International Journal of Agriculture System
Vol. 7 Issue 1, June 2019
Nationally Accredited Journal Decree No. 48a/E/KPT/2017
P-ISSN: 2337-9782, E-ISSN: 2580-6815. **DOI: 10.20956/ijas.v7i1.1842**

Cultivating *Canavalia ensiformis*: Is Institutional Function Still Needed?

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How to Cite: Nuddin, A., Putra, R.A., Irmayani., Nuringsih., Akib, M.A. (2019). Cultivating Canavalia ensiformis: Is Institutional Functions Still Needed?. *Int. J. Agr. Syst.* 7(1): 39-51

ABSTRACT

Several problems deal with Canavalia ensiformis cultivations. They are the low-price competitiveness, the absence of processing industries and appropriate agricultural technology controlled by the farmers, the absence of fostering of farmers, especially in terms of marketing and postharvest processing. Therefore, the study explores how the role and function of coordination in institutions is needed as a solution for developing Canavalia ensiformis cultivation? The research was conducted from March to August 2019, using the survey method. Data collection is done through an expert system/or practitioner approach. The data obtained were analyzed using the Interpretative Structural Modeling (ISM) method. The results show that the existing institutions have not understood their roles and functions in the development of Canavalia ensiformis cultivation. This is an indication of the weak coordination function. The weak function of coordination is a result of weak understanding of the visions, low institutional knowledge and conflict between institutions. The results of the ISM analysis show that there are two key strategic programs in developing the commodity of Canavalia ensiformis, namely human resource and marketing development. These two sub-elements are institutional indicators. Therefore, strengthening institutional functions is still needed in the development of Canavalia ensiformis cultivation.

Keywords:
Canavalia ensiformis; institution; coordination function; interpretative structural modeling

1. Introduction

Canavalia ensiformis (*C. ensiformis*) is one type of commodity that has a profitable prospect to be developed in Indonesia. One of the objectives of developing this commodity is to overcome dependence on soybeans as the raw material for the tempeh industry. All of this in order to ensure food security includes, among others: national availability, accessibility, utilization and affordability of food (Asih, D. N., *et al*, 2017). Besides that, in terms of nutritional needs, *C. ensiformis* contains quite high carbohydrates (50.6%), protein (28.6%). In addition, they also have low fat content (2.26%) (Susanti, *et al.*, 2013), so that from a health point of view it is useful for increasing endurance.

Other advantages of *C. ensiformis* include: (1) easy to adapt to sub-optimal land; (2) produce biomass for green manure and feed; and (3) high production (12 tons / ha) with harvesting can be done 4 times during the plant life cycle (15 months). Besides that, it is very adaptive to dry land with all types of soil even on ex-mining lands. Therefore, the potential of *C. ensiformis* is very large in supporting national food diversification and food security programs. The findings of Susanti et al. (2013) show that the support of *C. ensiformis* towards the most popular food verified by consumers is in the form of tempeh, year, milk, and snacks.

Indonesia, as the largest *tempe* producer in the world, needs soybean raw materials, so that it holds the title of the largest soybean market in Asia. But with the national soybean production that has not been able to meet domestic needs, the government encourages and develops *C. ensiformis* as a substitute for soybean. *Canavalia ensiformis* is expected to at least be able to reduce dependence on domestic soybeans, which is increasingly exacerbated by the presence of domestic production which is much lower than the need (Susanti et al., 2013). This is an increasingly serious problem because the national *tempe* industry depends on imported raw materials. In 2017 Indonesian soybean imports are quite large, reaching> 2.5 million tons, or reaching ± 1.2 billion US dollars (BPS, 2018). With the increasing price of soybeans, *C. ensiformis* became a substitute in the tempeh and tofu industry. In addition to the raw material for tempeh, *C. ensiformis* can be produced into a variety of snacks needed by consumers.

Until the last decade, more and more research findings have revealed how farmers can master how to cultivate *C. ensiformis* as a plant that can support soil conservation, to its contribution in supporting national food security. Akib, M.A, et al. (2017) conducted a study to see how much influence the application of pruning technology to leaf growth. Yuniarti, E. T, and Muslimin, (2013) showed the prospect of developing *C. ensiformis* both in terms of ease of cultivation and its potential as raw material for the tempe-tofu industry. The marketing and economic challenges of institutional culture of *C. ensiformis* in the future have also been revealed by Kherallah, M., & J. F. Kirsten, (2010). Nevertheless, the basic question that must be answered immediately is why the cultivation of *C. ensiformis* does not develop, and on the contrary farmers turn to other commodities such as corn and vegetables.

