

# The Policy on The Development of Integrated Coastal and Livestock Area Based on Geospatial in East Kalimantan

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**Abstract.** In term of ecologically and economically, a coastal area which has different spatial characteristics according to the land conditions has high potency to be developed as it has physical and geographic advantages that can be utilized as the center of community activities. The development in the livestock sector requires a database including geospatial information and statistic data as the reference in the decision-making of livestock development area as not all areas are potential. The livestock in the coastal area in East Kalimantan Province has the potency to be developed into a livestock development area as it has been supported by the availability of land and feed sources. Besides agricultural areas, the land ecosystem which is located in the coastal areas can also be utilized by communities to rear livestock such as beef cattle, buffalo, sheep, and goats. Livestock breeding in this location can role as an income substitution for communities and could be an alternative livelihood for fishermen who can not go fishing due to bad weather and high waves. That pattern is expected to become a new activity concept that can improve communities' income and welfare to be more independent and productive.

**Key words.** Coastal Area, Zone, Development, Livestock, Geospatial

## Introduction

The human population is estimated will increase from 7,2 billion to 9,6 billion in 2050, [1]. Indonesia is an archipelagic country (16.056 islands) with a population in 2020 was 270,20 million people, [2] and covered by ocean and coastal area which larger than the land accounted to 70% (Abdunnur 2020), thus Indonesia is called a maritime country. With a wide sea and a long coastline ( $\pm$  81,000 km), Indonesia has a rich diversity of biological and non-biological resources [4]. The marine environment in Indonesia is divided into two, namely offshore and coastal areas [5]. The area of Indonesian waters reaches 6.4 million square kilometers which are divided into territorial seas (0.29 million square kilometers), inland waters and archipelagic waters (3.11 million square kilometers), and the Exclusive Economic Zone (3.00 square kilometers). Indonesia also has an additional water zone of 0,27 million square kilometers, a continental shelf of 2.8 million square kilometers, and a long coastline of 108,000 km. The diversity of natural resources found in the sea and coastal areas has potency to be explored, managed and utilized optimally for both conservation and productive economic interests to improve the welfare and prosperity of the Indonesian people [6].

East Kalimantan has a huge coastal resource potential with different spatial characteristics according to the land conditions. The coastal area management which is regulated under Law Number: 27 in 2017 Article 6 regarding the Management of Coastal Areas and Small Islands must be carried out by integrating activities between terrestrial ecosystem and aquatic ecosystem. The terrestrial ecosystem lying in the coastal area can be used by the community to raise livestock such as cattle, buffalo, sheep, and goats. The livestock business in this location can role as an income substitution for communities and could be an alternative livelihood for fishermen who cannot go fishing due to bad weather and high waves.

