach to supply chain management that is based on behavior, technological components, and inter-institutional interaction is known as the supply chain institutional model. Connections between suppliers, producers, and distributors made possible by supply chain institutions will aid in the construction of the optimum industrial structure, act as a defensive mechanism for industry, make information sharing, and coordination easier, integrate operations from top to bottom, and enhance supply chain performance (Mustaniroh *et al.*, 2023).

Institutionalization within the agro-industry supply chain can be key to enhancing the competitiveness and sustainability of this sector. Institutionalization refers to various organizations, institutions, and structures involved in the production, processing, distribution, and marketing of products. Unfortunately, the current sunflower agro-industry cannot be said to have optimal institutionalization, and the relationships among industry players currently exist only as loosely connected communities. Therefore, this research aims to design a model for the institutionalization of the sunflower agro-industry supply chain, accompanied by the design of an information support system to enhance the operational aspects of institutional programs. Prior to designing, a systems approach will be employed to assess the situational conditions and current needs of the sunflower agro-industry. The study's scope is limited to (1) focusing solely on the sunflower agro-industry under CV TLP, which collaborates with farmers in several regions, (2) the institutional model system design will not progress to implementation, and (3) the analysis and design of the information system will only cover the graphical user interface (GUI) design stage.

RESEARCH AND METHODS

This research is conducted based on a research flowchart or flowchart that represents sequential instructional steps in the research. The following is the research flowchart as displayed in Figure 1. This research begins with a literature review to identify the current conditions and research opportunities regarding the sunflower agro-industry. This review will be further explored and serve as the basis for conducting the research. The main research object is the shaded sunflower agro-industry under CV TLP located in the villages of Cihanjuang and Banjaran, Bandung Regency, along with collaborating farmers from various areas. Several farmers reached out to include those from Malang, Rawa Pening, Tasikmalaya, Sukabumi, and Medan. Input was gathered not only from farmer practitioners but also from academics and government officials to inquire about their perspectives. Stakeholders have asked for their opinion on this research.

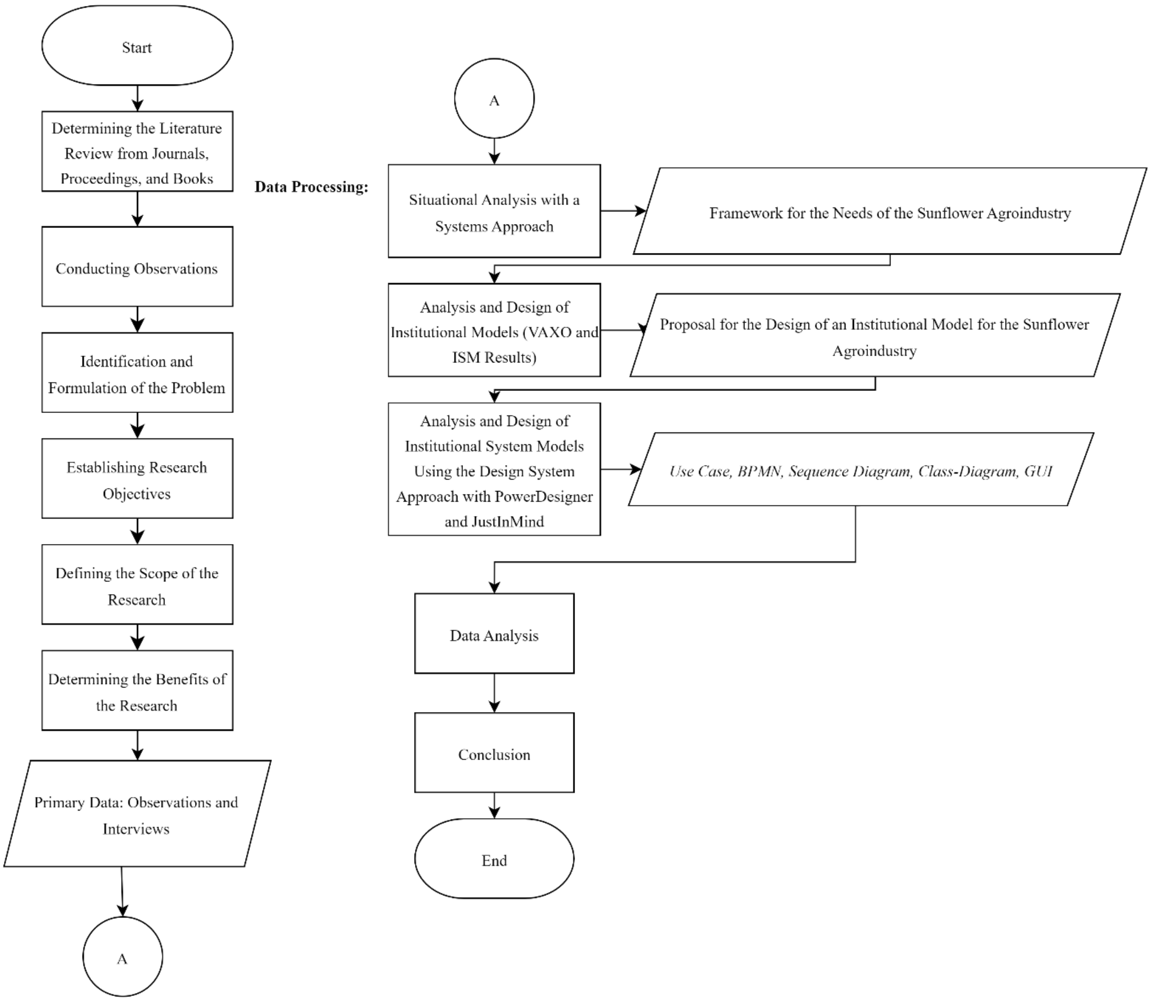

Figure 1. Research Methods

Stakeholders are a fundamental factor in this research and in the sunflower agro-industrial organization. (Ali *et al.,* 2023). Within the research object, observations, problem formulation, and data collection were conducted. Primary data were obtained from the opinions of practitioners, academics, and government officials to understand the actual conditions, challenges, and opinions regarding effective institutionalization. The opinions gathered were translated into a questionnaire format according to mutual agreement.

The systems approach is the first step to understanding the actual conditions and system needs within the sunflower agro-industry supply chain. This approach is used to resolve issues that generally consist of several stages of processes, but in this study, it aims to identify the needs of the sunflower agro-industry supply chain system. The systems approach stage refers to two main aspects to identify system needs: (1) needs analysis and (2) framework of needs diagram in the form of an input-output diagram. Needs analysis initiates the examination of a system by stating its requirements and then describing them (Marimin, 2004).

