The interpretive structural modeling (ISM) method approach in the development of Aloe vera agribusiness institutional models

Sulhajji Jompa, Rizal Syarief, Surjono H. Sutjahjo, Aton Yulianto

Study Program of Natural and Environmental Resource Management, Graduate School Faculty, IPB University, Bogor, Indonesia. Corresponding author: S. Jompa, sulhajji@yahoo.com

Abstract. One of the requirements for analyzing the development of the agricultural sector is to build an institutional model. The success in developing the institutional model is determined by the selection of the influencing variables (elements). With the large number of elements and their sub-elements, as well as the complex relationships between them, the analysis also becomes more complicated. This study aimed to formulate an institutional form and model of agribusiness that allows stakeholders to work together to encourage the growth of Aloe vera agribusiness in Bogor Regency using the Interpretive Structural Modeling (ISM) method. The study used four elements (objectives, actors, constraints and needs) and 29 sub-elements. The four elements and the 29 sub-elements were then assessed by experts from various fields (agribusiness actors, direct policy implementers/local governments, associations, non-governmental organizations in the field of agribusiness, academics and policy makers/legislative members). The opinions of the experts were then analyzed using the ISM. The results of the analysis show that the Aloe vera agribusiness institution can develop well by setting the main goal of creating a joint business group, supported by important actors, especially business groups, the Office of Food Crops, Horticulture and Plantation and the Regional Development Planning, Research and Development Agency.

Key Words: agricultural development, agribusiness, Aloe vera, ISM, institutional model.

Introduction. The agricultural sector still plays an important role in the economic development of a country. The role of agriculture in the economic development is to provide cheap food with cheap labor. Increased productivity in the agricultural sector can contribute to the overall economic growth, and supply labor and capital to other sectors. Nevertheless, industrialization is still considered the main driver of economic growth, and the agricultural sector is still considered a traditional sector with low productivity (Dethier & Effenberger 2011).

In Indonesia, the agricultural sector is still the main driver of national economic development. The contribution of the agricultural sector to Indonesia's GDP (gross domestic product) in 2020, based on current prices, reaches 13.7% and is in second place after the manufacturing sector, with a contribution of 19.9% (Central Bureau of Statistics 2021). In addition, the agricultural sector also absorbs the largest number of workers. Of the 128.5 million Indonesian workers (August 2020), 38.2 million (29.8%) of them work in the agricultural sector, more than the trade sector (24.7 million people or 19.2%) and the manufacturing sector (17.5 million people, 13.6%) (Central Bureau of Statistics 2021).

There is a lot of land in the Bogor Regency area that has not been used by the owners. This opens up opportunities to be utilized in agribusiness development. Aloe vera agribusiness in marginal or abandoned land is one alternative. Aloe vera agribusiness is an agricultural activity-based business that develops Aloe vera commodities widely. The development of the agricultural sector basically builds the foundation of the national economy. The development of the agricultural sector has been implemented since Indonesia's independence, but there are still many things that need to be improved. There are several serious problems faced in agricultural development, including: the conversion of agricultural land to commercial land, the decline in labor in the agricultural

sector, the decreasing level of farmers' aggregate welfare and the increasing imports of foodstuffs from other countries.

Agricultural development is not a separate sector, but includes activities from upstream to downstream subsystems. The government is tasked with coordinating private and public institutions in infrastructure development, seed industry, strengthening rural agro-industry, market information, market restructuring and trade policies, developing MSMEs (micro, small and medium enterprises), macroeconomic stability, land deregulation, strengthening governance, environmental sustainability and increasing rural productivity (Nainggolan 2002). Therefore, the development of the agricultural sector is closely related to the institutions.

Institutions in agricultural development are influenced by various factors. Accelerating institutional transformation is done by leveraging knowledge economy, technology, organization and management (Putsenteilo et al 2020). Agricultural institutions that only rely on farmer groups, cooperatives and community economic institutions have not played a maximum role in increasing agricultural added value, but also need to be supported by external institutions such as R&D institutions, banking, production facilities, processing and marketing activities (Sinaini & Iwe 2020).