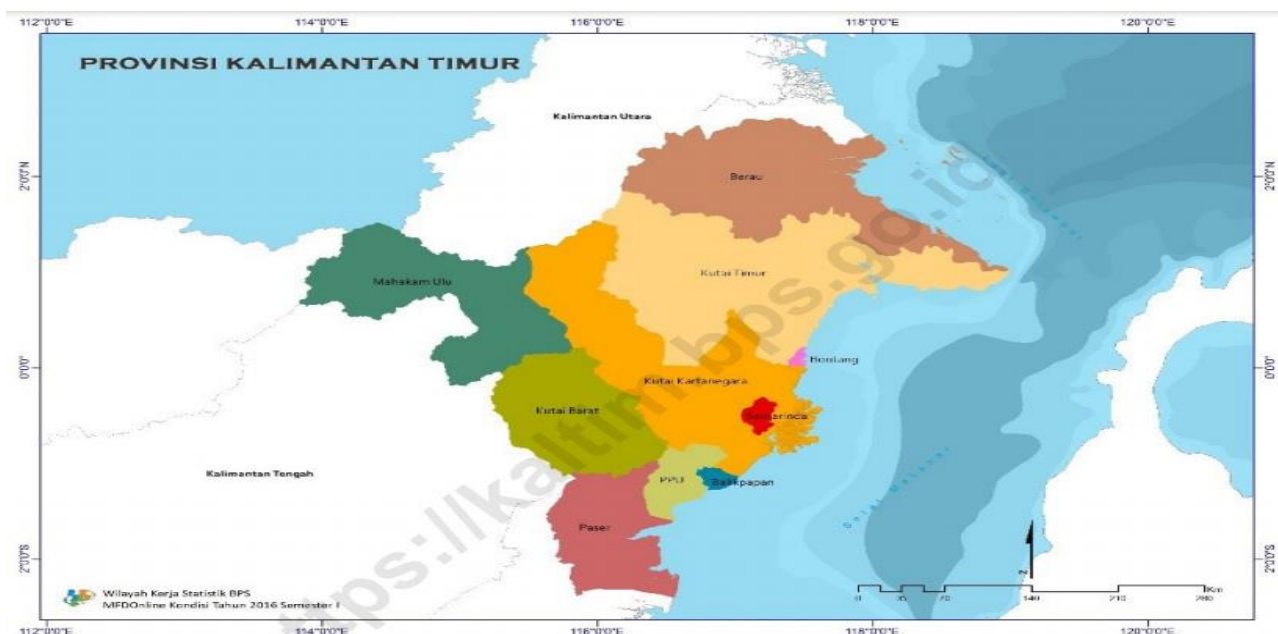
In term of the ecologic and economic aspect, the coastal area is very potential to be developed [3], because historically it has physical and geographical advantages which can be utilized as the center for community activities

such as fisheries, forestry, mining and groundwater resources [4]. Principally, the livestock development in coastal areas must be carried out through a regional approach. The regional approach is an effort to develop livestock commodities in an area that meets agroecological requirements, agro-economically and agro-socio-technology feasible has adequate location accessibility, and the resulting diseconomic-externality can be controlled in a sustainable manner. In its implementation, the livestock development in coastal areas requires objective and accurate data and information. The availability of data and information is an important component in the process of utilizing parts of coastal areas for livestock development because it can support policy-making and promote the success of these activities, especially geospatial-based data such as geographic information systems or Geographical Information Systems (GIS). GIS-based spatial analysis has been widely used to investigate the suitability of land in various sectors [7]. This review article is aimed to explore the potential of coastal areas that can be integrated with the development of livestock based on geospatial data.

**Discussion**

**Geographic Condition of East Kalimantan Province**

East Kalimantan Province has a total land area of 127,346.92 square kilometers, geographically located between



113°35'31" and 119°12'48" East Longitude, 02°34'32" North Latitude, and 2°44'14" South Latitude. The provincial border in the northern part is North Kalimantan Province, the eastern part is Sulawesi sea and Makassar strait, the southern part is South Kalimantan Province, and in the western part is West Kalimantan Province, Sarawak (East Malaysia), and Central Kalimantan Province [2].

