



vol. 17 / 2023



## **The 7th International Conference on Science Technology**

organized by  
Faculty of Social Science and  
Law Universitas Negeri Manado and  
Consortium of International Conference  
on Science and Technology

# **The Innovation Breakthrough in Digital and Disruptive Era**

# Availability of Land, Water, Human and Technology Resources in the Development of Food Estate Areas in Merauke-Indonesia

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**Abstract.** The development of a food estate area in Merauke requires the availability of adequate resources in terms of quality and quantity. The research objective is to analyze the availability of resources in the development of industrial estates based on agricultural production produced in the development of *food estates*. The research was conducted in the food estate development area, namely Merauke Regency, analyzing secondary data. The data were analyzed from spatial data and then analyzed using a qualitative descriptive analysis approach. Some observation indicators are data on the availability of agricultural land for cultivation, analysis of potential water sources and needs, availability of human resources, and supporting infrastructure. The results of the analysis show that the availability of Merauke's land resources for the food estate is sufficient in terms of quantity and quality for agricultural cultivation, but has not been supported by adequate human resources, namely farmers and agricultural extension workers. Likewise with the availability of water resources and infrastructure facilities such as road networks, ports, electricity, and irrigation networks, it is necessary to revitalize existing facilities and add basic infrastructure networks for the development of a food estate area in Merauke.

**Keyword:** land, technology resources, farmer, infrastructure, agricultural cultivation

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## 1 Introduction

The agricultural sector is one of the main sectors in Indonesia's economic development [1]. Food as one of the results of agricultural cultivation activities is a primary need that must be met both individually and nationally, because food needs are part of a strategic policy that must be given a quick and appropriate solution. Conditions when everyone at all times physically, socially and the economy have access to sufficient, safe and secure food. The creation of food security is a strategic condition for the success of the economic and social development process that is based on an endogenous strategy. For this reason, the issue of food production and food security is very important [2]. Therefore, the position of the agricultural sector is very strategic in the structure of the national economy [3], so that the government together with the local community must be able to map the resources they have to design and build the economy in the region [4], [5].

The food security system in Indonesia comprehensively includes four sub-systems, namely: (i) availability of food in sufficient quantities and types for the entire population, (ii) smooth and even distribution of food, (iii) food consumption for each individual that meets adequacy balanced nutrition, which has an impact on (iv) the nutritional status of the community [6].

Merauke is one of the regions in Indonesia which is directly adjacent to a neighboring country, namely Papua New Guinea with an area of 46,791.63 km<sup>2</sup>. Merauke is one of the areas designated as a food production center area in Eastern Indonesia. The appointment and determination is not without basis. A land area of 1.2 million ha in Merauke Regency has the potential to be used as a food production center. Based on the commodity development potential, land resource potential and land suitability spread over 20 districts, it has the potential to develop food production consisting of food crops (rice and horticulture), livestock (cattle, pigs and goats), and fisheries (capture fisheries and cultivation). The production potential of the agricultural and horticultural, livestock and fisheries sectors has made Merauke a food *estate development plan*.

The food estate program in Merauke is nothing new. During the administration of President Susilo Bambang Yudhoyono, the Merauke Regency Government proposed a similar program called Merauke Integrated Rice Estate (MIRE) which was launched in 2007. The central government then adopted the proposal into a national program called Merauke Integrated Food and Energy Estate (MIFEE) in 2010 [7].

The plan to develop a food production center (*food estate*) in Merauke has already started with several programs and activities to increase food production, but from several important lessons that have been carried out through the food security program in Merauke Regency, this should be used as a lesson in determining future steps by focusing on production center development plans. food from upstream to

downstream based on land potential and potential production factors in the area at this time while still implementing the concept of sustainable development by reducing the impact of environmental degradation. The decline in environmental quality as a result of land-based development has already occurred. Based on an analysis of land cover due to economic development from the large-scale plantation sector and the cultivation sector, Merauke in 4 periods of carbon emissions always increases along with reduced forest land cover [8], [9]. The development of land-based economic areas should pay attention to environmental aspects which can be carried out lightly so that both goals can be realized [10], [11].

