

# Prospective analysis of sustainable mangrove ecotourism development policy

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**Abstract.** The Bandar Bakau area of Dumai City is very strategic to be used as an international tourism development area, because Dumai City is located in the international trade cross-country area of the Melaka Strait. The impact of Dumai City being made a special economic zone is the destruction of mangrove areas, so that the environment becomes unsustainable. To maintain environmental sustainability, a policy is needed that combines tourism potential with environmental sustainability, such as an ecotourism development policy. Ecotourism has emerged as a sustainable approach to tourism development that emphasizes the conservation of natural resources and cultural heritage while promoting community engagement and economic growth. The aim of the research is to formulate sustainable ecotourism development policies. The method used is a mix method using prospective analysis. Prospective analysis can offer future-oriented policy frameworks for stakeholders to ensure environmental sustainability. The findings reveal stakeholders' concern for mangrove areas through education and research, rich arts and cultural heritage, as well as tourism potential in Bandar Bakau Dumai, indicating that ecotourism-based area development policies are very possible to be developed sustainably.

## 1 Introduction

The city of Dumai is very strategic to become an international tourism development area, because Dumai is in the international trade cross-country area of the Melaka Strait which connects four countries, Indonesia, Malaysia, Thailand and Singapore. As a special economic area, Dumai City is obliged to create economic growth, equal development, and increase the nation's competitiveness. This city was developed through preparing areas that have geoeconomics and geostrategic advantages and function to accommodate industrial activities, exports, imports and other economic activities that have high economic value and international competitiveness.

The negative impact of Dumai City being made a special economic zone is the destruction of several environmental areas, especially in mangrove areas, which have been used as industrial areas, thereby reducing the area of mangrove areas in Dumai City.

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In addition, there are activities from the community who take mangrove wood to make “cerocok wood”, charcoal wood and firewood. In fact, the mangrove ecosystem has a function as a barrier to abrasion or sea water currents which can erode coastal land, absorbing carbon dioxide gas, producing oxygen and processing toxic waste as well as a place for marine biota such as fish, crabs, snails, clams, butterflies and other marine biota to live. for shelter and foraging for food.

There is one area in Dumai City that has tourism potential that can be developed into a mangrove ecotourism area, namely Bandar Bakau. This area is located in Pangkalan Sesai Village, West Dumai District, which has an area of 31 Ha, and the newly managed area is still 13 Ha. The Bandar Bakau Dumai area is very strategically located because it is in the middle of Dumai City and close to the international port of Dumai City. The status of this area has been confirmed as Limited Production Forest through government policy in the form of Dumai City Regional Regulation Number 15 of 2019 concerning Dumai City Regional Spatial Planning for 2019-2039, which is a derivative form of implementation of Riau Province Regional Regulation Number 10 of 2018 concerning Plans. Riau Province Regional Spatial Planning for 2018-2038, and Decree of the Minister of Environment and Forestry Number 903 of 2016 concerning Riau Province Forest Areas. With the birth of this regulation, the management of Bandar Bakau is under the supervision of the Bagan Siapi-api Forest Management Unit (Riau Unit III Production Forest Management Unit) together with the Riau Province Environment and Forestry Service so that this area can be developed into a mangrove ecotourism area by the bandar mangrove forest farmer group.

The mangrove area in Dumai City really needs to be maintained and preserved, because mangroves are a product of natural forest resources which have direct benefits and indirect benefits including the benefits of nature tourism/recreation services, water/hydrogen protection services, beauty, uniqueness and carbon transfer and storage [1]. Based on the national mangrove map officially released by the Ministry of Environment and Forestry in 2021, it is known that the total area of Indonesian mangroves is 3,364,076 Ha. In the same year, the area of mangroves in Riau Province was recorded at 224,895 Ha. Dumai City, as an autonomous region in Riau Province, has 3,477 Ha of mangrove land.