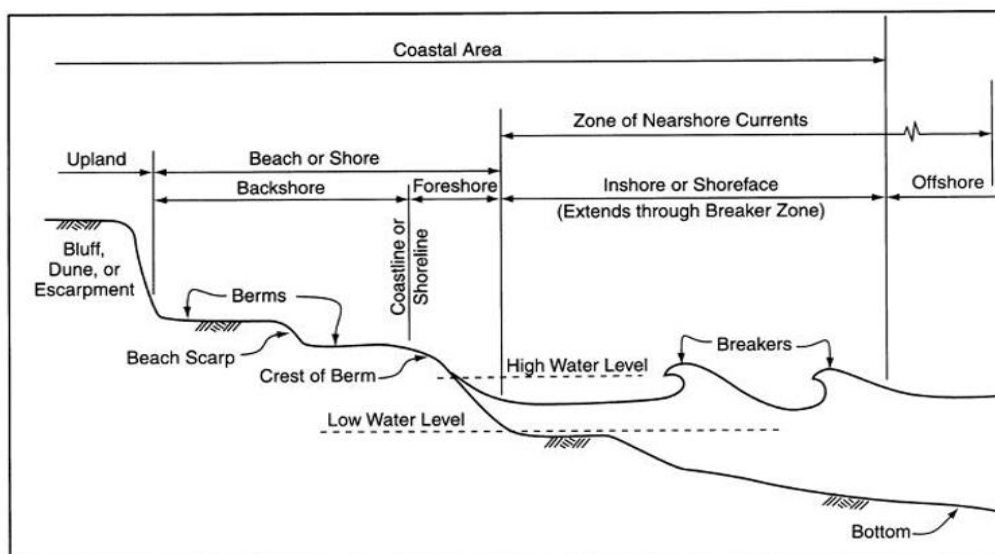
**Figure (1): Map of East Kalimantan Province [2].**

East Kalimantan Province has a wavy topography, low and wavy hillside basins, and high mountains which are formed by the physical properties of the rock and its geological structure. Lowland areas found in the watershed area lie in altitude ranging from 0-1500 m above sea level (asl) with a slope of 0°-60°, hilly areas, and mountains with an average altitude of more than 1,000 m asl with a slope of 300% [8]. The climate of East Kalimantan is tropical wet with a rainfall intensity of 282.50 mm, air temperature ranges between 23.2-35.8°C, average air humidity between 39.0-97.0%, and wind speed of 12.86 m/sec [2]. East Kalimantan Province has an aquatic area of 98,000 square kilometers, inland open waters of 2.28 million ha, and the fisheries and marine sectors are sources of economic growth [9]. East Kalimantan Province has potential natural resources to be developed into an area for livestock development through the use of land and coastal areas.

**The potency of Coastal Area**

Coastal areas are defined as the interface or transition areas between terrestrial and aquatic ecosystems which affected by changes in both areas. The resources in coastal and inland areas comprise biological resources (fishes, coral reefs, seagrass beds, mangroves, and others biota), non-biological resources (seawater, sand, seabed minerals), artificial resources (marine infrastructures related to marine and fisheries), and environmental services (natural landscape, seabed surface to place underwater installations associated with marine and fisheries, and energy contained in the coastal areas). The characteristics of natural resources in coastal areas have an impact on the characteristics of human resources and the social institutions around them because all of them interact with each other [10].

The coastal areas are strategic areas that have an important role for some of the community, especially as a livelihood, and part of it is used as a settlement/housing area (60% of Indonesia's population lives in coastal areas and more than 70% of large cities are located in coastal areas). Coastal areas have strategic values with comparative and competitive advantages so that they are the potential to be developed [4]. Management of coastal areas based on their respective purposes must pay attention to coastal boundaries and land suitability because each area or zone has different environmental and resource characteristics [11].



**Figure (2): Coastal zone area [11]**

The direction of coastal areas usage based on coastal zone category is described in this table.

**Table (1): Zoning and Coastal Areas**

Zoning based on Law of Spatial Planning No. 26 the Year 2007	Zoning based on Law of Management of Coastal Area and Small Islands No.1, Article 11 the Year 2014	Zoning based on Regulation of Minister of Marine and Fisheries No. PER.16/MEN/2008 Article 15
Aquaculture Area	Plan on Public Uses Area	Public Uses Area: 1. Tourism 2. Housing Area 3. Port 4. Agriculture 5. Forest 6. Mining 7. Aquaculture 8. Capture Fisheries 9. Industry 10. Public Infrastructure 11. Limited Uses Zone according to environment biogeophysical characteristics
Conservation Area	Plan on Conservation Area	1. Aquatic Conservation Zone 2. Coastal and Small Islands Conservation Zone 3. Maritime and Coastline Conservation Zone
Special Area	National Strategic Plan for Special Area	1. Defend and Security Zone 2. World Heritage Site 3. Borders and Outer Small Islands

**Table (1): Zoning and Coastal Areas**

Source: [11].