After ensuring the urgency of current needs within the sunflower agro-industry, an analysis and design of institutional models were conducted using the Interpretive Structural Modeling (ISM) method with the utilization of ISM software. The ISM method is an effective approach for organizing and designing hierarchies of abstract and qualitative issues. This method can illustrate the mapping of problems through quadrants and structuring problems according to their priority levels (Casnan *et al*., 2021). In its regulations, there are 8 stages of the ISM method as follows (Kukana *et al.,* 2021); (Kot *et al.*, 2020).

1. Element Identification: Determining elements and sub-elements that correspond to real-world conditions.
2. Contextual Relationships: Establishing contextual relationships among elements and sub- elements based on the intended goals.
3. Structural Self-Interaction Matrix (SSIM): The result of respondents' perceptions regardingthe comparison of relationships between two targeted elements. Symbols and definitions for SSIM are as follows (Yusuf *et al*., 2020).

Table 1. SSIM symbols and definition

Symbol	Definition
V	Element-*i* is more important than element-*j* / Element-*i*influences element-*j*
A	Element-*j* is more important than element-*i* / Element-*j* influences element-*i*
X	Both elements are equally important and mutually influential
O	Both elements are not important and have no influence

1. Reachability Matrix: The matrix formed to convert the symbols of the SSIM matrix into a binary matrix is as follows (Utami *et al.*, 2020):
   a) If the relationship of Ei to Ej = *V* in SSIM, then the elements Eij = 1 and Eji = 0 in the reachability matrix
   b) If the relationship of Ei to Ej = *A* in SSIM, then the elements Eij = 0 and Eji = 1 in the reachability matrix
   c) If the relationship of Ei to Ej = *X* in SSIM, then the elements Eij = 1 and Eji = 1 in the reachability matrix
   d) If the relationship of Ei to Ej = *O* in SSIM, then the elements Eij = 0 and Eji = 0 in the reachability matrix
2. Level of Participation in the Reachability Matrix
3. Diagraph: One of the final outcomes describing the classification of sub-elements is asfollows (Nirmalasanti *et al.*, 2021):
   a) Weak driver-weak dependent variables (Autonomous), Sub-elements that are not boundto the system, have a relationship that is weak but strong (Sector I)
   b) Weak driver-strongly dependent variables (Dependent), Variables are not independent and influenced by programs from other sectors (Sector II)
   c) Strong driver-strongly dependent variables (Linkage), These variables are studied carefully because the relationships among them are unstable. Every action on one variable will impact others, and feedback can reinforce its effect (Sector III)
   d) Strong driver-weak dependent variables (Independent), Having a significant driving role in the success of the program but depending slightly on the program (Sector IV).

This classification visualization can be depicted in Figure 2 (Sembiring *et al.*, 2020).

4. Interpretive Structural Model: The ISM is generated by moving the entire number of elements with actual element descriptions. Therefore, ISM provides a clear overview.

After conducting ISM analysis, a proposed institutional model will be designed based on the analysis results and adjusted to the situational conditions of the sunflower agro-industry. Additionally, a supporting information system model will be built to support the operational aspects of the institutional program using system analysis and design. The stages of system analysis and design consist of two main aspects, namely design using Unified Modeling Language (UML) and Graphical User Interface (GUI) design. UML design includes Business Process Modeling Notation (BPMN), use case diagrams, sequence diagrams, and class diagrams conducted in PowerDesigner software.

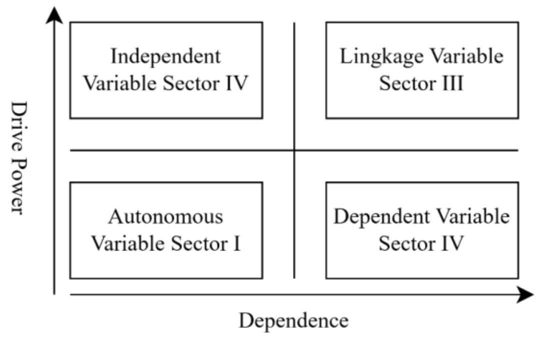

Figure 2. Diagraph Classification

RESULTS AND DISCUSSION

Analysis of System Requirements for the Sunflower Agro-industry Supply Chain

After understanding the requirement analysis, which consists of component identification along with its components, the next step is to identify the appropriate requirements and design the system requirement framework in the form of an input-output diagram as depicted in Figure 3.

Based on Figure 3, it can be concluded that the current requirement is to design an institution expected to enhance productivity and ensure optimal supervision in the sunflower agro- industry supply chain.

Interpretive Structural Modeling (ISM) Analysis

The next step is to conduct ISM analysis, starting with identifying elements and sub-elements for the case of designing the institution for the sunflower agro-industry. Here is an explanation of each element in the nine elements that have been established.