The 2020-2024 National Medium-Term Development Plan is one of the references in the development of food production centers (*food estates*), one of which is by emphasizing the food diversification program towards a healthy food pattern. Although besides that, food estates are expected to be an alternative to handling conflicts in Papua Island by using an economic-social and cultural perspective approach [7]. In addition, the development of food production centers (*food estates*) must be developed in an inclusive manner so as to improve the socio-economic conditions of the people who are directly or indirectly involved as concrete evidence of accelerating development in eastern Indonesia. The development of food production centers (*food estates*) is expected to contribute to reducing poverty. Poverty is quite high in frontier, remote and lagging areas to be one of the reasons for developing the agriculture, livestock and fisheries sectors with a focus on developing the capacity of rural communities, so as to create jobs in rural areas.

Merauke was appointed by the President of the Republic of Indonesia as a food estate area since 2014 as outlined in the Papua Island Spatial Plan policy document, namely a policy to create a center for economic growth based on agriculture, fisheries, tourism, and mining that is competitive with sustainable principles. Development of the Merauke area as a business-based center for food crop agriculture, plantations and livestock and encourage the formation of an integrated industrial area in Merauke. In the development of an integrated industrial area, an area must be supported by the potential and availability of main and supporting resources [12].

Thus, it is considered important to carry out an empirical study entitled "availability of natural resources and technology in the development of food estate areas in Merauke-Indonesia". This study aims to analyze the availability of resources in the development of industrial estates based on agricultural production produced in the *food estate development* in Merauke.

## 2 Research Methods

The research used a descriptive qualitative research approach using a survey method. Research in Merauke Regency with the object of study is the plan and implementation of the development of a food

production center area (*food estate*). The study analyzes the plans and implementation of the development of the food estate area in Merauke Regency. The data source used is secondary data, in the form of a food estate development plan document in the priority zone and is analyzed qualitatively. Several indicators will be measured to answer research objectives related to the potential for developing an agricultural industrial area in Merauke, namely 1) availability of land, 2) human resources in quality and quantity; 3) water resources; 4) supporting infrastructure.

### 3 Results and Discussion

#### 3.1 Availability of land

Merauke Regency is one of the areas outside Java Island which has abundant land availability for agricultural investment, with the largest rice production in Papua Province in 2021 of 394,192,32 tons. The potential of paddy fields in Merauke Regency is very wide and has not been utilized optimally. The area of land designated for agricultural cultivation area is 2,962,786 ha a.

Land potential and suitability are absolute requirements in the agricultural area development plan [13] to find regional superior sectors to be developed into a special area [5], [14]. The potential of agricultural land in Merauke Regency with an area of 1,284,940.00 ha is grouped for food crops, horticulture and plantation commodities as follows:

- The potential for agricultural land for food crop areas is 66,674.35 ha which is spread over the Kurik District which is the widest with an area of 16,929.03 ha, Semangga District with an area of 16,452.28 ha, Tanah Miring District with an area of 14,232.56 ha and other districts with an area of less than 10 thousand ha a. For Ilwayab, Kaptel, Naukenjerai, Tabonji, Tubang, Ulilin and Waan Districts, these are districts that have no potential for the development of food crop areas.
- The potential for agricultural land for horticulture area is 43,209.12 ha which is spread over the Jagebob District which is the widest with an area of 22,297.54 ha followed by Tanah Miring District with an area of 15,903.77 ha, Animha District with an area of 1,652.10 ha and Sota District with an area of 1,352, 11 h a. For the Districts of Elikobel, Ilwayab, Kimaam, Kurik, Malind, Semangga, Tabonji, Ulilin and Waan the horticultural area of each district is less than 1000 ha a. While the other districts have no potential.
- The potential for agricultural land for plantation areas is 219,978.15 ha which are spread over the Districts of Animha, Elikobel, Ilwayab, Jagebob, Koptel, Kurik, Malind, Muting, Nguti, Semangga, Tanah Miring and Ulilin. The largest district is the Ulilin District with an area of 92,920.14 ha and the Ilwayab District with an area of 194.47 ha is the smallest district.

- Other potential locations for agricultural land are in the convertible production forest (HPK) area of 955,078.16 ha spread over all districts except Merauke, Naukenjerai and Waan Districts. With the widest district in the Ilwayab District covering an area of 178,238.17 ha and the smallest in the Tanboji District covering an area of 446.16 ha.

