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STRUCTURAL MODEL OF THE ROLE OF HYDROPONIC VEGETABLE AGRIBUSINESS INSTITUTIONS TOWARDS FOOD SELF RELIANCE IN BORDER AREAS

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ABSTRACT

The role of institutions is crucial in the hydroponic vegetable agribusiness subsystem, encompassing input procurement to marketing to enhance product quality and value. However, the institutions in the hydroponic vegetable agribusiness system in Tarakan City have not shown a significant role, indicating the non-functional institutionalization of related institutions. This has led to both horizontal and vertical sectoral egos and conflicts between institutions. This research uses a systems approach to identify and study the institutions involved and the structural model of the hydroponic vegetable agribusiness institution. The research method used was descriptive qualitative with Interpretative Structural Modeling (ISM) data analysis techniques. Purposive sampling was utilized for data collection. The findings reveal that institutions that should have a role in hydroponic vegetable agribusiness are the Food Security and Agriculture Department, Agricultural Extension, Middlemen, Cooperative Department, Small and Medium-sized Enterprises (SMEs), Industry and commerce Department, Cooperatives, Banks, Association of Farmers Groups**,** Farmer Group, Agricultural Shops, and Central of Bureau of Statistics. The institutions' roles include policy-making, facilitation, provision of farming inputs and infrastructure, financial services, lending, selling, marketing, and processing of products. The structural model of the institution's involvement in hydroponic vegetable agribusiness in Tarakan City consists of four levels, with the Key Actor Institution at Level 1, including the Food Security and Agriculture department, Agricultural Extension, Middlemen, Farmer Groups, and Agricultural Shops. The fifth institution is expected to be a driving force in hydroponic vegetable agribusiness.

Keywords: Hydroponics, Structural Model, Role of Institutions

INTRODUCTION

In recent years, the government has directed its attention towards border areas as they hold a strategic position with the potential to support national economic development. Typically, residents inthese regions generate income through agricultural activities. Therefore, developing the agricultural sector is viewed as a means of improving the welfare of the population in these areas.

The characteristics of border areas encompassing small islands pose biophysical, socio-economic, and cultural challenges to achieving food self-sufficiency (1). Consequently, sustainable food production in the region is essential. Nevertheless, there is a potential for food insecurity, given the significant food insecurity resulting from the distribution of food supplies via sea transportation that can be hindered by harsh weather and prolonged dry seasons (2). While achieving food self-sufficiency isnot without its challenges and obstacles, it remains a crucial objective, considering the considerable potential of this region (3). Innovative solutions, such as adequate technology and community institutions, can guarantee the availability of locally produced food, as the Agency for Agricultural Research and Development recommended in 2013.

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One such innovation is hydroponic farming technology, which utilizes limited land or yard space to cultivate self-produced food (4).

The city of Tarakan is strategically located, with its northern side serving as the border betweenIndonesia and Malaysia (5). As is common with urban areas, the development of land in Tarakan is usuallynot for agricultural purposes. However, agricultural activities within urban areas can significantly impact future urban financing, particularly in terms of land use (6). Furthermore, due to the decreasing availability of agricultural land in urban areas, the implementation of urban farming systems presents an effective means of meeting the food requirements of urban residents. By planting various types of vegetables within their yards, individuals can fulfill their supply needs. Proper and efficient management of yard land can offer numerous benefits to communities, including the potential to provide food, reduce expenses, and increase family income (7).

The advancement of hydroponic farming technology is closely linked to the function of an integrated agribusiness system from upstream to downstream, including all the institutions involved in each of the subsystems of agribusiness. The success of agricultural development, specifically in hydroponic vegetable cultivation, heavily depends on the role of agribusiness institutions that contributeto the accessibility and bargaining position of farmers and markets. These institutions are part of the procurement, cultivation, processing, and marketing subsystems. Farmers, as the main actors, participate in agribusiness development and benefit from the services provided by supporting institutions. However, if there are gaps or inconsistencies between these institutions, the agribusiness system may not operate optimally, and accordingly, farming activities may suffer (8).