Canavalia ensiformis cultivation business in South Sulawesi has been developed since the 2000s, especially in three districts, namely Sidenrang Rappang, Soppeng, and Enrekang Regencies. One obstacle for farmers in the field is instability in marketing factors. Therefore, in the latest development, the production of *C.ensiformis* in three regions was threatened and not even found in three regions. This condition occurs because of weak human resources and lack of guidance from related institutions.

Farmers generally switch to commodities such as corn and various types of vegetables. The transition of *C. ensiformis* farmers to other commodities is caused by several factors, including: First; the weak competitiveness of the price of *C. ensiformis* (Rp. 2000-Rp. 2500/kg). This was triggered by the existence of market monopoly practices by middlemen, although under certain conditions Arsyad, et al. (2018) showed that middlemen could contribute positively in terms of capital access and marketing for small cocoa farmers in rural areas. Second; the absence of a processing industry supported by appropriate technology controlled by local farmers, and Third; weak institutional role in protecting farmers especially in terms of marketing (Callejo, I., & V. Cossio, 2009) and postharvest processing. This is relevant to Lakitan's findings, et al. (2019) in South Sumatra, that the weak role of institutions is a factor causing farmers

not to be motivated to increase food production in wetlands. The same thing was revealed by Aini & Nadida, (2014) that in order to improve infrastructure performance, it must be overcome by increasing the activities of institutional and farmer organizations.

Therefore, the institution is very important to be strengthened, given its huge contribution in accelerating the development of socio-economic farmers, accessibility of agricultural information; capital, infrastructure, marketing, and innovation in the agribusiness system. This is in line with the findings of Osorio, A. A., & A. Rivas. G, (2017) that the weakness of institutional programs has resulted in social forces that have not been able to produce solutions to social problems in the region. Therefore institutional strengthening is an urgent need in developing socio-economic conditions of farmers.

In addition, the existence of farmer institutions will facilitate government agencies and other stakeholders to facilitate the fulfillment of farmers' needs. Based on the explanation above, this study highlights the development of cultivation of *C. ensiformis* from an institutional perspective. First, it wants to show how the role of institutions in the development of *C. ensiformis* has been so far. Secondly, there is an indication of the weak coordination function in developing *C. ensiformis* cultivation so far, so this study wants to show what factors are the causes of the weak coordination function. Third, the study wants to reveal whether the development of *C. ensiformis* cultivation requires strengthening institutional functions? These three questions will be answered in the research.

2. Materials and Method

To answer the research question as stated earlier, this study analyzes the facts, and the relationship between phenomena through the expert system approach using the survey method. This research was conducted from May to August 2018 in Enrekang District, South Sulawesi (Figure 1). There are three elements analyzed, namely: 14 sub-elements as role institutions, seven sub-elements causing weak coordination functions, and nine sub-elements as strategic programs in developing *Canavalia ensiformis* (*C. ensiformis*) cultivation. To obtain and determine the sub-elements, interviews were conducted with a number of experts through Focus Group Discussion (FGD).

Instrument used in this study is a questionnaire, which is in the form of a list of questions used as a guide for interviews with respondents. The interview was conducted with a direct visit to the respondent's address to maximize the respondent's understanding of the interrelationship between sub-elements in accordance with the research objectives.

The research employed Interpretative Structural Modeling (ISM) analysis techniques to present graphically a description to explain contextual relationships between sub-elements (Marodin, G. A., *et al.,* 2018). This is in line with Rizal, M., et al. (2016) that ISM can be used in interpreting contextual relationships to analyze complex and complex problems in a system. Interpretive Structural Modeling is used to present hierarchical-based models, and to describe the contextual relations between sub-elements (Faisal, M. N., 2010), both acting institutions, the causes of weak coordination functions, and strategic programs in developing *C. ensiformis* cultivation.