Land clearing for the development of agricultural cultivation areas may have an impact on global climate change and will affect the livelihoods of other sectors such as capture fisheries carried out by coastal communities [15] [16]

#### 3.2 Human Resources

The main resource that plays an important role in agricultural development is labor or human resources. In the development of the Merauke food estate, the intended workforce is farmers as land owners and paddy rice cultivation business actors. In addition, a workforce of workers who work on a corporate scale. Land optimization scenarios with intensification of cleared land and opportunities to develop cultivation areas on a large scale in potential wetlands in Semangga District, Tanah Miring District, Kurik District, and Malind District require a large number of productive workers. Most of the agricultural workforce, in this case farmers, are currently unproductive because they are getting old. Regeneration of the agricultural workforce or millennial farmers needs to be carried out as an effort to fulfill the workforce or farmers needed for the development of lowland rice cultivation can be realized. The limited productive workforce in the agricultural sector can be overcome with a rice paddy farming scenario by prioritizing the role of advances in mechanization technology that can reduce the use of labor.

The main agricultural resources broadly as the main actors of agriculture itself are farmers. Agricultural development is generally carried out by the main actors of farmers who generally have low education. The low quality of human resources, including in the agricultural sector, especially farmers, is mostly officers/technical apparatus/agricultural extension officers, even though the human resources of farmers/agribusiness actors are also agricultural extension officers. Quality agricultural human resources are an absolute prerequisite for the success of agricultural development. To support MFE, human resources must be improved in terms of quality and quantity.

##### 3.2.1 Farmer

At the global level, the issue of aging farmers has received less attention compared to other issues, for example the issue of reduced production due to climate change, whereas the problem of aging farmers is a serious demographic challenge that needs attention because it involves the sustainability of the agricultural sector. The decline in the interest of agricultural

workers has become a common phenomenon that needs serious attention from policy makers in order to save the agricultural sector. It is a common phenomenon that structural changes in the demography of the agricultural sector in Indonesia lead to the aging phenomenon of farmers.

Total data on farmers in Merauke Regency spread across 20 districts, namely  $\pm$  21,000 farmers with a productive land area of  $\pm$  64,000 ha in 2020. The average cultivated area of farmers is currently 2-3 ha per household, even in In the field there are farmers who have cultivated areas of up to 10 ha for all agricultural commodities, but the largest land area of farmers is for cultivating rice food crops. The potential for large paddy field areas is not accompanied by the availability of labor, so it must be substituted with full mechanization of land preparation, planting, harvesting and post-harvesting.

This condition encourages crop failure or a decrease in the quality of agricultural products in addition to the lack of innovation in cultivation technology at the farm level due to limited capital, labor, and lack of continuous assistance from the community. For the development of MFE in Merauke with a land optimization plan, if it is not accompanied by an increase in the number of farmers, full mechanization must be carried out by supporting the provision of adequate agricultural machinery, and improving the quality of farmer resources through a field school program with ongoing assistance from extension workers or experts. In addition, increasing the capacity of farming and fishing communities must be improved through agricultural extension.

### 3.2.2 Agricultural Extension

Agricultural extension workers are people whose job is to provide encouragement to farmers so they are able to change ways of thinking, ways of working, and ways of life that are more in line with developments, both cultivation knowledge and technology. Agricultural extension agents play a role in the following matters.

- Extension agents as initiators, who always provide new ideas.
- Extension agents as facilitators, who always provide a way out/conveniences, both in counseling/teaching process, as well as facilities in advancing farming. In terms of counseling extension agents facilitate in terms of business partnerships, access to markets, capital and so on.
- Extension agents as motivators, extension workers always make farmers know, willing and able.
- The extension agent acts as a liaison (liaison with the government) in this case the extension worker as a conveyer of the aspirations of the farming community as an example in the form of agricultural extension programs. Extension officers as a messenger of policies and regulations concerning policies and regulations in the agricultural sector.
- Liaison with researchers, in this case extension workers always bring new innovations to research results to be able to advance farming.
- Extension agents as teachers, mentors of farmers, who always teach and train farmers as adults.
- Extension officers as organizers and dynamists, who always grow and develop farmer groups so that they are able to function as teaching-learning classes, vehicles for cooperation and as production units.
- Extension agents as analyzers, extension agents are required to be able to analyze problems, because those in farming and in farming families are able to analyze the needs of farmers which in turn is input in making agricultural extension programs.
- Extension agents as agents of change must always be able to influence their targets in order to change themselves towards progress. In this case the instructor acts as a catalyst, a helper in solving problems, a process helper, and as a linking resource.