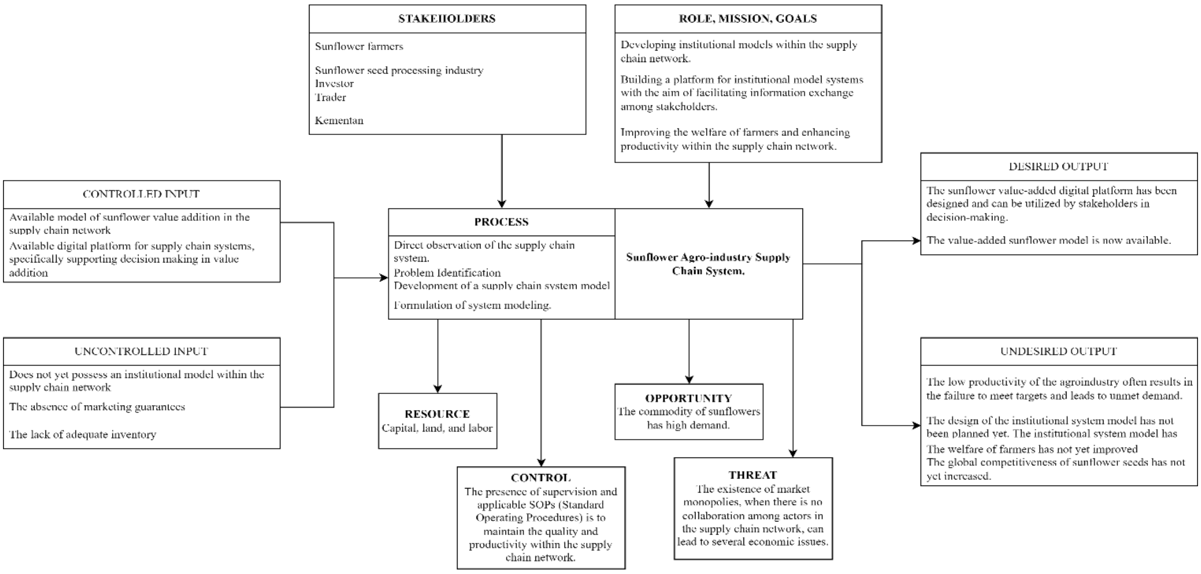

Figure 3. Framework of input output diagram requirements

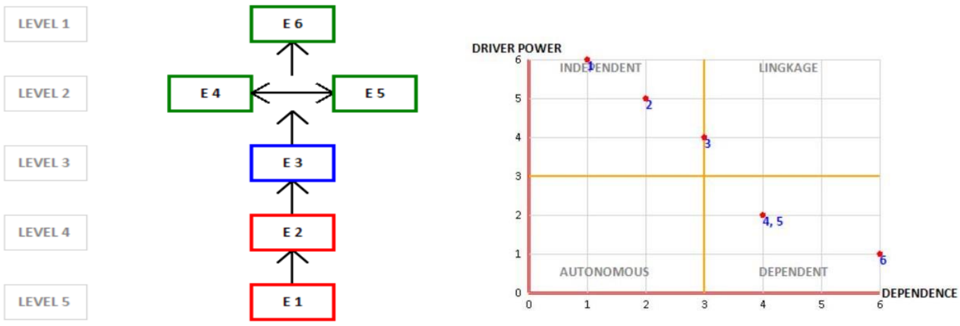

Figure 4. The result of ISM Element 1

Element 1: Affected Community Sector

The affected community sector is the first element of the ISM analysis representing the groupof people directly or indirectly impacted by the analyzed system. Several sub-elements are identified for this element, namely (1) farmers, (2) investors, (3) traders/exporters, (4) seed processors, (5) farm workers, and (6) seed processors. Based on data processing using ISM with consistency value reaching 94.44%, it is known that farmers are the lowest-ranking sub- element, indicating their highest rank as shown in Figure 4. Therefore, farmers play a significant role as a sub-element in the affected community sector.

Based on Figure 4, it is visualized that sub-element 1 (farmers) is positioned in Sector IV, whichis an independent sector. This indicates that farmers are a driving force or the main driving sub-element to achieve other sub-elements. This positioning suggests that farmers operate independently and play a significant role in influencing other sub-elements within the system. The high ranking of farmers as the lowest sub-element reflects their foundational impact on the agricultural system, serving as the primary producers of raw materials essential for the entire agro-industry supply chain. By driving agricultural activities, farmers impact seed processors, traders/exporters, and other players in the value chain, thereby directly or indirectly affecting the entire community sector. Their involvement is crucial in ensuring the continuity and sustainability of agricultural practices, making them a pivotal element in achieving the system's overall goals.

Element 2: Program Needs

Program needs are the second element of the ISM analysis intended as a basis for developing programs that meet user needs and system objectives. This element aims to help developers understand what the program should do, how the program should work, and the constraints considered. Several sub-elements are identified for this element, including (1) skilled human resources, (2) production technology, (3) cultivation technology, (4) superior seeds and harvests, (5) supervision systems and SOPs, and (6) information systems on inventory and agro-industrial production.

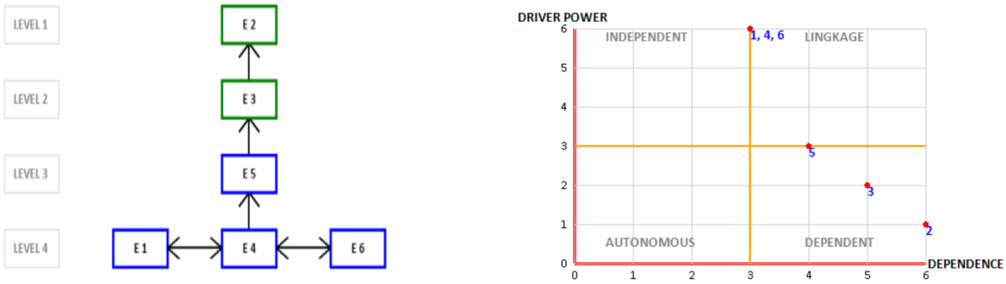

Figure 5. The result of ISM Element 2

Based on data processing using ISM with a consistency value of around 89%, it is found that the lowest-ranking sub-elements, which indicate their highest priority, include (1) skilled human resources, (4) superior seeds and harvests, and (6) information systems for inventory in agro-industrial production.

Based on Figure 5, it is visualized that the highest-ranking sub-elements are positioned in Sector III, which is a linkage sector. This implies that these three sub-elements have low influence but high dependency on each other. In this quadrant, the related elements are relatively less stable and require careful examination.

Element 3: Main Constraints

The main constraints are the third element of the ISM analysis, defined as the most significant factors hindering the achievement of goals or the success of a program or project. This element can be internal or external obstacles and can be physical, social, economic, political, or others. Several sub-elements are identified for this element, including (1) limited funding and capital, (2) high prices of superior quality seeds, (3) limited availability of agro-industrial technology, (4) low crop productivity, and (5) inadequate infrastructure and facilities. Based on data processing using ISM with a consistency value of approximately 100%.

Based on Figure 6, it is visualized that sub-elements 1 and 2 are positioned in Sector IV, which is an independent sector. This indicates that limited funding and capital are a driving force or the main driving sub-elements to achieve other sub-elements. This positioning implies that these factors operate independently and play a critical role as primary driving forces within the system. Limited funding and capital serve as essential prerequisites for the success of any program or project, as they directly impact the allocation of resources required for other activities, such as acquiring quality seeds or implementing agro-industrial technology. Similarly, high prices for superior seeds can create financial barriers that hinder access to essential inputs, subsequently affecting overall crop productivity and the overall success of agro-industrial efforts. These sub-elements are pivotal in shaping the system's performance and success. They act as fundamental enablers or constraints, influencing the achievement of other sub-elements in the program. As such, addressing these independent factors can significantly drive progress in overcoming other challenges, such as limited agro-industrial technology or inadequate infrastructure. Therefore, limited funding and capital, along with high seed prices, need focused attention to ensure a more sustainable and efficient pathway toward achieving system objectives.

Element 4: Possible Changes

Possible changes are the fourth element of ISM analysis, defined as factors that can be alteredto enhance the success prospects of a program or project. This element can be internal or external factors and may be physical, social, economic, political, or others. Several sub- elements are identified for this element, including (1) improving farmer welfare, (2) increasing productivity, (3) the development of sunflowers as industrial raw materials, (4) good coordination among agro-industry stakeholders, and (5) the availability of information technology infrastructure. Based on data processing using ISM with a consistency value of approximately 100%.

Based on Figure 7, it is visualized that sub-element 3 is positioned in Sector IV, which is an independent sector. This indicates that the development of sunflowers as industrial raw materials is a driving force or the main driving sub-element to achieve other sub-elements. This positioning indicates that the development of sunflowers acts independently and plays a key role as a primary driving factor within the system. It serves as a fundamental enabler, capable of influencing and driving progress in achieving other sub-elements such as improving farmer welfare, increasing productivity, and coordinating agro-industry stakeholders. The development of sunflowers as industrial raw materials holds significant potential to transform the agro-industrial landscape by providing a sustainable and reliable source of inputs for various industries. By fostering the cultivation and processing of sunflowers, the availability of raw materials can be ensured, leading to improved efficiency in production, reduced dependency on imported raw materials, and the creation of new economic opportunities for farmers and related stakeholders.