Application of ISM in this research is carried out through stages: first making a Structural Self Interaction Matrix (SSIM), where sub-elements are arranged so as to form a contextual relationship between variables i and j. Second, compile the reachibility matrix (RM) by changing V, A, X and O with numbers 1 and 0, and third, composing a Matrix power-dependent driver to determine the arrangement of structural levels. Furthermore, a structural problem solving model was developed in the development of C. ensiformis cultivation.

Figure 1. Research site

The classification of sub-elements is presented in four quadrants as follows:

Quadrant 1:
Weak driver-weak dependent variables (autonomous). Changes in this sector are generally not related to the system, and / or maybe the relationship is strong but does not affect the system.

Quadrant 2:
We are driver-strongly dependent variables. Generally the changes here are not free (depending on other variables) and the effect on the system is weak.

Quadrant 3:
Strong driver-strongly dependent variables (linkage). The effect on the system is very strong. Similarly, it depends on other variables. Therefore variables in this sector must be carefully examined, because the relationship between variables is not stable. Every action on these variables will have an impact on other variables so that the feedback effect can increase the impact or create new problems.

Quadrant 4:
Weak dependent variables (independent) strong drivers. Variables in this quadrant have a large influence on the system, in addition to dependence on other variables. Therefore, the variables in this quadrant are independent variables.

3. Results and Discussion

3.1. Cultivation Institution Governance of *Canavalia ensiformis*

To identify the agency in the institutional development of *C. ensiformis* cultivation, this study purposively determined 14 institutions (sub-elements) through assessment by 24 experts/practitioners. These 14 sub-elements are analyzed using Interpretative Structural Modeling (ISM) method, so that the drivers-power (D) and dependent (D) weights are obtained as in Table 1.

Table 1. Power driver (DP) and dependent (D) weights as indicators of the importance of the role of institutions in the development of *Canavalia ensiformis* cultivation

Institution (sub-element)	Weight	
	Driver power (DP)	Dependent (D)
1. Agriculture Service	1.00 *)	0.64
2. Farmers Group	0.64	0.57
3. Food Security Service	0.92	0.78
4. Fisheries & Animal Husbandry Service	0.71	0.57
5. Agro market	0.57	0.78
6. Field Agricultural Extension	0.71	0.42
7. Agricultural Extension Agency	0.86	0.36
8. Forestry / Plantation Service	0.57	0.50
9. Cooperative	0.57	0.93
10. Regional Development Planning Agency	0.57	0.78
11. Regional Trade Industry Agency	0.50	0.64
12. Transportation / Transportation business	0.14	0.86
13. Banking	0.36	0.92
14. Central Statistics Agency (BPS)	0.36	0.78

Remarks:
**) Key actor agency*

After the results of the ISM analysis (Table 1) are converted into the power-dependence driver matrix (Figure 2), 10 sub-elements are found as agency in the development of *C. ensiformis* institutions. The 10 institutions are distributed in the matrix (Figure 2), namely four institutions in independent positions, and six institutions in the position of linkage. The other four institutions are in a dependent position, which is an institution that has weak influence on the development of *C. ensiformis* cultivation.

Independent institutions are the driving force with a driver of power towards the development program of *C. ensiformis* cultivation. The four institutions are: respectively: Agricultural Extension Agency (DP = 0.86), Regional Development Planning Agency (Bappeda) (DP = 0.71), Field Agricultural Extension (PPL) (DP = 0.71), and Forestry and Plantation Service (DP = 0.57).

Furthermore, there are six other institutions in the position of linkage (Figure 2), which in addition has a large driving force for the program, also has dependence on other institutions as indicated by the weight of driver power (DP) and dependent (D) (average DP and D> 0.50) (Table 1). The six institutions are: Agriculture Service (DP =

1.00), Food Security Agency (DP = 0.92), Fisheries/Animal Husbandry Service (DP = 0.71), Farmer Group (DP = 0.64), Agro Market (DP = 0.57), and Cooperatives (DP = 0.57). The magnitude of the DP and D indicates that the six institutions, in addition to having a large driving force for the development program of *C. ensiformis* cultivation, also have dependence on other sub-elements (variables). Therefore, the six institutions must be effectively coordinated to anticipate the influence of other factors that can be a barrier to the program. Based on the ISM analysis of the contextual relationships of sub-sub elements (Table 1), it was identified that the Agriculture Service was a key role institution (DP = 1.00) in the institutional development of *C. ensiformis* cultivation. As a key institution, its role is very important as a determinant of the course of the program.