Currently, the number of agricultural extension workers in Merauke Regency, based on the latest data for 2020, is 119 people spread across 14 districts with either the status of government employees, self-help, or daily workforce. To support the expansion of planted land with an existing land optimization approach, it is necessary to increase the number of agricultural extension workers based on data on the potential for land development to be carried out in each district which is used as the Merauke food estate development area . Analysis data on the addition of agricultural extension workers which can be used as planning for increasing the number of agricultural extension workers in each development district is presented in Table 1 .

**Table 1.** Estimated data on land potential and the number of needs for agricultural extension workers to support the development of the Merauke Food Estate based on existing land use data for extension workers

District	Wetland Potential (Ha)	Extension Requirements (Person)	Existing Land (Ha)	Current number of extension workers (Person)
Merauke	1,340.00	2	9,501.00	9
Semangga	11,222.71	16	13,825.00	20
Tanah miring	16,711.06	265	1,757.00	28
Kurik	6,465.69	404	352.00	21
Malind	8,789.12	32	1,975.00	7
Kimaam	154,454.04	154	1,007.00	1
Waan	1,814.42	5	406.00	0
Ilwayab	94,752.89	135	704.00	1
Tabonji	203,273.02	204	45.00	0
Okaba	29,777.68	289	205.00	2
Tubang	213,461.57	214	185.00	0
Ngguti	99,201.68	310	320.00	0

Source: Secondary data processed from the Office of Food Crops, Horticulture and Plantations, (2020).

Based on Table 1 , the distribution of agricultural extension workers has not been normally distributed in areas where the development of lowland rice cultivation is spread in Merauke, even in some districts there are no extension workers who can help farmers with problems in the agricultural sector, especially in matters of rice production. This can be seen in several districts that have the potential to develop lowland rice

cultivation based on the potential of paddy field agricultural land, namely Waan, Tabonji, Tubang, and Nguti Districts. In addition, in some areas the number of extension workers is still very few and can be seen in areas of paddy rice production centers with a greater number of extension workers, namely in Merauke, Semangga, Tanah Miring, Kurik and Malind Districts.

In the development of the Merauke *Food Estate* in the production center area, it must be supported by the availability of reliable and competent agricultural extension field workers who can carry out the performance of agricultural extension workers who play an important role in agricultural development, especially changing people's behavior to be able to adapt to advances in science and technology related to agriculture. Lowland rice as the main commodity of Merauke Regency in the food estate program.

### 3.3 Water resources

Merauke Regency is a district that belongs to the Einlanden – Digoel – Bikuma River region. Based on the Einlanden – Digoel – Bikuma River area, Merauke Regency has 3 (three) watershed areas, namely the Bikuma Watershed, Bulaka Watershed, and Dolak Watershed. The Bikuma watershed itself consists of 3 (three) watersheds, namely the Bian, Kumbe and Maro watersheds. Some areas of Merauke Regency are included in the Digul watershed area. The watershed area in Merauke can be divided into 6 (six) groups, namely:

- Ulilin, Muting, Animha, Kurik, Kaptel, Malind, Ngguti and Okaba Districts are part of the Bian Watershed (DAS Bikuma) with an area of 950,071 ha .
- Elikobel, Muting, Tanah Miring, Jagebob, Semangga, Merauke, Kurik, Animha and Malind Districts are part of the Kumbe Watershed (DAS Bikuma) with an area of 481,092 ha .
- Elikobel, Muting, Tanah Miring, Jagebob, Semangga, Merauke, Kurik, Animha and Sota Districts are part of the Maro Watershed (DAS Bikuma) with an area of 560,988 ha .
- Ilwayab, Kaptel, Kimaam, Ngguti, Okaba, Tubang Districts are part of the Bulaka Watershed 764,906 h a .
- Ilwayab, Tabonji, Kimaam and Waan Districts are part of the Yos Sudarso Watershed with an area of 1,166,552 ha .
- Ilwayab, Kaptel, Muting, Nguti, and Ulilin Districts are part of the Digul Watershed with an area of 235,010 ha .