Developing agricultural institutions (including agribusiness and agro-industry) requires a clear strategy. The strategy refers to the elements needed in developing and developing agricultural institutions. There are various important elements that are often used in the development of agricultural institutional models. Some of the elements that are often used include: actors, objectives, constraints, needs, change, scope, management, scale, productivity and others (Sianipar 2012; Feriadi 2016; Pradini et al 2017; Cai & Xia 2018; Rosadi 2018; Silalahi et al 2018; Sukwika 2018; Rohmah et al 2019). Researchers use either single elements or combinations.

Besides that, another important thing in understanding the institutional model of agriculture is the method of analysis. There are various methods used. One method that is widely used in the development of agricultural development models is the Interpretive Structural Modeling (ISM) method. This study aimed to formulate an institutional form and model for agribusiness that allows stakeholders to synergize with the growth of Aloe vera agribusiness using the ISM method.

Material and Method

Location and time of research. The research was conducted from January to May 2021. The research locations were in Bogor Regency, West Java Province.

Experimental design and data analysis. This research was conducted in several stages (Figure 1). Starting with a literature study to find out various previous literature related to agribusiness institutions, and what elements are widely used in institutional development. Then determine the elements and sub-elements that influence the Aloe vera agribusiness institution. Then determine the experts who will be selected to assess the importance of each element and sub-elements of the institution. Experts are selected from various groups, such as agribusiness actors, direct policy implementers (local government), associations, non-governmental organizations in the agribusiness sector, academics, and policy makers (legislators). The experts were then asked to determine the order of importance between each sub-element for each element. Opinions from experts are then analyzed using ISM.

ISM is a process that helps compiling collective knowledge and modeling complex interrelationships. ISM helps to identify structures in a system and to analyze them from several points of view (Alawamleh & Popplewell 2011). It is an interactive, computer-assisted process to produce structural models that describe the structure of systems or fields, consisting of complex relationships between elements, via designed patterns, using graphics and words. The specific relationship and the overall structure are described in a diagraph model (Sushil 2012). ISM processes data in a structured manner to connect various variables that affect the system (interrelationships). ISM helps solving

problems from various relationships between elements related directly or indirectly to a complex system (George & Pramod 2014).

In a complex system, involving many variables and complex interactions between variables, the analysis becomes complicated. There are various variables related directly or indirectly, which may not be articulated in a clear way and are not clearly presented and defined, making the system structure even more complex. ISM allows to identify and simplify more easily the structure of a system (Thalib et al 2011). ISM helps in analyzing based on group judgments and decisions whether and how system elements are linked, from a complex set of system variables (Digalwar & Giridhar 2015).

In this research activity, ISM began the process of changing the questionnaire result matrix (aggregate opinions of experts) into a Structured Self Interaction Matrix (SSIM). The SSIM results were then transformed into Reachability Matrix (RM) through transitivity, partitioning and lower-triangular format processes. The RM results were later changed to the final SSIM. The final SSIM is classified for each sub-element of each element based on the value (position) of driving power (DP) and dependence (P) in the form of a DP-P matrix (Sushil 2012; George & Pramod 2014; Dachyar et al 2014; Digalwar & Giridhar 2015; Rosadi 2018; Sharma & Ilavarasan 2018).