Coastal and marine resources are ecologically interacting between land and coast so that the two areas must be managed jointly [10]. The utilization of coastal resources can be carried out optimally and sustainably through

integration with the livestock sub-sector. Utilization efforts are carried out by considering the potential resources, carrying capacity, and ecological processes that occur in the area. Management of coastal areas and small islands based on Law Number 27 the Year 2017 Article 6 is carried out by integrating among sectors, between terrestrial and aquatic ecosystems, between science and management principles. Strategic planning, development, management of coastal and marine resources in an integrated manner requires more general expertise and comes from various disciplines including agriculture, anthropology, policy analysis, ecology, oceanography, hydrooceanography, engineering, economics, law, and sociology [10] as well as animal husbandry. Formulation and development of spatial planning, as well as resources management, can be done to avoid overlapping between one activity and another [10].

### **Feed Carrying Capacity**

The coastal areas based on the Regulation of the Minister of Marine and Fisheries Number PER.16/MEN/2008 Article 15 (table 1) have public uses areas which suitable for agriculture and industry (especially for food crops). Geographically, sloping coastal land is formed by fertile alluvial deposits that can be used as productive agricultural land [12]. The agricultural sector and the food processing industry have the potential to provide by-products and/or waste that can be used for animal feed. The marine products processing industry in the coastal areas produces waste and/or by-products that can be utilized. The waste and/or by-products are classified into two groups, namely liquid and solid. Liquid by-products include fish oil (by-products generated from making canned and flour fish), and surimi washing water waste. However, these liquid by-products have not been widely utilized. Solid by-products include meat and bones from the processing of fish filets, fish heads, shrimp heads, and shrimp skins (Kadim, 2018). This solid waste can be processed into flour and used as a source of protein in concentrates for livestock (Mayulu, 2021). Feed materials that can be provided from agriculture include crop residues, crop-by-products, and agro-industrial by-products (Mayulu, 2020). The uses of the agricultural by-product can be an alternative for feed materials, including rice straw, but rice straw has low nutritional quality. The application of feed processing technology (another) makes rice straw has great potential to meet the needs of livestock. In addition to its abundant amount of rice straw, this feed material is cheap so it is affordable for breeders and will have an impact on reducing feed costs [16]. Those conditions indicate that some coastal areas have great opportunities in providing feed for livestock because the areas for livestock development must be supported by continuous availability of feed both in quality and quantity, and can be developed with an integrated pattern.

Feed is the most important component in the livestock business because it has a big influence on livestock productivity [16]. Livestock production experiences problems due to fluctuations in feed availability. The production of livestock will be optimum when feed is abundant and the production decreases when there is a lack of feed [17]. The definition of feed is the intake given to livestock as a source of energy, supporting growth and life consisting of forage, agricultural waste, processed feeds using silage or fermentation, and processing into concentrate. Sources of animal feed include fresh forages, dry forages, silage, and concentrates [16]. The criteria for feed materials include: 1) easy to obtain; 2) low price; 3) does not compete with human needs; 4) non-toxic; 5) palatable, and 6) contains nutrients which capable to meet the needs of livestock.

The application of the feed forage budgeting concept, developing superior forages, developing integrated businesses between livestock and food crops or plantations, and utilizing the potential of local feed are efforts that can be made to support livestock development [18]. Potential forage carrying capacity is determined by the landform, area shape, climate, and land use. The ability of the land to produce a source of animal feed, accessibility, and availability of infrastructure are the basic parameters for land assessment. Soils have varying levels of fertility, which naturally impacts the nutrient content of grass [19].