The zoning unit of the DAS is further divided into three regional parts, namely the upstream area , as the part of the area that stores water, the middle area (*median*), as the part of the area that both drains and stores water, and the three downstream areas , as estuaries. from the river flow. So that the water resources needed for agricultural cultivation in Merauke have an adequate water supply, although in general the water needs for rice fields in Merauke are very dependent on rainfall.

The availability of water from the river flow will greatly assist the irrigation of rice fields through irrigation that has been built and supports agricultural cultivation activities, especially the cultivation of food crops, namely rice as a leading commodity in Merauke when rainfall begins to decrease, river water becomes a source of irrigation for rice fields.

### 3.4 Infrastructure

Infrastructure is the backbone of economic development, in the sense that economic development requires support from the availability of infrastructure as one of the main prerequisites for economic activity to take place. For economic development, the availability of infrastructure is a factor that influences the production costs of economic sectors. Infrastructure also has an important influence on improving welfare and determining the quality of life of the community.

In the development of the Merauke food estate, infrastructure development includes several things including the main agricultural infrastructure such as irrigation systems and a network of farm roads then supporting infrastructure such as land, river and sea transportation networks to support the supply of agricultural needs *and* also to support the marketing of agricultural products. Energy is an infrastructure requirement that must be prepared to support the development of food production centers. The need for electricity is mainly in fulfilling the need for post-harvest activities and also agricultural support industries. An aspect that is no less important is the provision of basic infrastructure as an effort to serve the community, especially the agricultural community to support the operation of food production centers.

#### 3.5.1 Road Network

The area development program with an agricultural allocation that covers almost the entire Merauke Regency area requires the development of maximum access and connecting networks. This needs to be supported by plans for infrastructure that will facilitate the flow of commodity goods from producer locations to distributor locations or even consumers. In accordance with Law Number 22 of 2009 it is the reference for the 2014 Indonesian Road Capacity Guidelines (PKJI), which in this case forms the basis for determining the allocation of the road network in the development of the Merauke Regency agricultural area. For this reason, the determination of the proposed freeway needs to be seen from various aspects, including determining:

- Plan site terrain class .
- Starting point and planning .
- The results of the identification of areas that are worth crossing based on the soil mechanics structure, geological structure, and contour conditions .

So that there is a need for identification and deeper study related to plans to build city connecting roads between districts within the scope of agricultural area

development. The area development program with an agricultural allocation that covers almost the entire Merauke Regency area requires the development of maximum access and connecting networks. This needs to be supported by plans for infrastructure that will facilitate the flow of commodity goods from producer locations to distributor locations or even consumers. The road plan is 12 meters wide and 20 cm thick with the Merauke City – S. Bian and S. Bian – Kimam corridor route with a distance of about 400 km.

The topography of Merauke Regency is not completely flat and is not blocked by rivers and swamps. The planned access road will pass through several rivers that flow in the Merauke Regency area. The big river that divides Merauke Regency is the Bian River, so it is necessary to build a large bridge that can connect access roads from the eastern and western regions. Recommend the construction of a bridge across the Bian River as stated in the Merauke District RPJPD that connects Animha District and Kaptel District.

The length of roads according to the level of government authority in Merauke Regency in 2021 is divided into 3 (three), namely 204.64 km of state-authorized roads, 413.00 km of provincial-authorized roads and 1,313 district-authorized roads in Merauke Regency. 80 km. The regency roads consist of 367.35 km in good condition, 641.94 km in moderate condition, 155.57 km in slightly damaged condition and 148.95 km in heavily damaged condition with 541.40 km of paved road surface. m while the rest are unpaved roads.

The road network development plan prioritizes connectivity between activity centers and transportation nodes. One of the main keys to the success of food production centers is the effectiveness of existing commodity markets within the district and regional levels. As a production function, Merauke is expected to have a lot of land that connects food production centers to seaports and airports. Regional access to Boven Digoel Regency is relatively better compared to access to Mappi.