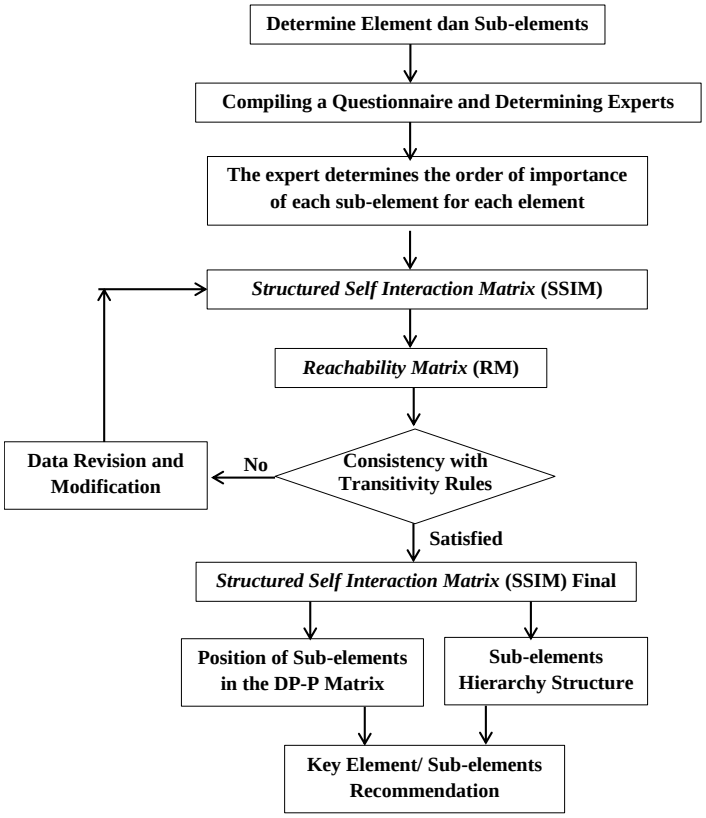
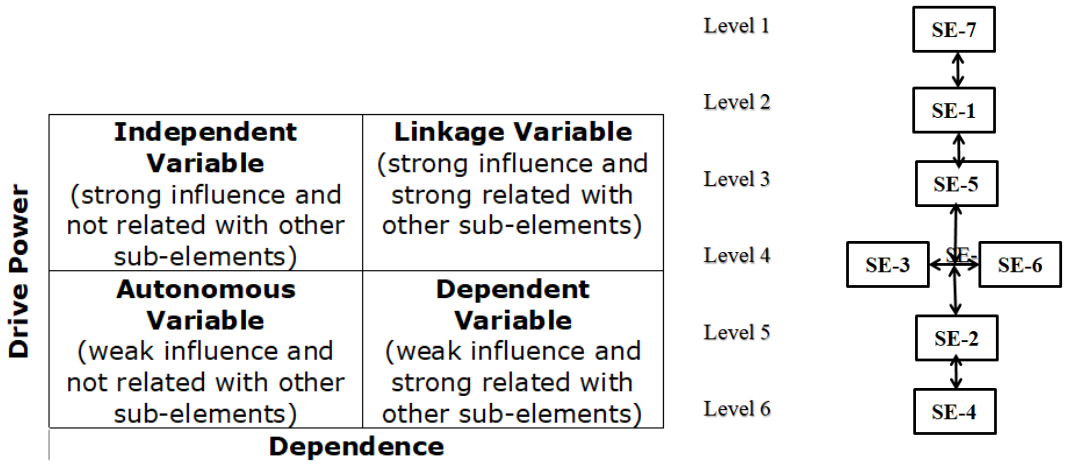


Figure 1. Stages of institutional analysis using Interpretive Structural Modeling (ISM).

The results of the ISM process are then described in two forms: (a) Driver Power – Dependence Matrix (DP-P Matrix) and (b) Hierarchical Structure. The DP Matrix describes the position of each sub-element in the quadrant for each element (Figure 2a). Meanwhile, Hierarchical Structure describes the level of each sub-element for each element (Figure 2b).



(a) (b)

Figure 2. Driving power-dependence matrix (a) and hierarchical structure (b) of an element.

For each element, the DP-P Matrix (Figure 2a) is divided into four quadrants, according to the position of the driver power (DP) and dependency (P) for each sub-element:

a. Quadrant 1 is an autonomous variable where the driving power is weak and the dependence is also weak. The sub-elements included in this quadrant are generally not related or weakly related with other sub-elements.
b. Quadrant 2 is the dependent variable, with a weak driving power and a high dependence. The sub-elements that enter this quadrant are generally not free and are very dependent on other sub-elements
c. Quadrant 3 is a linkage variable with a strong driving power and a high dependence. The sub-elements that are included in this quadrant should be further analyzed, because the relationship with other sub-elements is unstable. In addition, the handling of this sub-element will affect (impact) the other sub-elements.
d. Quadrant 4 is an independent variable, with a strong driving power and a low dependence. The sub-elements that are included in this quadrant have great potential, because they have the power to make changes.