In the hydroponic vegetable agribusiness subsystem, institutions played a crucial role in activities ranging from input procurement to marketing, providing quality improvement and added value to the produced products. However, in Tarakan City, the institutions' role in the hydroponic vegetable agribusiness system is not significantly visible, indicated by the existence of non-institutionalized institutions leading to sectoral egos, horizontal and vertical conflicts within the institutional system (9). This indicates that there are institutions that should play a role but do not show a significant role, and the coordination among relevant agencies in programs or policies related to hydroponic vegetable farming in Tarakan City is still weak.

Based on the problem mentioned previously, studying the problems related to institutions in hydroponic vegetable farming is crucial, particularly in understanding the role of relevant institutions. The main objective of this research is to identify the institutions that should be involved in hydroponicvegetable agribusiness and the contribution of agribusiness institutions in each subsystem, including the upstream, on-farm, and downstream, as well as services and supporting services subsystems. An expert system approach is utilized to achieve this objective and formulate a structural model that outlines the role of institutions in hydroponic vegetable agribusiness. The ultimate goal is to achieve maximal food self-sufficiency in border areas through an integrated agribusiness system from upstreamto downstream.

RESEARCH METHODS

The research was conducted in Tarakan City, North Kalimantan Province, with the consideration that the area has several hydroponic vegetable farmers. The purposive sampling

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method was used to select the participants for this study. The study involved ten hydroponic vegetable farmers as business owners and four Gapoktan members. Additionally, 14 key informants and experts who aredirectly involved in hydroponic vegetable agribusiness activities were selected from various institutionsthat have links with hydroponic vegetable farming. The primary and secondary data sources were usedin this study, and the data collection methods included literature study, observation, interviews, documentation, and triangulation. The data analysis process used a qualitative descriptive approach involving three stages: data reduction, data presentation, and conclusion. Moreover, Interpretative Structural Modelling (ISM) was used to group elements into Autonomous, Dependent, Linkage, and independent sectors according to their level of priority and importance. This approach can also show the interrelationships between elements within each sector. The stages involved in the ISM analysis included:

a. Create a Structural Self-Interaction Matrix (SSIM) by having respondents assess existing sub-elements through contextual factors using symbols such as V, A, X, and O. V is eij = 1 and eji = 0A is eij = 0 and eji = 1X is eij = 1 and eji = 1O is eij = 0 and eji = 0In which: 1 = there is a contextual relationship between elements0 = no contextual relationship between elements
b. Create a Reachability Matrix chart by substituting the symbols V, A, X, and O with the digits 1 and 0.
c. Generate a hierarchical structural model for each element.
d. Create a Driving Forces (DP) – Dependence (D) Matrix consisting of four elements: Autonomous,Dependent, Linkage, and Independent.

FINDINGS AND DISCUSSION

The research conducted under the title "Structural Model of the Role of Hydroponic Vegetable Agribusiness Institutions Towards Food Self-Reliance in Border Areas" yielded the following results:

1. Figure 1 below displays the role of institutions in hydroponic vegetable agribusiness in the Tarakan City area.

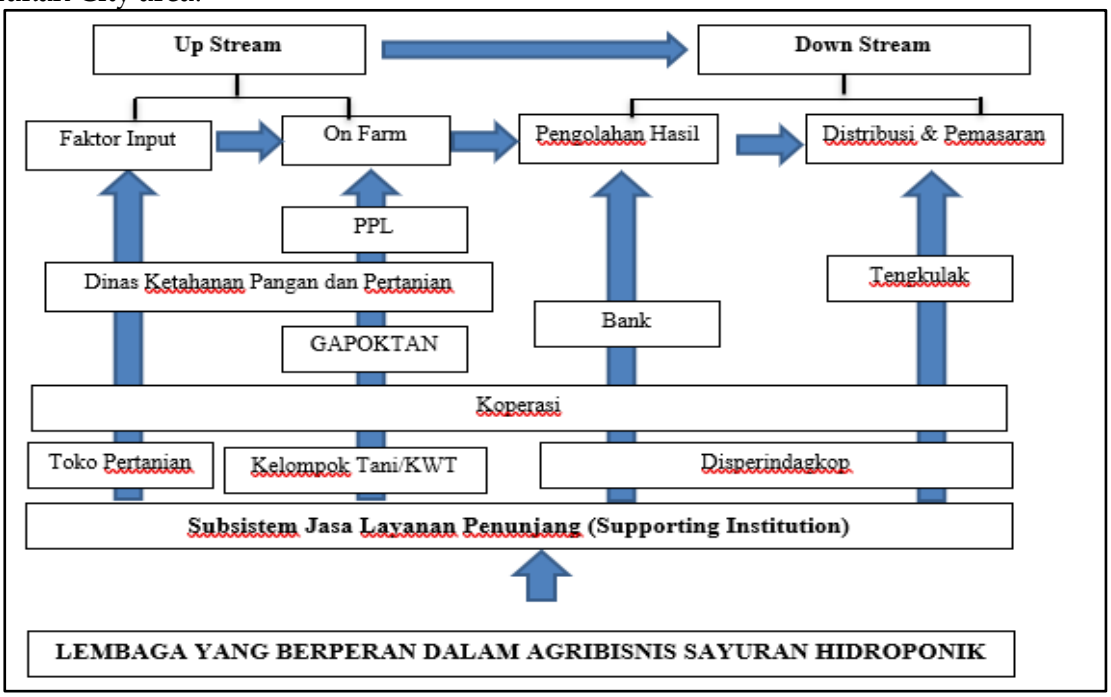

Figure 1. Institutions Playing a Role in Hydroponic Vegetable Agribusiness

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According to Figure 1, the institutions involved in hydroponic vegetable agribusiness in Tarakan City can be categorized into three subsystems: upstream, downstream, and supporting service. Theupstream agribusiness subsystem pertains to procuring agricultural production facilities, which involve producing and distributing materials, tools, and machines needed in farming. Examples of economic activities that provide production facilities for agriculture include the agrochemical industry and trade (fertilizers, pesticides), the agro-automotive industry (machinery and equipment), and the seed/seedling industry (10). The institutions that play a role in thissubsystem include the Food Security and Agriculture Department of Tarakan City, Agricultural Extension, Association of Farmers' Groups, Cooperatives, Farmers' Groups/Women's Farmers' Groups, and Agricultural Shops. The downstream subsystem includes institutions involved in marketing and distribution, such as the Department of Cooperative, Small and Medium-sized Enterprises, and the Department of Industry and Commerce of Tarakan City, Cooperatives, Banks, and Middlemen. The supporting service subsystem includes institutions that provide services to support the other two subsystems, such as the Food Security and Agriculture Department of Tarakan City, Agricultural Extension Officers, Association of Farmers Groups, Cooperatives, Farmer Groups/Women Farmer Groups, Agricultural Shops, Department of Cooperative, Small and Medium-sized Enterprises (SMEs) and Department of Industry and Commerce of Tarakan City, Banks, and Middlemen.

2. The institutions involved in hydroponic vegetable agribusiness in Tarakan City play various roles,including **a role in the upstream subsystem**. This subsystem represents the initial phase of the agribusiness process, producing or supplying the infrastructure and facilities used in agricultural activities. It involves the acquisition of agricultural production facilities, such as seeds, nutrients, machinery, tools, and production equipment necessary for hydroponic vegetable farming. This subsystem is crucial in achieving agribusiness success due to the need for integrating various elements. The industries that provide such facilities are known as the upstream agro-industry. (11) referred to this subsystem as the input factor subsystem responsible for procuring agricultural production facilities. The activities of this subsystem include the production and distribution of materials, tools, and machines required for farming or cultivation. **The downstream subsystem** (Down Stream) of Hydroponic Vegetable Agribusiness involves a series of activities, including collecting, processing, storing, and distributing hydroponic vegetable products. The majority of products produced from farming are distributed directly to end consumers. The actors involved in this subsystem include product collectors, processors, traders, distributors to consumers, and others. Industries that process hydroponic vegetable products are known as downstream agro-industries. The processing subsystem is a business activity that involves transforming primary agricultural commodities into final products. This activity spans from product processing to marketing. It involves distributing agricultural products from the producer to the consumer while adding time value, place value, form value, and the value of property rightstransfer through marketing agencies. **The Supporting Service** Subsystem in Hydroponic Vegetable Agribusiness involves institutions that support the development of all subsystems, including the upstream, farming, and downstream hydroponic vegetable subsystems. The institutions included in this subsystem are those related to finance, extension agents, research, andinsurance. The role of extension

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agents and consultants is to provide farmers and business actors with information services, foster production techniques, and manage hydroponic vegetable businesses. In addition, financial institutions such as banks, venture capitalists, and insurance companies provide financial services such as loans and business risk coverage. Research institutions, such as research centers and universities, provide information services on production technology, cultivation techniques, and sustainable hydroponic vegetable research and development.