Regionally, the land route that needs to be developed is the road to Mappi Regency and Boven Digoel Regency in the north of Merauke. One of the main development targets is to connect Merauke Regency with Mappi Regency.

### 3.5.1 Sea Transportation Network

The condition of most areas in Indonesia which are dominated by archipelagic areas with very wide waters is bounded by the need to foster a national development movement. The air transportation and sea transportation sector plays an important role in bringing one region closer to another, an area with remote islands and border areas in the framework of realizing the archipelago concept, so as to stimulate the growth of trade in general.

Transportation as a basis for economic development and societal development as well as the growth of industrialization. With the existence of transportation, causing specialization or division of

work according to expertise in accordance with the culture, customs of a nation or region. The economic growth of a country or nation depends on the availability of transportation in the area concerned. An item or commodity has value according to place and time, if the item is moved from one place to another (*time utility and place utility*).

In this case, using transportation can create goods/commodities that are useful according to time and place. Port development to support access and infrastructure for the Merauke Special Economic Zone is the Kumbe Port, Bian and Kimaam Ports.

- Kumbe Harbour .
- Bian Harbour .
- Its status is a fishing port managed by the Ministry of Maritime Affairs and Fisheries .
- Kimaam Port – Wanam Harbor .

Things that need to be known in the process of port development and port class revitalization include:

- Existing port facilities .
- Economic activity – market and or trading center .
- Road network – quality, quantity, road access conditions or road type .
- Total population of the village or district served .
- Departmental or ministry of transportation programs related to access to transportation and communication .
- Power grid .
- The depth of the river or sea water facing the harbour .
- Gladak – type, length, condition .
- Harbor lighthouse – control office .

The port is also a gateway to enter a certain area and as a connecting infrastructure between regions, between islands, even between countries. The port has a position in the technical and operational aspects, so in spatial development planning it will include activity function plans, space utilization plans, port facility plans, environmental management plans, shipping lane facilities and infrastructure plans, development implementation phase plans, investment program phase plans and cost plan as well as port service unit indication.

Looking at the topography and natural conditions of Merauke Regency and looking at the National Port Order contained in the Minister of Transportation Regulation Number 53 of 2002, the most feasible port allocation recommendations can be placed in the following areas:

- Ilwayab District with River Harbor in Wanam City which is a local scale .
- Tubang District with a River Harbor in the local-scale Kimaam Area .
- Kurik District, Malind District and Animha District with River Harbor in Area
- Local scale Bian River .
- The main port of Merauke City with a regional scale ferry port class with the need for a dock for loading and unloading .

### 4.1.1 Irrigation System

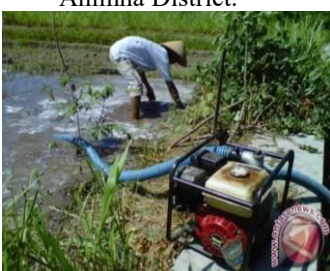
According to the main reference for regional planning in Merauke Regency, the development of irrigation networks and also the provision of raw water facilities depend on the management of the Einladen-Digul-Buraka-Biguma watershed which needs to adapt to the needs created from current uses. The Merauke Regency RTRW document states that the development of wet rice farming which is allocated for an area of 490,000 hectares requires a supply of 505,000 liters of irrigation water every second, the construction of which is adjusted to the determination of the plot of land.

The potential indicative paddy field area of 1,240,606 hectares has a water requirement of 1,798,878 liters per second assuming 1.45 liters per second per hectare for paddy field flooding. Surface water sources in Merauke Regency come from 6 watersheds (DAS) with a total annual mainstay discharge of 21,775 cubic meters per second or 21,775,000 liters per second. The biggest potential source of water in Merauke Regency comes from the Bian River. Fulfillment of irrigation water needs to be studied in more depth in calculating the total water demand to irrigation technical planning.