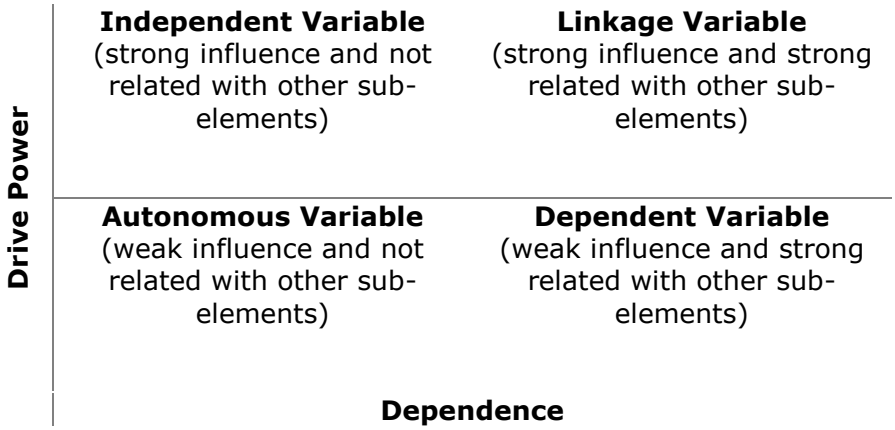


Figure 2. DP-P matrix.

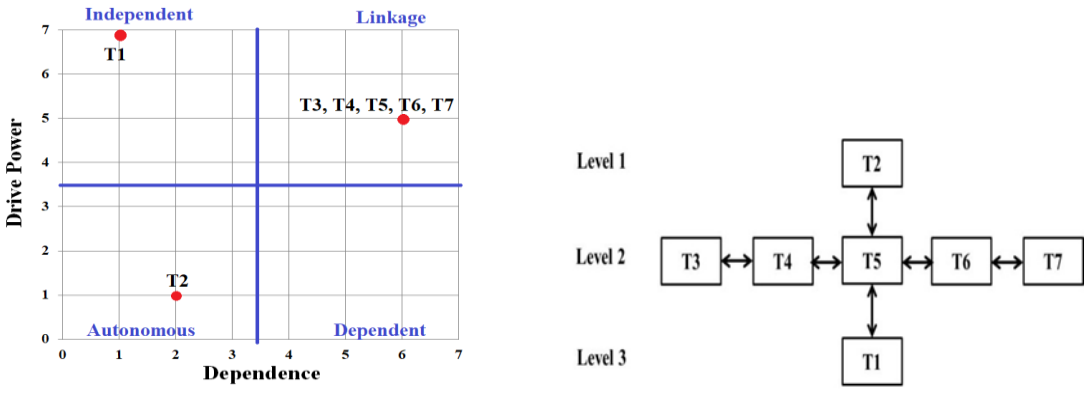
Results and Discussion. The institutional model of Aloe vera agribusiness in Bogor Regency uses four elements, i.e.: (1) objectives, (2) actors, (3) constraints and (4) needs. These four elements along with the details of their sub-elements are then discussed with experts consisting of: government representatives (Bogor Regency Agriculture Technical Service), legislators (central and Bogor Regency), academics (University professors), associations (Chairperson), non-governmental organizations (members of several organization) and farmers. These elements of institutional development are analyzed using ISM, which is a methodology to identify relationships

between elements and sub-elements, both direct and indirect, in order to describe the situation more accurately.

Analysis of objective elements. For the Objective Element, there are seven accompanying sub-elements used, i.e: (T1) Creating a Joint Business Group, (T2) Optimizing unused/utilized land, (T3) Developing Aloe vera agribusiness as a leading commodity, (T4) Expanding farmers' employment, (T5) Increase farmers' income, (T6) Increase business opportunities and collaboration and (T7) Increasing product diversification (processed products).