3. The research results, utilizing ISM analysis, illustrate the interconnectedness of institutions involved in hydroponic vegetable agribusiness. The study presents a structural model that outlinesthe importance of each institution's role in hydroponic vegetable agribusiness, with a hierarchical ranking starting from level 1, such as the Food Security and Agriculture Department, AgriculturalExtension, Middlemen, Farmer Groups/ Women Farmer Groups, and Agricultural Shops. Level 2includes the Association of Farmers Groups, and Banks, while level 3 encompasses the Departmentof Cooperative, Small and Medium-sized Enterprises (SMEs), Industry and Commerce Department. Lastly, level 4 is comprised of the Central Bureau of Statistics and Cooperatives. The figure can be seen in the following:

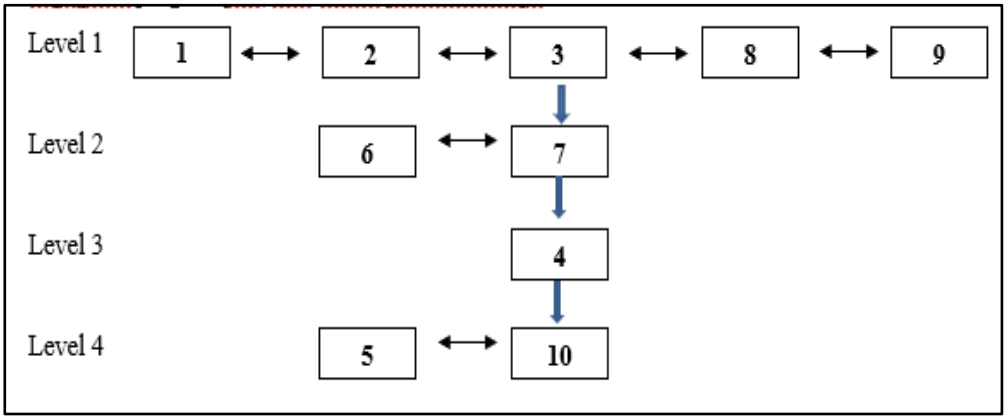

Figure 2. Structural Model of Actors in Hydroponic Vegetable Agribusiness in Tarakan City

Descriptions:
1 = Department of Food Security and Agriculture
2 = Agricultural extension
3 = Middleman
4 = Department of Cooperative, Small and Medium-sized Enterprises (SMEs), Department of Industry and Commerce
5 = Cooperative
6 = Bank
7 = Association of Farmers Groups
8 = Farmer Groups/Women Farmer Groups9= Agricultural Shops
10 = Central Bureau of Statistics

CONCLUSION

Based on the results of research conducted using the Interpretative Structural Modelling (ISM) approach and empirical studies, it can be concluded that the institutions that play a significant role in hydroponic vegetable agribusiness in Tarakan City are the Food and Agriculture Security Department,Agricultural Extension, Middlemen, Cooperative Office, SMEs, Industry and Commerce Department, Cooperatives, Banks, Association of Farmers Groups, Farmer Groups/ Women Farmer Groups, Agricultural Shops, and Central Bureau of Statistics. These institutions

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play various roles in all subsystems of agribusiness, from upstream to downstream, serving as policymakers, facilitators, providers of farming input facilities and infrastructure, financial service providers, lenders, sellers, and marketers. Furthermore, the structural model of the role of hydroponic vegetable agribusiness institutions in Tarakan City consists of four levels, with level 1 being the most important institution thatincludes the Food Security and Agriculture Department, Agricultural Extension Officers, Middlemen, Farmer Groups/ Women Farmer Groups, and Agricultural Shops.

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