Irrigation network planning needs to pay attention to the physical condition of the land and the selection of the right irrigation technique. The results of the pre-feasibility study of one million Merauke paddy fields (2015) indicated that there were *pyrite levels* which affected agricultural yields (toxic in nature) if the land was open at a depth of about 1 meter and in contact with water. Initial indications through the mapping stage in a feasibility study (FS) need to be carried out in order to provide proper planning so as to produce optimal and sustainable production.

The development of rice field farming areas in several locations is on dry land. The model of managing and operating irrigation on dry land can be done by several methods including:

- Local Irrigation through pipeline process . Here gravity also applies, where high land gets water first. However, the water that is distributed is only limited once or locally. Piping can be applied to areas with wavy topography. Piping may be implemented as in Muting District, Olikobel District, Ulilin District.
- Water Pump Irrigation Water is taken from wells and also rivers which is then raised by means of water pumps (Figure 3.3 8 ). In several districts that are flowed by rivers such as Muting District, Jagebob District, Tanah Miring District, and Animha District.



**Figure 1.** Pump Irrigation

Merauke District irrigation network needs to consider raw water sources and appropriate irrigation techniques applied to each agricultural area. Sources of raw water on the surface come from rainwater and rivers. Raw water sources originating from subsurface water can also be utilized but need to be studied in terms of location, quality and environmental impacts. Basically groundwater or subsurface water is a reserve when surface water is no longer able to meet needs.

### 4.1.2 Energy

In general, electricity services in Merauke Regency are provided by the State Electricity Company for the Merauke region and the electricity system for the Papua region using diesel power plants. The target that must be achieved so that Merauke Regency has 100 percent electricity is by recommending power plant points that are allocated to be in the centers of agricultural commodity activities in each District. The provisional calculation of the need for electricity for rice processing is 279 MWh plus 18,717.6 MWh for the needs of residents who work as farmers and public facilities is assumed to be 18.6 MWh. The temporary total demand for electric power to support the needs of Merauke Regency's national food land is 19,015.2 MWh.

**Table 2.** The need for electricity to support the Merauke Regency National Food Field.

Use	Power	Amount	Total (MWh)
Rice Mill	3 MWh/unit	93	279
Resident	213 KWh/capita	87,876	1.8717,6
Public facilities	0.2 MWh/site	93	18,6

Source: PU, 2008; Setiono, 2013 and Analysis, 2015

The Power Plant, which has so far been based on PLTD, for the development of the Merauke agricultural area also recommends developing micro-hydro technology by utilizing natural water resources which are still abundant through rivers and water sources spread over high contours throughout Merauke Regency or outside areas capable of supplying electricity.

The need for electricity each year will continue to increase in line with the growing population. Likewise in Merauke Regency the need for electricity will increase until the planned year, namely 2041. The demand for electricity reaches 103,410,013 VA and a total of 165 substations are needed which are spread throughout the district.

### 4.1.3 Agricultural machinery

Alsintan or agricultural tools and machines need to be updated and/or equipped in order to increase the productivity of food production. The provision of agricultural tools and machines that are adequate in quality and quantity is a very important factor and must be realized in order to achieve the production target for the paddy field optimization program in Merauke Regency, based on data on the availability of alsintan

in 2020 according to data from the Food Crops, Horticulture and Agriculture Office. Plantation on a land area of 49,676.50 ha, the number of agricultural machinery needed to support the Merauke *Food Estate* is presented in Table 3.

**Table 3.** The Need for Agricultural Equipment and Machinery in the Land Optimization Program to support the Merauke *Food Estate* .

Alsintan	Need	Availability
Rotary Tractors	501	436
Hand Tractors	3,297	2,992
Power Treser	24,896	23,278
4" Water Pump	6.178	5,898
6-8" Water Pump	2,471	2,331
Comb	501	248
Hand Spr	49,406	49,208
Transplanters	4,940	305
RMU	6.178	5,774

## 5 Conclusion

Availability of resources in the development of agricultural resource-based industrial areas to support the food estate area in Merauke, such as availability of land, availability of human resources, availability of water, and supporting infrastructure. This study concluded that the potential availability of land to support the agricultural cultivation industry is an area of 1,284,940.00 ha, where the land can be grouped according to its land suitability for cultivating food crops covering an area of 66,674.35 ha, cultivating horticultural crops 43,209.12 ha, land for cultivation plantations 219,978.15 ha, and potential land that can be used as other agricultural cultivation areas, most of which are in conversion production forest areas.