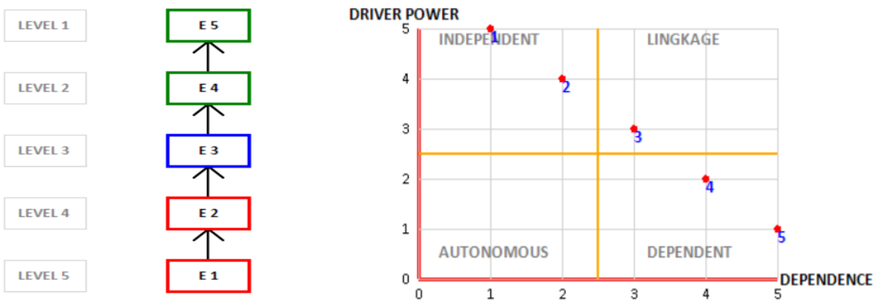

Figure 6. The result of ISM Element 3

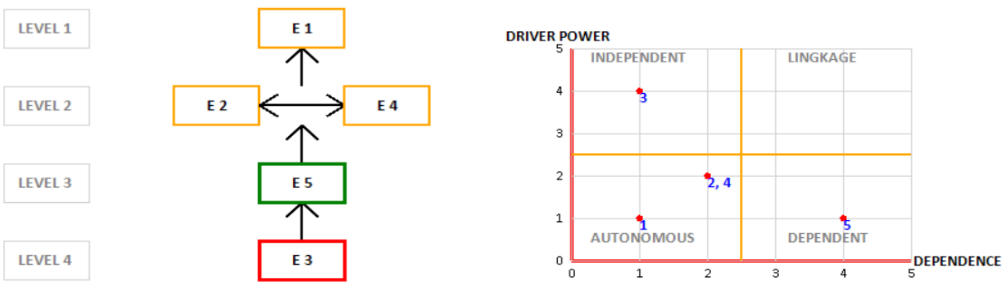

Figure 7. The result of ISM Element 4

This sub-element not only addresses immediate needs for raw materials but also contributes to long-term system stability and growth. As a result, focusing on the development of sunflowers as industrial raw materials can act as a catalyst, driving forward progress in other critical areas and enhancing the overall success prospects of the program or project.

Element 5: Program Objectives

The program objectives are the fifth element of the ISM analysis, defined as an overview of what the program aims to achieve. This element should be specific, measurable, achievable, relevant, and time-bound. Several sub-elements are identified for this element, including (1) expanding job opportunities, (2) increasing foreign exchange earnings, (3) enhancing public education, (4) improving productivity, (5) enhancing the quality of sunflower seeds and derivatives, (6) achieving balance in coordination and distribution of benefits, and (7) competitiveness of Indonesian sunflower products. Based on data processing using ISM with a consistency value of approximately 97%.

Based on Figure 8, it is visualized that sub-element 1 is positioned in Sector IV, which is an independent sector. This indicates that expanding job opportunities is a driving force or the main driving sub-element to achieve other sub-elements. This means that expanding job opportunities acts independently and serves as a key driving factor to achieve other sub-elements such as increasing foreign exchange earnings, enhancing public education, and improving productivity. By creating more employment opportunities, the program can directly impact various sectors, stimulate economic growth, and contribute to the achievement of broader program objectives. Therefore, expanding job opportunities is essential for driving progress in related areas and ensuring the overall success of the program.

Element 6: Metrics for Evaluating Each Objective

Metrics for evaluating each objective are the sixth element of ISM analysis, defined as indicators used to measure whether the objectives have been achieved or not. The metrics element should be specific, measurable, relevant, and achievable. Several sub-elements are identified for this element, including (1) increased income and welfare of farmers, (2) increased productivity of the sunflower agro-industry, (3) improved quality of the produced raw materials, (4) increased sales both domestically and internationally, and (5) increased private investment in agro-industry. Based on data processing using ISM with a consistency value of approximately 96%, it is known that the lowest-ranking sub-element, indicating its highest rank, includes increased productivity of the sunflower agro-industry.

Based on Figure 9, it is visualized that sub-element 2 is positioned in Sector IV, which is an independent sector. This indicates that increasing productivity in the sunflower agro-industry is a driving force or the main driving sub-element to achieve other sub-elements. This positioning indicates that increasing productivity acts independently and serves as a key driving factor to achieve other sub-elements, such as improving raw material quality, increasing sales, and boosting private investment.

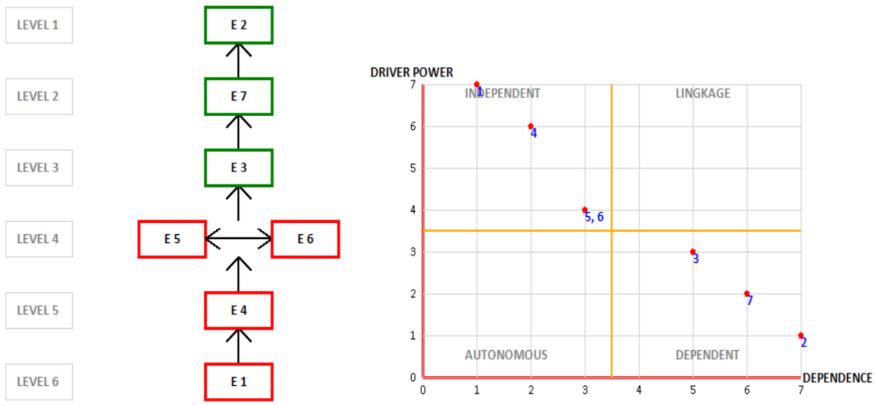

Figure 8. The result of ISM Element 5

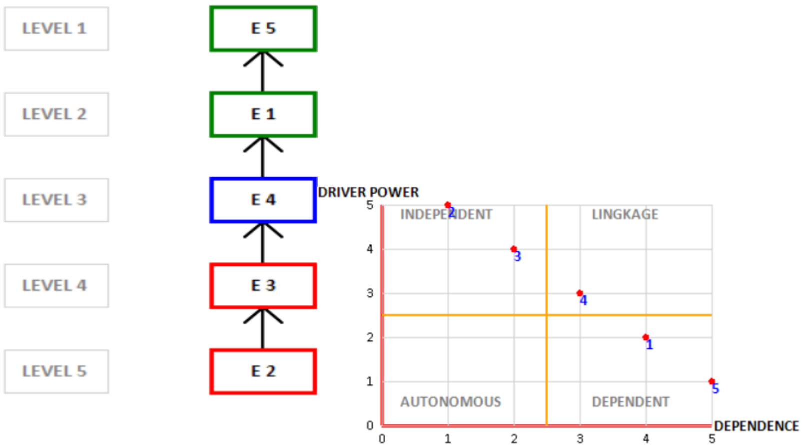

Figure 9. The result of ISM Element 6

By enhancing productivity, the sunflower agro-industry can achieve greater output and efficiency, leading to more sustainable growth and the realization of the program's objectives. Therefore, focusing on productivity is essential for driving forward progress in other areas and ensuring the success of the program.