The natural wealth contained in Bandar Bakau is a very crucial natural resource that must be maintained considering that all activities carried out by the community will have a big impact on the flora and fauna ecosystem. Activities in this area are ports and settlements. Considering that mangroves are plants that play an important role in coastal areas of the ocean, their potential and useful value should be preserved and paid attention to. The potential of Bandar Bakau Dumai comes from the richness of mangrove vegetation. There are 17 types of true mangroves found, namely: *Avicennia marina*, *Avicennia alba*, *Bruguiera gymnorhiza*, *Bruguiera parviflora*, *Ceriops tagal*, *Heritiera littoralis*, *Lumnitzera littorea*, *Lumnitzera racemosa*, *Nypa fruticosa*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Rhizophora stylosa*, *Scyphiphora hydrophyllacea*, *Sonneratia alba*, *Sonneratia ovata*, *Xylocarpus granatum* and *Acrostichum* sp.

The mangrove forest ecosystem is a biodiversity of coastal areas, dominated by terrestrial plant species that can invade and grow in seawater environments [2]. The mangrove ecosystem, both as a natural resource and as an environmental protector, has a

very important role in the economic, social and ecological aspects of the surrounding environment [3]. The function of mangrove forests is divided into three, namely ecological functions, social functions and economic functions [4]. The ecological function of mangrove forests is to protect coastlines, prevent sea water intrusion, as a habitat for various types of birds, and so on [5]. The social function of mangrove forests is as a place for research, education, art, culture and as a bond for community social relations [6]. Meanwhile, the economic functions of mangrove forests are producing household needs, producing industrial needs and producing seeds [7]. The large benefits that exist in the mangrove forest ecosystem have consequences for the mangrove forest ecosystem itself, namely the increasingly high level of exploitation of the environment which often ends in quite severe environmental degradation [8].

The huge potential of this mangrove forest, especially in the Bandar Mangrove Dumai area, has made many parties interested in managing it, from the government, private sector and the community. Management that has not been well planned has raised concerns about the sustainability of the mangrove ecosystem in the mangrove area. For this reason, it is necessary to develop policies developed by the government so that development in the mangrove area can be sustainable. The development of policies that are formulated must of course look at the existing conditions in the mangrove area such as social, economic and ecological conditions so that the policies implemented can guarantee the sustainability of the mangrove ecosystem in the mangrove area.

## **2 Literature review**

Mangroves are a very unique plant because they grow in the tidal zone and are plants in wetland areas [9]. The definition of mangroves was originally a plant community dominated by trees in tropical coastal areas where there are tidal waters, and these mangrove forests are better known as mangrove forests [10].

Mangrove forests are found in many tropical, subtropical and temperate countries, there are around 118 countries in this area which is often called coastal areas [11], Mangrove forests or mangrove forests are rich in natural resources whose availability can be utilized by coastal communities, as a food source for fish and invertebrates as well as producing quality wood for development [9]. However, current conditions with the rapid development of development seen from the increase in population, industrialization, urban expansion and globalization, the area of mangrove forests has been reduced a lot and many of them are fragmented or degraded [12].

Mangrove areas that are still relatively intact today are areas that are in remote areas, areas that cannot be accessed, such as areas protected by the government in the form of protected areas and designated as conservation areas or areas under state protection [12]. Currently, mangrove forests are receiving increasing attention and recognition for their role in providing food for fish, protecting beaches from the threat of abrasion, providing biodiversity and as a huge carbon producer. For this reason, increased efforts are needed to ensure rehabilitation, conservation and restoration efforts in all mangrove areas [9].

Efforts to support the rehabilitation, conservation and restoration of sustainable mangrove management need to be informed intensively and massively, to meet the

reporting standards of the Ramsar Convention in an effort to achieve sustainable development goals. One of them is by making the mangrove area an ecotourism area [8].