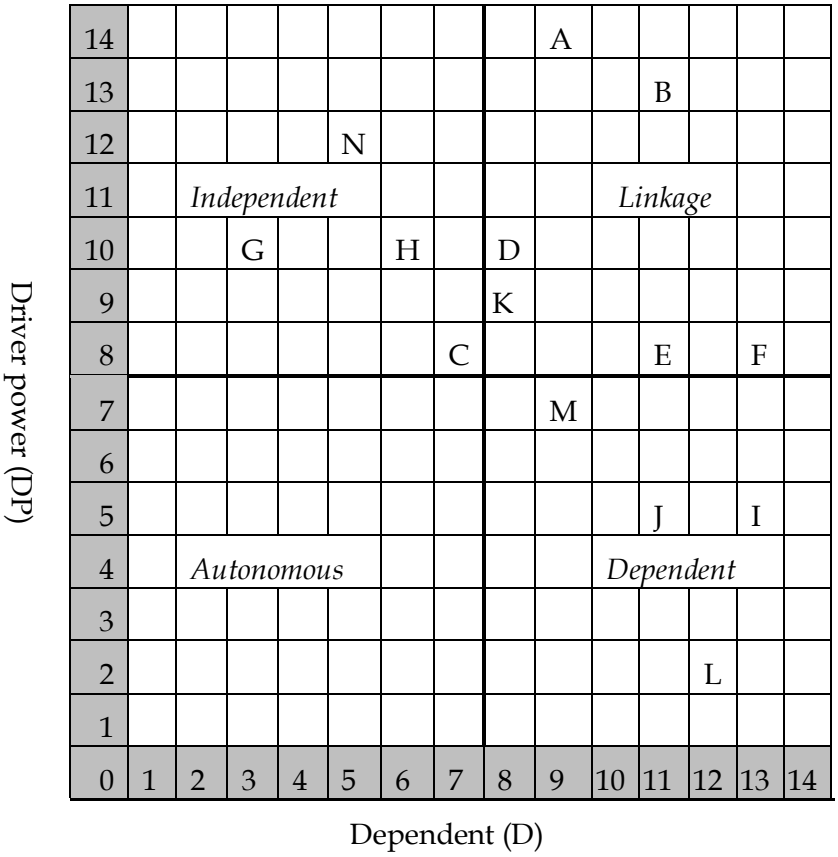


Figure 2. Position of agency in the development of *Canavalia* cultivation.

Remarks:

A = Agriculture Service.
B = Food Security Agency.
C = Forestry/Plantation Service.
D = Fisheries/Animal Husbandry Service.
E = Agro Market.
F = Cooperative.
G = Regional Development Planning Agency.
H = Agricultural Extension.
I = Banking.
J = Central Bureau of Statistics.
K = Farmer group.
L = Transportation/transportation business.
M = Office of Industry & Trade.
N = Agricultural Extension Agency.

Based on this ISM analysis, the 10 institutions 4 in independent positions and 6 in the linkage position) should make a real contribution in the development of *C. ensiformis* cultivation. However, there are indications in the field that among these institutions, there are still many who do not understand their roles and functions in developing agricultural production. This is a fact of the weak function of coordination in the institutional culture of *C. ensiformis*.