Element 7: Activities Required for Action Planning

The activities required for action planning are the seventh element of ISM analysis, defined asthe steps needed to achieve program objectives. This element should be specific, measurable, relevant, and achievable. Several sub-elements are identified for this element, including (1) cultivation and processing activities in the sunflower agro-industry, (2) assurance of prices from the government or buyers, (3) field counseling, (4) development of a transparent and easily accessible information system, (5) coordination between farmers and industrial sector entrepreneurs, and (6) the presence of clear incentives for seeds and fertilizers. Based on data processing using ISM with a consistency value of approximately 97%, it is known that the lowest-ranking sub-element, indicating its highest rank, includes cultivation and processing activities in the sunflower agro-industry.

Based on Figure 10, it is visualized that sub-element 1 is positioned in Sector IV, which is an independent sector. This indicates that cultivation and processing activities act independently and serve as a key driving factor to achieve other sub-elements, such as assurance of prices, field counseling, and coordination between farmers and industrial sector entrepreneurs. By focusing on these activities, the efficiency and output of the agro-industry can be enhanced, leading to improved overall performance and progress toward achieving program objectives. Therefore, cultivation and processing activities are crucial for driving forward other related steps and ensuring the success of the program.

Element 8: Activity Metrics for Evaluating the Results Achieved by Each Activity

The activity metrics for evaluating the results achieved by each activity are the eighth elementof ISM analysis, defined as indicators used to measure whether activities have achieved their goals or not. The activity metrics element should be specific, measurable, relevant, and achievable.

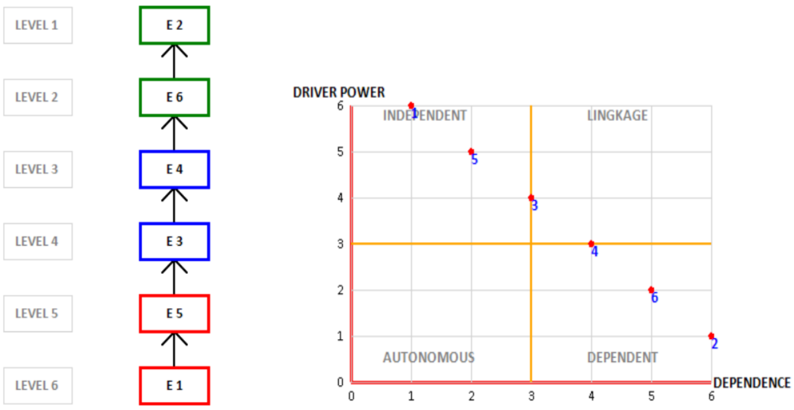

Figure 10. The result of ISM Element 7

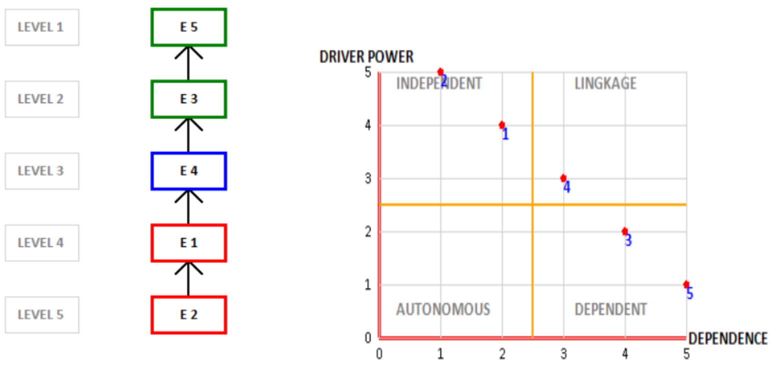

Figure 11. The result of ISM Element 8

Several sub-elements are identified for this element, including (1) indicators of theachievement of cultivation results in the sunflower agro-industry, (2) indicators of the achievement of yield results in processed sunflower products, (3) the moisture content to be achieved in the sunflower seed processing process is 12%, (4) farmer's compliance with the established best practices, and (5) accuracy of information received by both parties. Based on data processing using ISM with a consistency value of approximately 100%, it is known that the lowest-ranking sub-element, indicating its highest rank, includes indicators of the achievement of yield results in processed sunflower products.

Based on Figure 11, it is visualized that sub-element 2 is positioned in Sector IV, which is an independent sector. This indicates that these indicators act independently and serve as a key driving factor to achieve other sub-elements, such as cultivation results, moisture content, farmer compliance, and accuracy of information. By focusing on yield achievement, the effectiveness of processing and production in the sunflower agro-industry can be improved, leading to better overall outcomes and the successful realization of program goals. Therefore, yield indicators are crucial for driving forward other related activities and ensuring the success of the program.

Element 9: Institutions Involved in Program Implementation

Institutions involved in program implementation are the ninth element in ISM analysis, definedas institutions or organizations responsible for executing the program. These institutions can be government agencies, non-governmental organizations (NGOs), non-profit organizations, or the private sector. There are several sub-elements identified for this element, namely (1) Ministry of Agriculture, (2) central government, (3) local government, (4) cooperatives, (5) banking institutions, (6) National Agency of Drug and Food Control (BPOM), and (7) National Halal Product Assurance Agency (BPJPH). Based on data processing using ISM with a consistency value of around 92%, it is known that the lowest sub-element, which means it has the highest rank, includes cooperative.

Based on Figure 12, it is visualized that sub-element 4, namely cooperatives, is in sector IV, which is an independent sector. This indicates that cooperatives act independently and serve as a critical driving force in program implementation. Cooperatives play a significant role in mobilizing resources, organizing farmers, and facilitating collaboration between various stakeholders, which makes them essential in achieving the program's objectives.