Ecotourism is an environmentally friendly tourism concept. This is a form of sustainable tourism activity that allows tourists to travel to natural areas while still paying attention to the needs of local communities and the benefits for local stakeholders in preserving cultural and natural areas [13]. In order for ecotourism to comply with sustainable tourism standards, there must be a minimum of three pillars that must be maintained, namely the pillars of environmental, social and economic sustainability [13].

### **3 Method**

This research used a mix method and in determining respondents used purposive sampling and snowball sampling methods from various parties such as the Maritime Nature Lovers Group, Redam Pilo Creative Joint Business Group, Bandar Bakau Tourism Awareness Group, Bandar Forest Farmers Group, Forestry Extension Unit Forest Management Unit III Riau, Dumai City Youth Sports and Tourism Department, partner companies and tourists. Data collection techniques use survey methods and in-depth interviews to gather information from key informants as well as assign scores to each direct influence between factors.

This research is to find a policy for developing ecotourism in Bandar Mangrove using prospective analysis. Prospective analysis aims to look for determining factors that have a strong influence but weak dependence in finding policies. This prospective analysis also functions to predict possibilities that will occur in the future. Prospective analysis can predict possibilities that will occur in the future, both positive or desirable and negative or undesirable. Prospective analysis also functions to prepare strategic actions that need to be taken and predict whether changes are needed in the future. Prospective analysis can also serve to formulate policies [14,15].

Prospective analysis in this research uses Microsoft Office software, namely Excel, which has been transformed into a system that can process and analyze data. The prospective analysis stage begins with setting research objectives in detail and easy for all respondents involved to understand to obtain the required information. Second, identify the factors that respondents need in a study system, in general these factors have an influence on achieving research objectives. Third, assign values to the factors identified as needed by the informants. Fourth, the factors in the first quadrant which are strong influencing factors are arranged according to the possibilities of the situation that occurs, then processed and analyzed to then formulate policy strategies that will be implemented in the future [15].

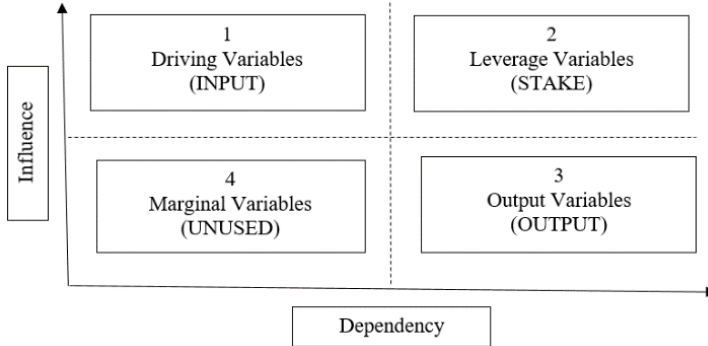
Guidelines for using prospective analysis regulate the assignment of scores to factors that have been identified by respondents. The prospective analysis guidelines explain that in the first stage there is a table format which is symbolized by the letters A, B, C, D and so on (see Table 1). Next, in the second stage, giving a score value, if the score value is 0, it means that the factor that has been identified has no influence at all on other factors. A score of 1 means that the factor that has been identified has a small influence, a score of 2 means that the factor that has been identified has a moderate influence, and if the score is 3 it means that the factor that has been identified has a strong influence [16].

**Table 1.** Direct influence matrix between factors.

	A	B	C	D
A				
B				
C				
D				

Source: Godet [16].

After each score is entered into the matrix, it will provide analysis results in diagram form. The diagram consists of four quadrants which have different meanings. The first quadrant is a determining factor, which means it has a very influential factor but has low dependence. The factors in the first quadrant are used as the locomotive factors that have the most powerful influence in the system. The second quadrant, is a connecting factor, which means having an influencing factor as well as having a strong dependency. The third quadrant is a dependent factor, which means it has low influence but high dependence. The fourth quadrant is an independent factor, which means it has low influence and dependency factors (See Fig. 1) [15].