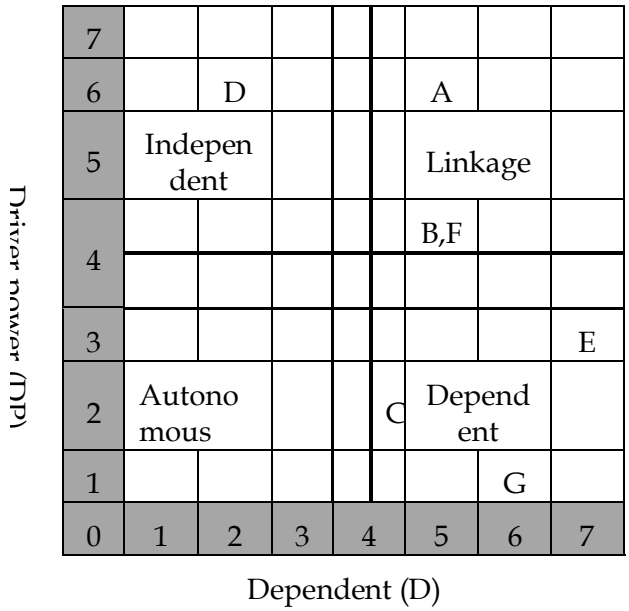
Weakness of the institutional structure of *C. ensiformis* cultivation in Enrekang Regency, can be shown based on the results of the ISM analysis, namely the existence of the Department of Industry and Trade in a dependent position (Figure 2), with a weight of DP = 35.71 and weight D = 57.14 (Table 1). This finding indicates that according to the expert / practitioner's assessment, the Department of Industry and Trade has not yet shown a positive role in the institutional arrangement of *C. ensiformis* cultivation. This is very contrary to the main tasks and functions as an institution responsible for industrial affairs / product processing and marketing. Therefore, it is not surprising that the marketing problem / low price of *C. ensiformis* is the main reason for farmers to switch to other commodities.

Fundamental question that needs to be answered is what factors are the causes of the weak coordination function in the institutional development of *C. ensiformis* cultivation. The results of the ISM analysis show that based on the contextual relationship of the sub-elements, we can show the weight of the driver power (DP) and dependent (D), as shown in Table 2.

Table 2. The weight of the power driver (DP) and dependent (D) sub-elements cause the weak coordination function in the institutional culture of *Canavalia ensiformis*

Sub-elements (causes of weak coordination function)	Weight	
	Driver power (DP)	Dependent (D)
1. Weak understanding of vision and mission	0.86	0.71
2. Low knowledge about institutions	0.57	0.71
3. Program uncertainty	0.28	0.57
4. There is competition between institutions	0.86	0.28
5. Weak responsibility for institutions	0.42	1.00
6. Low quality of human resources	0.57	0.71
7. Weak coaching	0.14	0.86

Results of this analysis also show that among the nine sub-elements, only four of them are factors that cause weak coordination functions, namely: the existence of competition (conflict) between institutions in an independent position, and three other factors namely (2) weak understanding of vision mission, (3) low knowledge of institutions, and (4) low quality of human resources in the position of linkage (Fig. 3).



Remarks:

A = Weak understanding of vision and mission
B = Low knowledge about institutions
C = Program uncertainty
D = There is competition between institutions
E = Weak responsibility for institutions
F = Low quality of human resources
G = Weak coaching

Figure 3. Position of sub-elements as a cause of weak institutional functions of *C. ensiformis*.

Increased production of *C. ensiformis* is the program objective to be achieved. To achieve this goal, all relevant institutions, as shown in Figure 2, must collaborate in a coordinative institutional order. In institutions, the coordination function is the main factor that determines whether an organization is an institution that is institutionalized to achieve the program objectives. This is in line with the findings of Takeyasu, et al., (2018) that in order to solve various problems in the community, cooperation between government institutions (central and regional), private institutions, and society in general needs to be built.

Each institution has different visions, but behind that difference there is a link between the program in accordance with the main tasks and functions of each institution. Because of this the lack of understanding of the vision and mission will affect the function of coordination between institutions. In addition to the weak understanding of the vision and mission, the low level of knowledge about institutions further weakened the coordination function.

Understanding of institutions has only been limited to translation. Institutions have not been interpreted as rules of the game that regulate institutions as players for how organizations (institutions) win games (Nuddin, *et al.,* 2007). The existence of such detention is the cause of the increasingly weak practice of coordination between institutions, so that the organization is not effective in giving birth to innovation. The findings of Lee, et al. (2016) show that the contribution of institutions to an innovation

is largely determined by the function of coordination between related institutions. Therefore, to streamline the coordination function towards a harmonious institutional order, Costa, et al., (2018) emphasizes the need to understand structural diversity and differences in characteristics between institutions.

Therefore, to strengthen the coordination function in the *C. ensiformis* cultivation institution, there are four strategic steps to be taken, namely: (1) increasing understanding of the institution's vision and mission, (2) improving institutional knowledge, (3) improving the quality of human resources, and (4) avoid/reduce the occurrence of conflicts of interest between institutions.