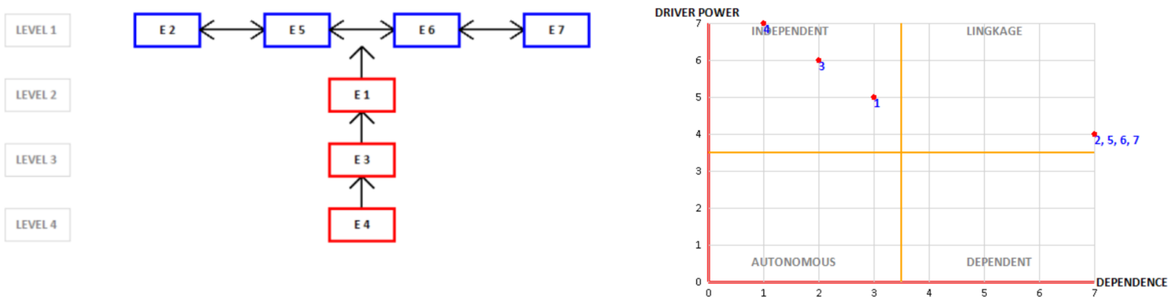

Figure 12. The result of ISM Element 9

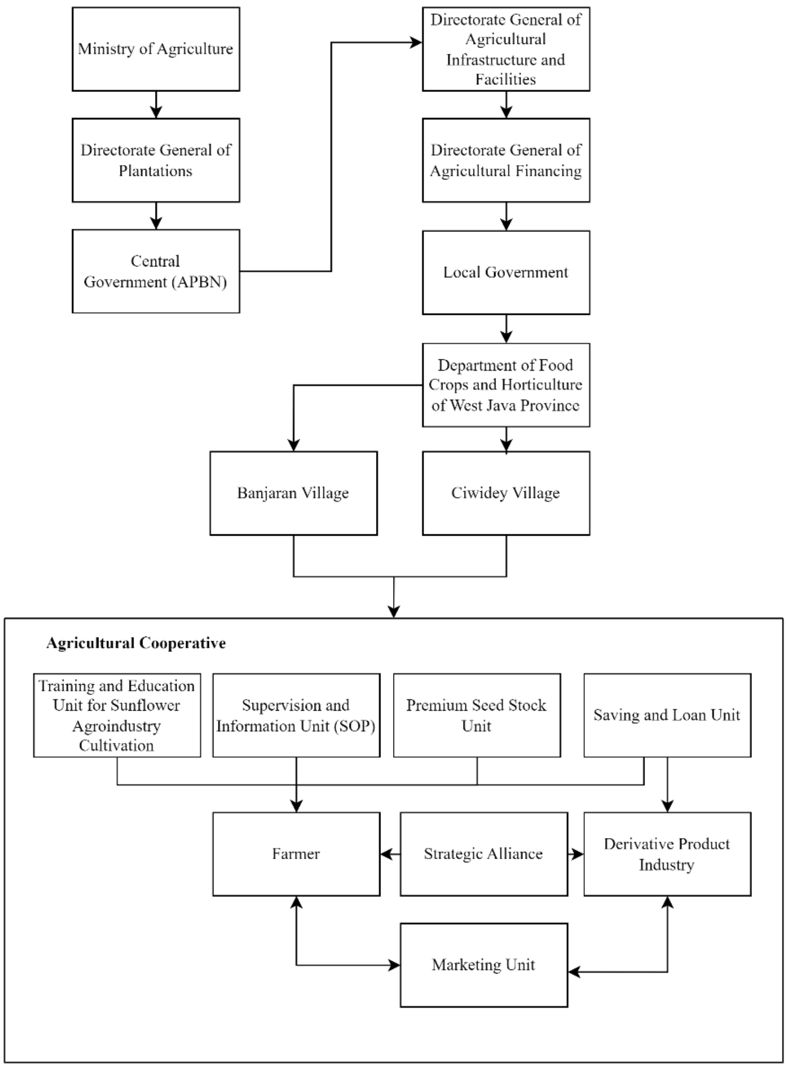

Figure 13. Institutional Model of Sunflower Agro-industry Supply Chain

By focusing on strengthening cooperatives, other sub-elements such as government agencies, banking institutions, and Halal Product Assurance Agency can be effectively engaged, leading to more successful and sustainable outcomes in the program

Proposed Institutional Model for the Sunflower Agro-Industry Supply Chain

Figure 13 illustrates the proposal for the establishment of a farming cooperative comprising various units tailored to the interests identified from the ISM results. These units include a training unit for farmers to improve their welfare, a SOP supervision unit, a unit for stocking selected seeds to address constraints in accessing superior seed supplies, and a savings and loan unit serving as a platform for farmers to obtain working capital. The working capital can beobtained from the government through the Ministry of Agriculture and local government departments. Additionally, it is also proposed to establish a strategic alliance between farmers and sunflower product processing industries to enhance agro-industry productivity and profitability.

Analysis and Design of Information Support Systems Using the Design System Approach

These requirements were obtained based on interviews with sunflower agro-industry stakeholders regarding the system needs they wish to have. Users of the system include farmers, traders, and processing industries. The identified system user requirements are as follows :

1. System users can access and input information regarding the stock of sunflower seeds and seeds from each producing area, along with information about the type of seeds and their origin.
2. System users can access and input information about the planting season in each producing area, accompanied by details about the timing of the season and the cultivated land area.
3. The next step involves adapting these requirements to the UML diagrams and GUI layout to be developed. Below are the results of the UML design along with the GUI interface.

Business Process Modeling Notation (BPMN)

Based on Figure 14, there are four distinct groups with their respective processes. The core process begins from inputting data information to be stored in the system until the latest data condition can be displayed on the system. The activities include data inputting, searching related information, data checking and management, and updating data display on the system.

Use Case Diagram

Based on Figure 15, there are 3 actors who will use this information support system, namely farmers, sunflower seed processing industries, and traders. The actor who can access and inputthe latest information is the farmer. Sunflower seed processing industries and traders can onlyaccess the latest information in the system. This is adjusted according to the needs of each actor.