After the mapping with the DP-P Matrix (Figure 3a), the results show that the sub-element (T1) Creating a joint business group, is included in the quadrant 4. This shows that this sub-element is very important, as the main driving factor in the development of Aloe vera agribusiness in Bogor Regency. Other sub-elements, such as: Developing Aloe vera agribusiness as a leading commodity (T3), Expanding farmers 'employment (T4), Increasing farmers' income (T5), Increasing business opportunities and collaboration (T6), and Increasing product diversification (processed products) (T7), have a great driving force, but remain dependent on other sub-elements. On the other hand, the sub-element Optimizing unused/utilized land (T2) has a low propulsion and low dependency.

Based on the hierarchical structure, the seven sub-elements of the objectives element are arranged into three levels (Figure 3b). Level-3 is a sub-element of T1. The sub-elements of T1 need serious attention, because it allows the achievement of all objectives in the development of Aloe vera agribusiness in Bogor Regency. Meanwhile, other sub-elements: T3, T4, T5, T6 and T7 also have a considerable influence; meanwhile, T2 has a relatively weak effect.



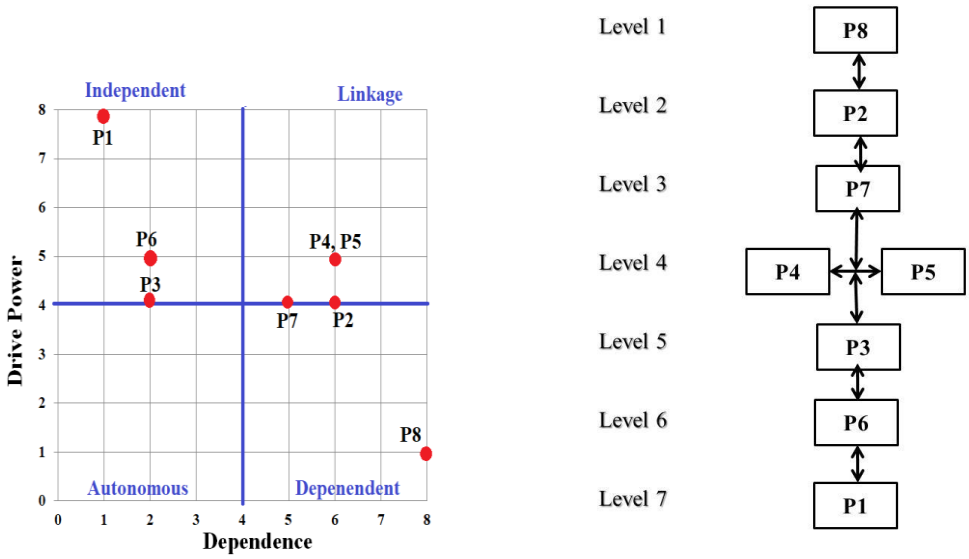
(a) (b)

Figure 3. Driving power-dependence matrix (a) and hierarchical structure (b) of objective elements in the development of Aloe vera agribusiness in Bogor Regency.

Analysis of actor elements. For the actor element, there are eight accompanying sub-elements, i.e: (P1) Joint business group, (P2) Agribusiness actors, (P3) Regional development planning, research and development agency (Bappedalitbang), (P4) Community and village empowerment offices, (P5) Village government, (P6) Food crops, horticulture and plantation offices, (P7) Financial institutions, and (P8) Research institutions.

From the mapping with the DP-P Matrix (Figure 4a), it resulted that the sub-element P1, P6, and P3 are very important sub-elements and the main actors in the development of Aloe vera agribusiness in Bogor Regency. Other sub-elements: P2, P7, P4, and P5, although they have a large driving force, they are also highly dependent on other sub-elements. On the other hand, P8 were of a weak influence.