3.2. Strategic Development of *Canavalia ensiformis* cultivation

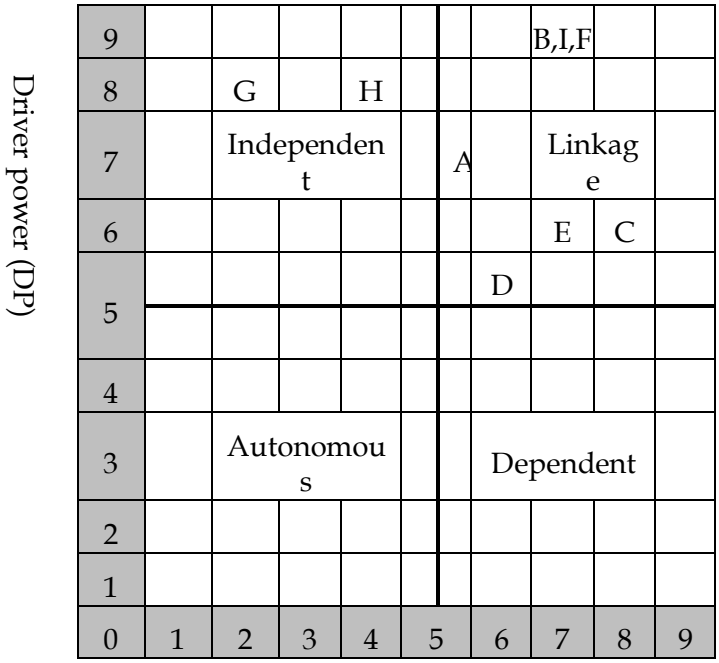
Although in recent years, more and more research findings have been useful for the development of *C. ensiformis* cultivation, this commodity has increasingly been abandoned by farmers. Many findings / results of research on the cultivation of *C. ensiformis* as stated earlier in this paper, but not adopted by farmers. All of this is important to be studied, so that a solution can be obtained wherever possible, especially in terms of developing *C. ensiformis* cultivation.

This study highlights that in addition to solutions concerning agrotechnology, is strengthening institutional functions needed as a strategy for developing *C. ensiformis* cultivation? Through ISM analysis 9 sub-elements (variables) can be shown as strategic programs in the development of *C. ensiformis* cultivation. The nine programs identified differences in the weight of the power driver (DP) and dependent (D) (Table 3) as indicators of priority levels and variable importance positions (Figure 4) in the development program of *C. ensiformis* cultivation. Two of the nine sub-elements were in an independent position, namely increasing farmer group participation and the effectiveness of extension workers in the field. This independent position indicates that the two sub-elements are programs that have a large driver power towards the development of *C. ensiformis* cultivation.

Furthermore, there are seven other sub-elements (variables) in the linkage position, namely the variables that have the weight of both the power driver (DP) and the dependent (D) are large. The weight of power and dependent drivers (Table 3 and Figure 4), is an indicator that the variables in this position (linkage) are programs that have an influence (driving force) on the development of *C. ensiformis* cultivation, in addition to having dependence on other variables. The seven variables imposed are: (1) the effectiveness of coordination between institutions, (2) human resource development, (3) crop management and assistance, (4) agro-industry business development, (5) provision of production inputs, (6) marketing development, (7) development of institutional functions. The seven programs must be developed seriously, because if they are not implemented properly, they will be a limiting factor/failure to develop *C. ensiformis* cultivation.

Table 3. Power driver weight (DP) and dependent (D) sub-elements of *Canavalia ensiformis* cultivation development program

Sub-element (Development program of *C. ensiformis* cultivation)	Weight	
	Driver power (DP)	Dependent (D)
1. Effective coordination between institutions	0.77	0.55
2. Human resource development	1.00	0.78
3. Plant management and assistance	0.67	0.89
4. Development of agro-industry businesses	0.55	0.67
5. Development of institutional functions	0.67	0.78
6. Marketing development	1.00	0.78
7. Increased participation of farmer groups	0.89	0.22
8. Effectiveness of extension agents in the field	0.89	0.44
9. Provision of production inputs	1.00	0.78



Remarks:

A = Effective coordination between institutions
B = Human resource development
C = Plant management and assistance
D = Development of agro-industry businesses
E = Development of institutional functions
F = Marketing development
G = Increased participation of farmer groups
H = Effectiveness of extension agents in the field
I = Provision of production inputs.