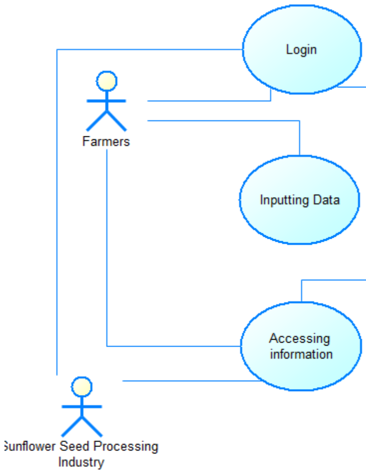

Figure 15. Use Case Diagram

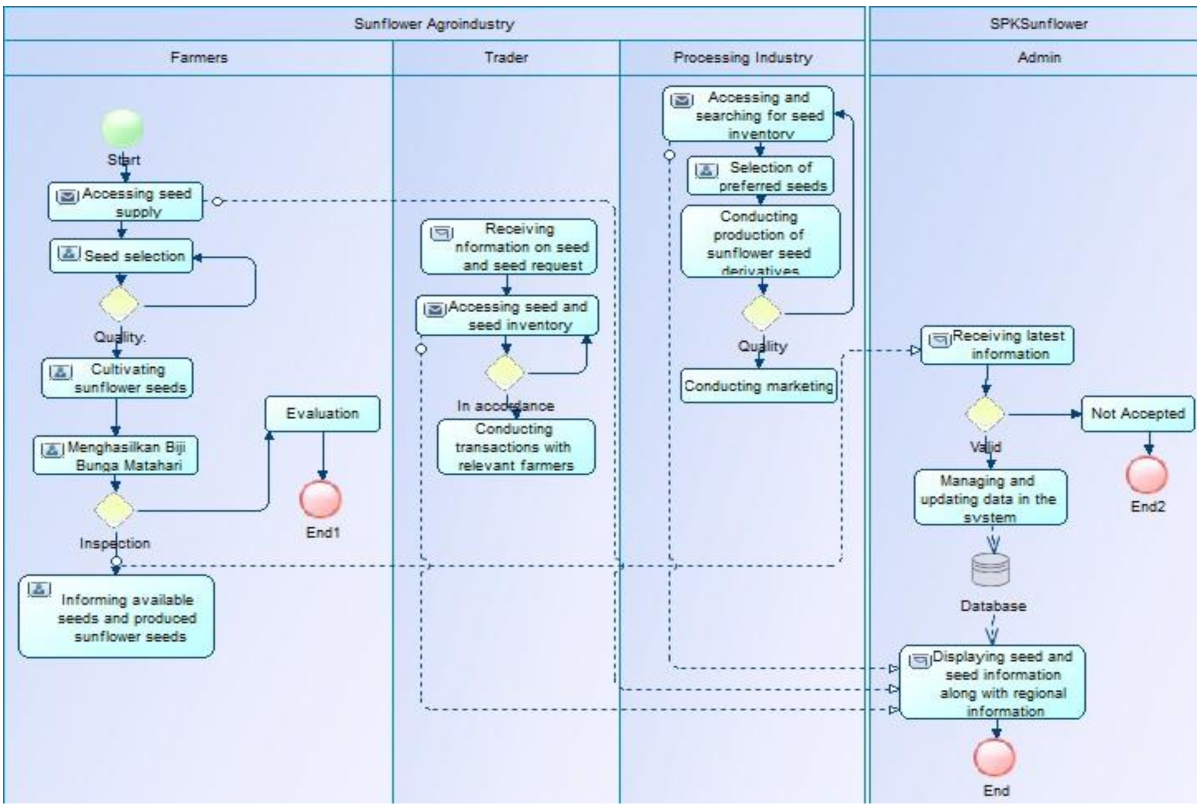

Figure 14. BPMN Diagram

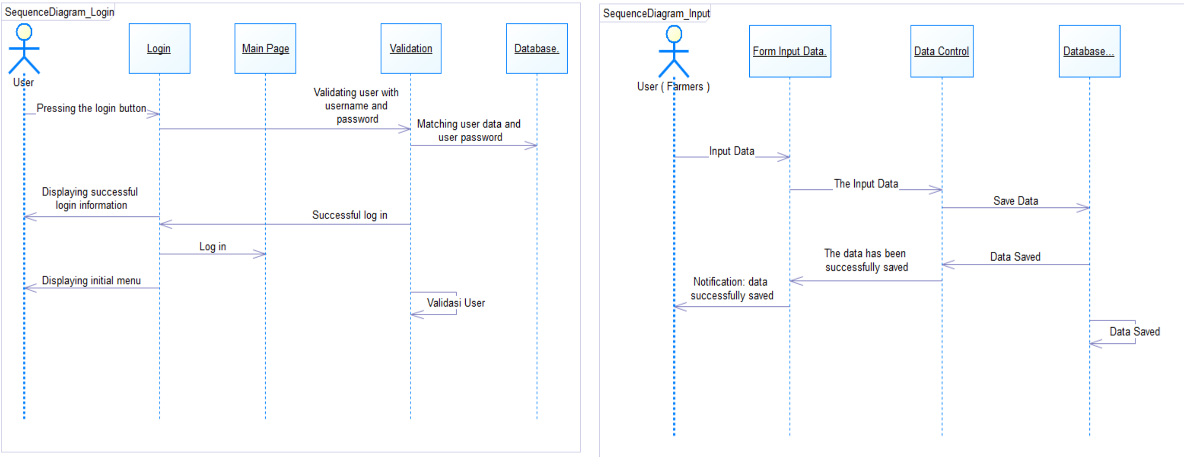

Figure 16. Sequence Diagram for Login (Left) and Input (Right)

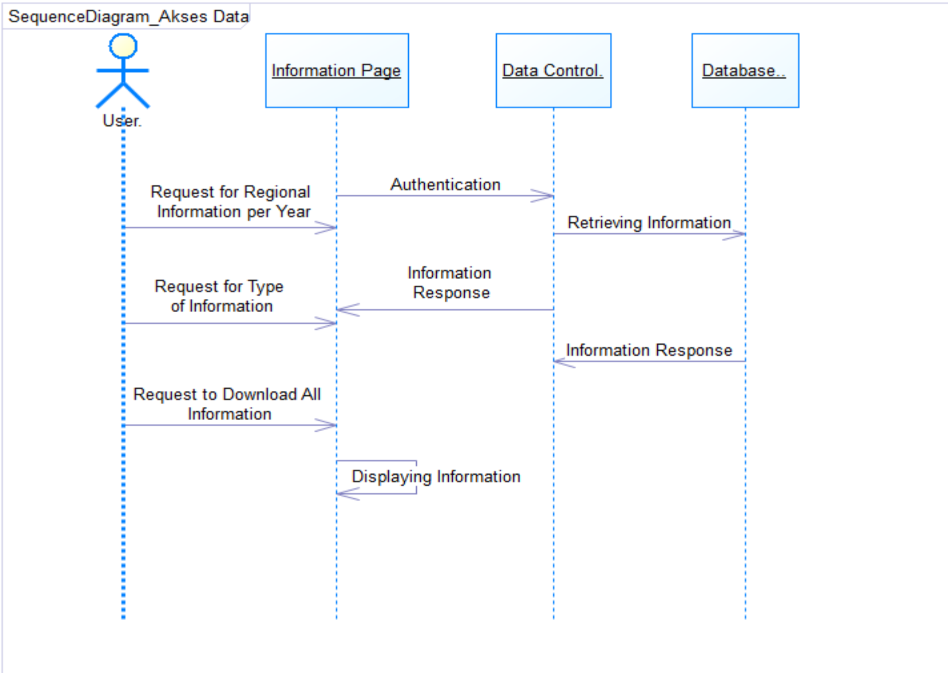

Figure 17. Sequence Diagram for Data Access

Sequence Diagram

The sequence diagram is presented to provide information on how the user interacts with the system, from logging in to performing activities within the system. This aims to illustrate the interaction between actors in the process performed in the system and ensure that this processruns securely and efficiently. There are three sequence diagrams based on the previously owneduse cases, namely login, input data, and data access. All three are outlined in Figure 16 and Figure 17

Class Diagram

Based on Figure 18, there are several classes, each with attributes and relationships between classes. In this system, the existing classes consist of login, input data form, and information page as interfaces. Then, data control and validation serve as control. Lastly, the database actsas the boundary. All classes are determined based on the boundaries present in the sequence diagram. As for the relationships between classes, from login to the main page, each login canreceive different views, one or more. Similarly, the relationship between the main page and theinput data form and information page follows the same pattern.