Based on the hierarchical structure, these sub-elements are arranged into seven levels (Figure 4b). P1 is at Level-7, which indicates that it needs serious attention, if all actors want to participate. Because the sub-elements allow the involvement of all actors in the development of Aloe vera agribusiness in Bogor Regency.



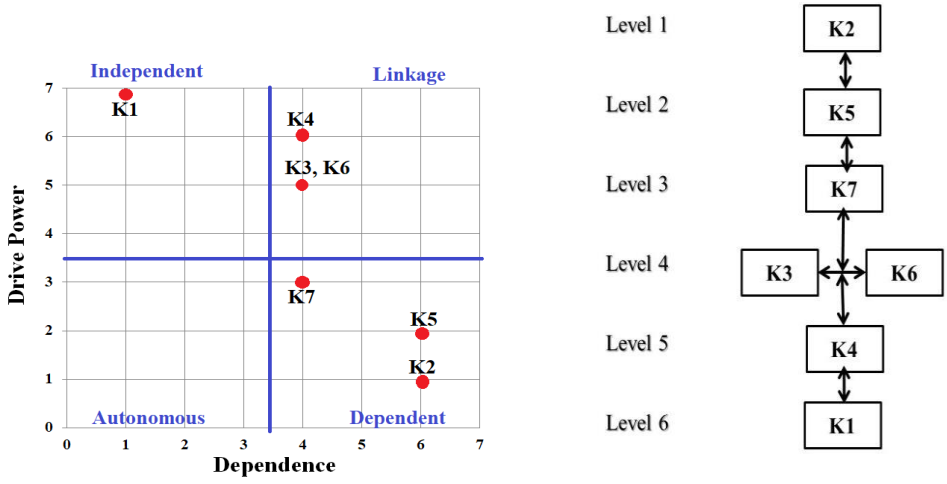
(a) (b)

Figure 4. Driving power-dependence matrix (a) and hierarchical structure (b) of Actor elements in the development of Aloe vera agribusiness in Bogor Regency.

Analysis of constraint elements. For the Constraint Element, there are seven accompanying sub-elements, i.e: (K1) Weak joint business institutions, (K2) Weak farmers in accessing capital, (K3) Narrow land ownership level, (K4) Lack of government support in agribusiness development, (K5) Change of land functions, (K6) Limited technology and (K7) Ineffective extension institutions.

The DP-P matrix (Figure 5a) shows the weakness of the Joint Business Institution (K1), included in the Quadrant 4. This shows that this sub-elements is the main constraints and very important to be addressed immediately in the development of Aloe vera agribusiness in Bogor Regency. Other sub-elements, such as K3, K4 and K7, although they have a large driving force, their dependence on other sub-elements is also high. Meanwhile, other sub-elements have a relatively small effect.

Based on the hierarchical structure, these sub-elements are arranged into six levels (Figure 5b). The weakness of the Joint Enterprise Institution is at Level-6 (the top of the Constraint Elements) which indicates that it is a key sub-element, as an obstacle that affects other constraint sub-elements. A success in overcoming the constraints of Weak Joint Business Institutions is very important in the development of Aloe vera agribusiness in Bogor Regency.



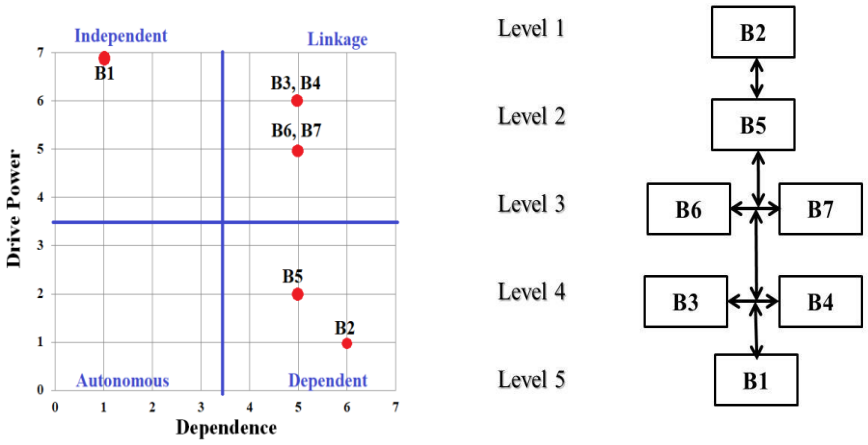
(a) (b)

Figure 5. The driving power-dependence matrix (a) and the hierarchical structure (b) of Constraint Elements in the development of the Aloe vera agribusiness in Bogor Regency.