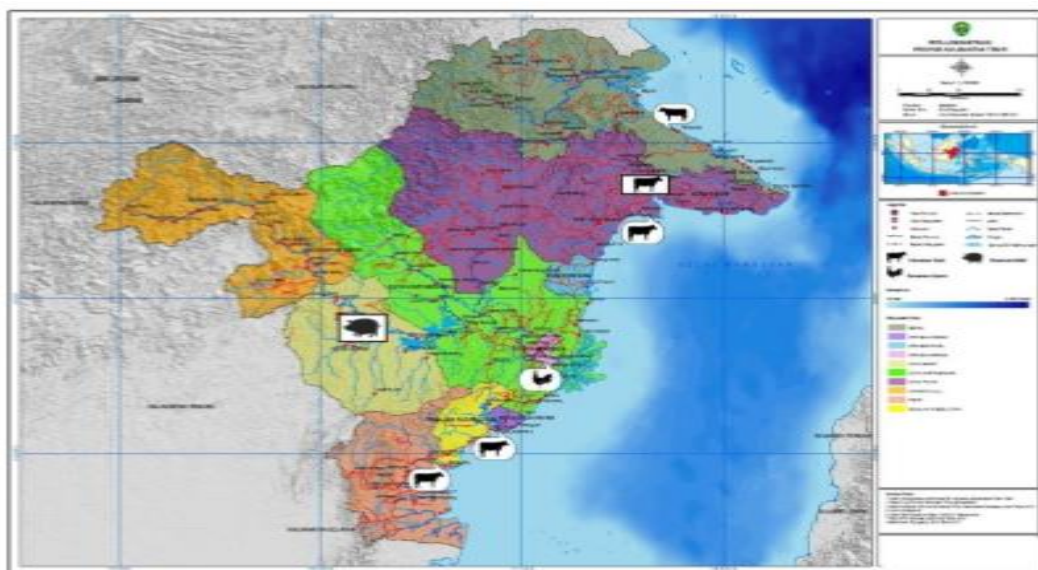
### **Potency on The Development of Livestock Zone**

Livestock is part of the fastest-growing agricultural sub-sector and plays an important role in realizing global food security. Livestock products contribute to 33% of protein consumption and 17% of the population's calorie consumption [20]; [1]. The increase in demand for livestock products is caused by several factors including increasing human population, increasing nutritional awareness to consume animal protein, changes in food preferences, income levels, urbanization, and advances in science and technology [20]; [21]; [22]. Those require planning, designing, implementing sustainable livestock systems holistically (environmental, social, economic) and having an impact on increasing competitiveness, income, and environmental sustainability [23].

Livestock activities require an environmental role, but not all areas can support livestock development [21]; [23]. The development of the livestock sector can be realized through a holistic (social, economic, public environment, and government policy), integrative, and spatial approach [23]. The coastal areas have the potential to be used for a livestock development area based on land support and the availability of feed and human resources. Livestock area can be defined as an existing area or a new location that has natural resources according to the agro-ecosystem, location (in one wide location or spread into several locations) is connected functionally through good accessibility

in one area, equipped with adequate infrastructure and facilities for regional development [24]. The development of livestock areas requires the availability of land resources [15], agro-ecology suitability for livestock, nearness between inputs and outputs, availability of infrastructure, and storage facilities [21]. The availability and supportive infrastructure and facilities are the main requirements or criteria that must be confirmed in determining the location of the livestock development area because it affects the quality of services and products being produced, including transportation, production, marketing, clean water, technology, research and development, resource development, human resources, finance, electricity, energy, telecommunication, institutional planning, regulations, and policies as well as health [24].

Optimization of resources to increase breeders' income, population, and production, to empower breeders' communities, creating a balance of development between regions is the objective of livestock distribution and development in regions (Rahman, 2018). East Kalimantan Province has an ecological base ranging from the coast to forests but is dominated by dry land, so the livestock development is directed based on dry land ecology. The wet tropical climate and relatively humid conditions indicate that only a few types of ruminants are potential to be developed, including beef cattle, buffalo, and goats.