Figure 4. Position of a strategic program for the development of *Canavalia ensiformis* cultivation.

The nine variables as strategic programs in developing *C. ensiformis* cultivation are part of institutional arrangements, namely (1) Effectiveness of coordination between institutions, (2) development of institutional functions, (3) crop management and assistance, and (4) agroindustry development (Figure 4), is a strategic program that is in the position of linkage. The development of institutional functions is needed to optimize coordination between institutions to be optimized so that institutional functions can run effectively. This is in line with the findings of Nuddin, et al., (2015), and Salcido, G. T., et al., (2015), about the importance of effective coordination between sectors in order to strengthen farmer institutions. The coordination function in the institutional development of *C. ensiformis* cultivation has identified weaknesses based on ISM analysis as shown in Figure 2. The results of this analysis are evidence of the weak institutional function of the development of *C. ensiformis* cultivation. Weak institutional functions are caused by three main factors, namely (1) weak understanding of vision and mission, (2) low knowledge about institutions and (3) conflict between sectors / institutions. Likewise the assistance / guidance of farmers is an important sub-element based on the results of the ISM analysis. This is in line with the findings of Santos, et al. (2018), regarding the importance of mentoring / assistance to promote regional development programs.

The marketing development program, and agroindustry development (Figure 4), are the main tasks and functions of the Department of Industry and Trade. But on the other hand, the results of the ISM analysis (Figure 2) show that the Department of Industry and Trade only occupies a dependent position. This means that in the effort to develop *C. ensiformis* cultivation so far, the role of this institution has not contributed according to its main tasks and functions. Because of that, it is not impossible for farmers to switch to *C. ensiformis* to other farms, especially in South Sulawesi, due to the failure of marketing management. This failure is a result of the involvement of the Department of Industry and Trade in the institutional function of cultivating *C. ensiformis*.

Among the nine strategic programs in this study, three of them are key strategic programs, namely: (1) human resource development, (2) provision of production inputs, and (3) marketing development. It was also identified that one of the factors contributing to the weak function of coordination was the low quality of human resources (Figure 3). Therefore, to maximize institutional functions, owned human resources both in government and private institutions, and farmers must be developed. This is in line with the findings of Takeyasu, et al., (2018) that increasing human resources can be done, among others, through increasing knowledge. Increased knowledge of farmers as stated by Nuddin, et al., (2018) is one of the strategies for institutional development of coffee farmers in South Sulawesi. The knowledge and skills of farmers must be improved to realize quality human resources as the spearhead in agricultural development.

4. Conclusion

Starting from the research objectives as stated in the beginning of this paper, three conclusions can be stated as follows. There are 10 institutions that must play an important role in developing C. ensiformis cultivation, namely the Agricultural Extension Agency, Regional Development Planning Agency, Field Agricultural Extension, Forestry and Plantation Services, Agriculture Service, Food Security Agency, Fisheries / Animal Husbandry Service, Farmers Group, Agro Market and

Cooperative. The weak function of coordination in the cultivation institutions of C. ensiformis is caused by four factors, namely: (1) weak understanding of the vision and mission of each institution, (2) low knowledge of institutions, (3) competition between institutions, and (4) low quality of human resources. Of the nine strategic activities that need to be developed, there are seven of them which are part of institutional functions, namely (1) effective coordination between institutions, (2) human resource development, (3) agroindustry business development, (4) marketing development, (5) developing institutional functions, (6) increasing farmer group participation, and (7) effectiveness of extension agents in the field. Therefore, in terms of developing C. ensiformis cultivation, strengthening institutional functions is still/very needed.

Acknowledgements

This research was conducted with the support of the local government of Enrekang Regency. Therefore, on this occasion, as a researcher, he did not forget to express his highest gratitude and appreciation to the regional government and staff for their support and participation so that this research can be realized. The award was also addressed to all experts/practitioners for their participation in providing data / information needed in this study.

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