Analysis of need elements. For the Need Element, there are seven accompanying sub-elements, i.e: (B1) Joint business assistance, (B2) Product price guarantee, (B3) Socialization and training, (B4) Appropriate production technology, (B5) Guarantee markets, (B6) Continuity of raw materials and (B7) Ease of access to capital.

The DP-P matrix (Figure 6a) shows that Joint Business Assistance (B1) is an urgent need. With a driving power of great influence, as well as a low dependence on other sub-elements, the Joint business assistance is a very important primary need in the development of Aloe vera agribusiness in Bogor Regency. Meanwhile, B3, B4, B6 and B7 are quite important needs.

Based on the hierarchical structure, these sub-elements are arranged into five levels (Figure 6b). B1 is at Level-5 (the top for the need elements) which indicates that this sub-element is a key affecting other need sub-elements.



(a) (b)

Figure 6. The driving power-dependence matrix (a) and the hierarchical structure (b) of need elements in the development of Aloe vera agribusiness in Bogor Regency.

Conclusions. The Interpretive Structural Modeling (ISM) method is able to describe the institutional model of Aloe vera agribusiness in Bogor Regency. The institutional model uses four elements, namely: Goals (T), Actors (P), Constraints (K), and Needs (B). Of the seven sub-elements in the Goal Element (T), the Sub-element Realizing a Joint Business Group (T1) needs serious attention, because it enables the achievement of all goals. Meanwhile, for the Actor Element (P), the sub-elements: Joint business group (P1), the Food crops, horticulture and plantation service (P6) and Bappedalitbang (P3) are very important sub-elements. For the Constraint Element (K), the sub-element Weak joint business institution (K1) is the main obstacle that is very important to be overcome immediately. On the other hand, for the Element of Need (B), the sub-element of Joint Business Assistance (B1) is the main requirement in the development of Aloe vera agribusiness in Bogor Regency. The synergy of various important sub-elements of the four elements in the institution will enable the Aloe vera institution in Bogor Regency to develop well.

Acknowledgements. Special thanks to IPB University for the administrative support in the conduct of this study.

Conflict of interest. The authors declare no conflict of interest.

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Received: 01 March 2021. Accepted: 16 April 2021. Published online: 30 April 2021.
Authors:
Sulhajji Jompa, IPB University, Study Program of Natural and Environmental Resource Management, Graduate School Faculty, Academic Ring Road Campus IPB Dramaga, 16680 Bogor, Indonesia, e-mail: sulhajji@yahoo.com
Rizal Syarief, IPB University, Department of Food Technology, Academic Ring Road Campus IPB Dramaga, 16680 Bogor, Indonesia, e-mail: rsyarief@apps.ipb.ac.id
Surjono Hadi Sutjahjo, IPB University, Department of Agronomy and Horticulture, Faculty of Forestry, Academic Ring Road Campus IPB Dramaga, 16680 Bogor, Indonesia, e-mail: surjonohadisutjahjo@yahoo.com
Aton Yulianto, Agency for Assessment and Application of Technology (BPPT), Jl. M.H Thamrin No. 8 Jakarta Pusat DKI Jakarta 10340, Indonesia, e-mail: aton.yulianto@bppt.go.id

How to cite this article:
Jompa S., Syarief R., Sutjahjo S. H., Yulianto A., 2021 The interpretive structural modeling (ISM) method approach in the development of Aloe vera agribusiness institutional models. AAB Bioflux 13(1):8-16.