**Figure (3):** Master Plan of the Livestock Development in East Kalimantan Province [24].

The development of livestock areas must pay attention to the land carrying capacity (land characteristics), feed carrying capacity, livestock population, livestock disease status, livestock infrastructure, breeder households, and livestock institutions as well as support from regulations and policies including livestock master plan. The development of a crop-livestock system can increase livestock production and productivity, this is because that there is a mutual support system and beneficial process, namely the livestock manure can improve the fertility of land and food crops, while land and food crops plants provide feed throughout the year for livestock (Mayulu and Suhardi, 2016).

**Policies on the Livestock Area Development**

Land management is a problem that requires serious attention by all parties, especially for policymakers to determine its sustainability [27]. The policy in the livestock area development is based on a planned and directed spatial planning and following the potential of the area, thus it can create competitive livestock agribusiness that is more productive, safe, and sustainable and has an impact on the welfare of the community, especially for breeder households as livestock business actors [21]. The suitability of land use or suitability of land types for a particular use is the basis of land use planning because it will allocate land resources to be more productive and at the same time conserve them [27]. Land suitability can be defined as the fitness of land unit for a land-use type which is assessed by comparing the land use requirements of each land utilization type with the land [27].

Land suitability analysis is an important instrument that is involved in decision-making to define certain locations in the regional planning process. The objectives of land suitability analysis are to identify the most appropriate spatial pattern of future land according to the specified requirements, preferences, and predictors of specific activities [27]. Challenges that remain on sustainability development are characterized by a complex relation of the location used as a common reference [28].

### Role of Geospatial Information

The development of the livestock sector in coastal areas requires a database including geospatial information and statistical data as the reference to determine the location for livestock development, because not all areas have the potential to be developed as livestock areas. Geospatial technology is a tool to increase capacity and measure the performance of sustainable development at different scales. Data and information on land resources play an important role, especially spatial data that presents soil/land characteristics, potency, land suitability level, distribution, and area to determine the area's potency to support the development of livestock areas [24]; [15].

Geospatial information is not only used for mapping and visualization but can integrate with other data sources (data analysis, modeling) in policymaking, decision making and supports the government in the development of necessary resources. Geospatial data can be used repeatedly to support a variety of different service applications. Geospatial concepts are location accuracy, precision, and proximity. Standardized and comprehensive land development for regional mapping needs accurate data so it can be updated regularly [21]. Determining the location of livestock development requires a supporting information system related to the geography and topography of an area, such as the sensitivity of the land to erosion which can be determined through the level of slope, erosion potency, soil, and geological characteristics [27]. Geographical data information, statistical data, and associated environmental data (geospatial data) are needed to measure the effectiveness, monitor, and mitigate challenges in livestock development [28]. Geospatial information plays an important role in creating good collaboration among communities, government, and regional agencies as well as supranational bodies [28]. Effective use of data leads to the improvement of development, implementation, traceability, and accountability [28]. The development of livestock in coastal areas must pay attention to the land carrying capacity (land characteristics), feed carrying capacity, livestock population, livestock disease status, livestock infrastructure, breeder households, and livestock institutions as well as support from the livestock master plan.

### Conclusion

The development in the livestock sector requires a database including geospatial information and statistic data as the reference in the decision-making of livestock development area as not all areas are potential. The coastal area in East Kalimantan Province has the potency to be developed into a livestock development area as it has been supported by the availability of land and feed sources. Besides agricultural areas, the land ecosystem which is located in the coastal area can also be utilized by communities to rear livestock such as beef cattle, buffalo, sheep, and goats. Livestock breeding in this location can role as an income substitution for communities and could be an alternative livelihood for fishermen who can not go fishing due to bad weather and high waves. That pattern is expected to become a new activity concept that can improve communities' income and welfare to be more independent and productive. The policy in the livestock area development which is based on well-planned spatial planning and following the potential of the area is expected can create a competitive livestock agribusiness that is more productive, safe, and sustainable.

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