Judging from the readiness of human resources, in this case the resources of farmers and the adequacy of agricultural extension workers. The number of farmers spread across 20 districts in Merauke amounts to approximately 21,000 farmers who manage  $\pm$  64,000 ha of land with an average land area/family of 2-3 ha/farmer. However, in reality the area of land cultivated by farmers per farmer is not evenly distributed so that it will affect farmer productivity. In addition, the quality of human resources, namely farmers are still dominated by semi-modern farmers where the level of knowledge of agricultural technology still needs to be improved because in general the education of farmers is still low. Meanwhile, the availability of agricultural extension agents in Merauke supports the productivity of farmers in cultivation activities. The availability of extension workers in 2020 totaled 89 extension workers in 14 districts, with the development of agricultural areas to support the food estate program in Merauke still requiring extension resources of 2030 extension workers for a potential area of cultivated land, namely 1,196,194 ha.

The availability of water resources to support irrigation of agricultural cultivation land supports the development of a food estate area in Merauke sourced from rainfed water. Availability of water to ensure the availability of water when rainfall decreases is sourced

from watersheds (DAS), namely Watersheds (DAS), namely DAS Bikuma, DAS Bulaka, and DAS Dolak which can irrigate paddy fields through irrigation networks that have been and will be built.

The readiness of the supporting instructors for the establishment of an agricultural cultivation industrial area requires several facilities and infrastructure, namely the road network consists of many lightly damaged and heavily damaged roads, even some roads are still dirt roads. Regionally, the land route that needs to be developed is the road to Mappi Regency and Boven Digoel Regency in the north of Merauke.

For the availability of the sea transportation network, port conditions need to be developed to support access and infrastructure. The food estate area is the Kumbe Port, Bian and Kimaan Ports. Furthermore, for the availability of irrigation networks, Merauke has a potential indicative area of 1,240,606 hectares of paddy fields with a water requirement of 1,798,878 liters per second assuming 1.45 liters per second per hectare for paddy field flooding. Surface water sources in Merauke Regency come from 6 watersheds (DAS) with a total annual mainstay discharge of 21,775 cubic meters per second or 21,775,000 liters per second. Irrigation network planning needs to pay attention to the physical condition of the land and the selection of the right irrigation technique. In general, electricity services in Merauke Regency are provided by the State Electricity Company for the Merauke region and the electricity system for the Papua region using diesel power plants. The target that must be achieved so that Merauke Regency has 100 percent electricity is by recommending power plant points that are allocated to be in the centers of agricultural commodity activities in each District. The provisional calculation of the need for electricity for rice processing is 279 MWh plus 18,717.6 MWh for the needs of residents who work as farmers and public facilities is assumed to be 18.6 MWh. The temporary total demand for electric power to support the needs of Merauke Regency's national food land is 19,015.2 MWh. Alsintan or agricultural tools and machines need to be updated and/or equipped in order to increase the productivity of food production. Provision of agricultural tools and machines that are adequate in quality and quantity to realize the achievement of production targets in the paddy field optimization program. The availability of agricultural tools and machinery is a work target that cannot be ignored to overcome the problem of limited farming resources in the plan to develop cultivation areas in the food estate development program in Merauke.

## 6 Recommendations

Some recommendations from the results of the studies provided for the development of a food estate area in Merauke are:

- To suppress open areas and reduce the impact of global environmental change from land clearing and agricultural activities, a program for optimizing cultivation land is carried out by

utilizing areas that are already open to reduce the rate of carbon emissions from opening new agricultural land;

- Improving modern agricultural systems with a corporate management approach in order to optimize human resources for farmers and improve the quality of human resources for farmers and agricultural extension workers;
- Revitalization of watersheds and primary and secondary irrigation to ensure the sustainability of water resources for agricultural cultivation land;
- Improving the quality and quantity of basic infrastructure by repairing the main road network or farm road network which is still in a slightly or severely damaged condition, as well as building a road network, expanding the quality of sea transportation by expanding ports, increasing electricity networks for agricultural areas, and building and revitalization of primary or secondary irrigation networks in cultivation areas.

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