Graphical User Interface (GUI)

Figure 19 depicts the GUI interface for the information support system in the institutionalmodel of sunflower agro-industry using JustInMind software.

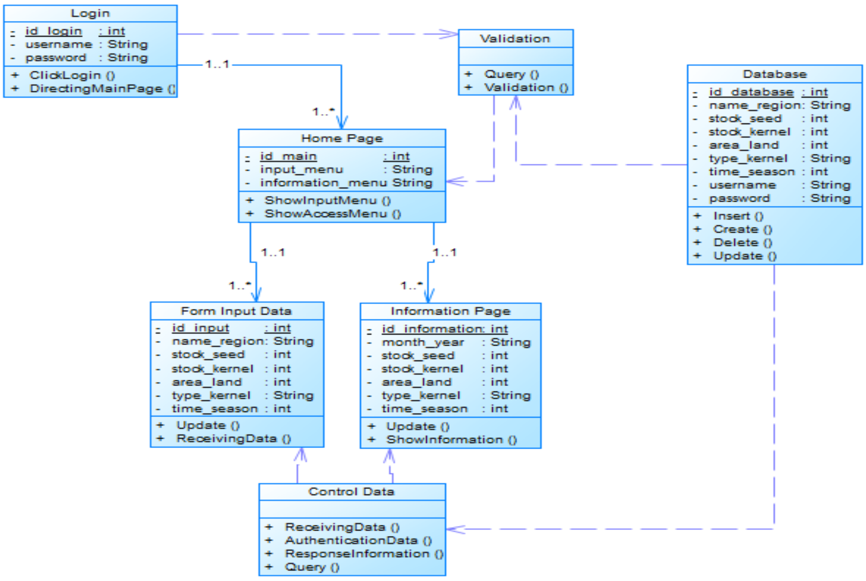

Figure 18. Class Diagram

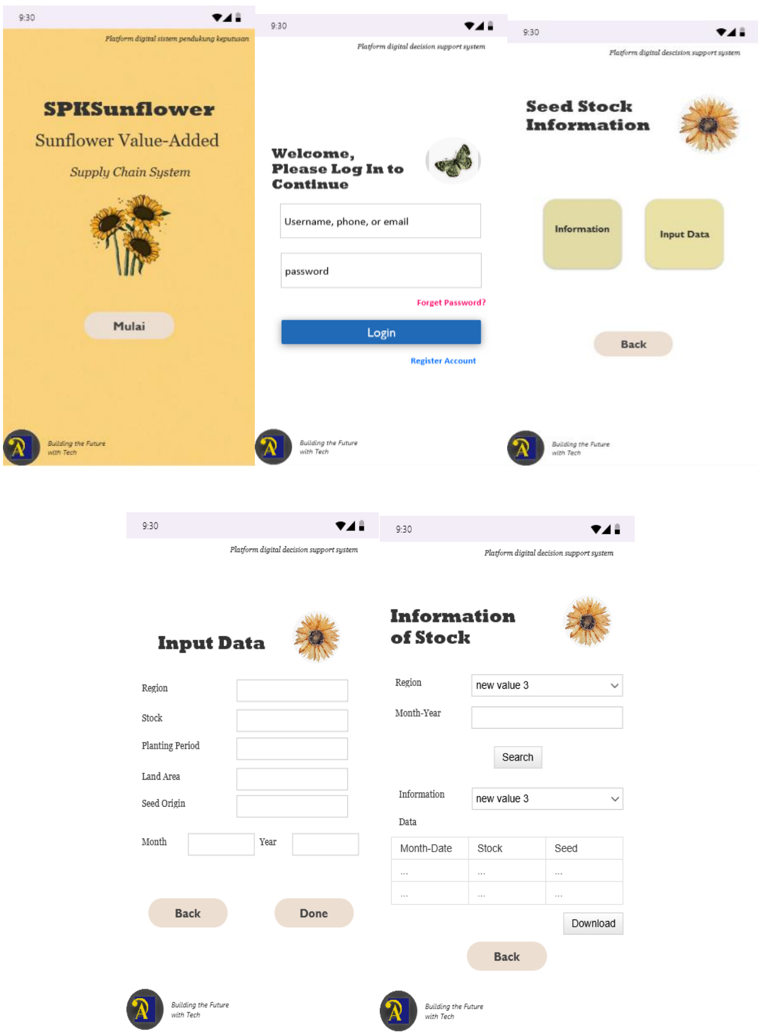

Figure 19. GUI Display

CONCLUSIONS AND RECOMMENDATION

Conclusion

Based on the findings of this research, the following conclusions can be drawn:

1. Situational analysis conducted through direct and indirect interviews elucidated several current conditions and needs of stakeholders in the sunflower agro-industry. Based on the situational analysis, a framework for system requirements was established. Through this framework, the main needs in the supply chain system of sunflower agro-industry were identified, including increasing the productivity of sunflower seed products, designing an optimal institutional model, and developing an information system model to support these institutions. The proposed optimal institutional model aims to be implemented within the sunflower agro-industry to establish effective and efficient business activities from upstream to downstream production, leading to enhanced productivity, increased competitiveness, and sustainability in this sector.
2. One of the needs in the sunflower agro-industry is the design of an optimal institutional framework. A comprehensive institutional analysis was conducted using the Interpretive Structural Modeling (ISM) method with nine elements representing the priorities in the institutional program to be developed. Based on these criteria, a model for the sunflower supply chain institution was designed.
3. Another requirement is the design of an information support system to facilitate the operational aspects of the institutional program. This was also identified as a priority need based on the ISM results. A design model for the decision support system, comprising BPMN, use case diagram, sequence diagram, class diagram, and GUI display, was successfully developed.

Recommendation

Based on the results of the analysis and discussion, the following recommendations can be proposed:

1. The limitations of this study do not extend to implementation, with the output being an institutional design model. This could serve as a basis for future research on the implementation and development of institutional design.
2. Future research could focus on the sustainability of the sunflower agro-industry supply chain.
3. The information system design in this study is limited to the GUI, so future research could continue with the development of the database and other related aspects.

GRATITUDE EXPRESSION

Thanks are extended to the *Lembaga Penelitian, Inovasi, dan Pengabdian Masyarakat* (LPIPM) University of al-Azhar Indonesia for funding the research activities under the Multi-Discipline Research Grant scheme in the fiscal year 2023.

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