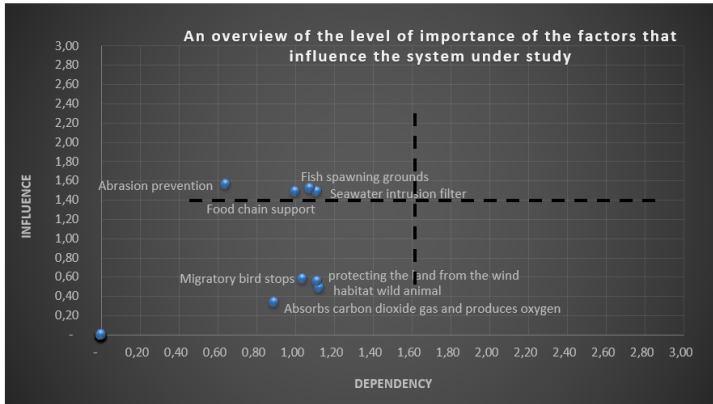


**Fig. 1.** Diagram of influence and dependency between factors in the system.

## 4 Results and discussion

The development of the mangrove ecosystem policy in the Bandar Mangrove Dumai area was formulated using prospective analysis and has resulted in a policy direction for developing the Bandar Mangrove area into an ecotourism area by prioritizing the principles of sustainable development from ecological, economic and social aspects. The emphasis in developing Bandar Mangrove ecotourism is in the fields of education, arts and culture. To obtain policy direction for the development of the Bandar Mangrove area, you can look at the following prospective analysis.

Prospective analysis from ecological aspects produces eight policy directions, namely abrasion prevention, fish spawning grounds, food chain support, seawater intrusion filter, migratory bird stopping, protecting the land from the wind, wild animal habitat, and absorbing carbon dioxide gas and producing oxygen (See Fig. 2).



**Fig. 2.** Ecological policy direction.

The results of the prospective analysis of the eight policy directions showed that there were four policy directions in the first quadrant, namely abrasion prevention, fish spawning grounds, food chain support, and seawater intrusion filter.

### Abrasion prevention

Ecologically, mangroves can prevent coastal erosion, this is very useful for maintaining land area in the Bandar Bakau area. Abrasion is the process of erosion of land by waves, causing the substrate to be washed away and land area reduced [13]. The beach will experience a rapid abrasion process if there is no barrier in the area. To anticipate this, around the coast, especially muddy beaches, it is necessary to plant mangroves [17]. This is in addition to improving the condition of the beach and restoring the balance of the coastal ecosystem so that it becomes intact again. By returning to the intact condition of the coastal ecosystem, the local community can use it as a place for educational tourism, a conservation area and so on [18]. The strong and dense root system of mangrove trees is able to bind and hold coastal sediment, preventing it from being carried away by strong sea currents and waves [19]. Through proper mangrove planting, sediment material will be trapped between the mangrove roots, forming a kind of natural embankment that can protect the coastline from abrasion. In addition, the complex roots also help slow water flow and waves, helping control sedimentation rates and reducing coastal damage. In the context of disaster mitigation, mangroves are known to reduce the intensity of sea breezes, and in some areas they have been proven to be effective in preventing destructive tsunami waves [20].

## **Fish spawning grounds**

According to Menéndez et al. [5], fertile mangrove forests are spawning grounds, nursery grounds and feeding grounds for certain fish and aquatic animals. Increasing root density can improve habitat conditions, because increasing the mud substrate will improve the habitat, thereby encouraging vegetation growth. Increasing vegetation can also increase the density and diversity of marine biota [21]. Mangrove forests are also a hiding place for baby shrimp and fish. As a spawning ground, mangrove areas play an important role because they provide shade. The roots of mangrove trees (*Rhizophora* sp.) are used by shrimp larvae as a shelter from predators until they grow into young shrimp [2].

## **Food chain support**

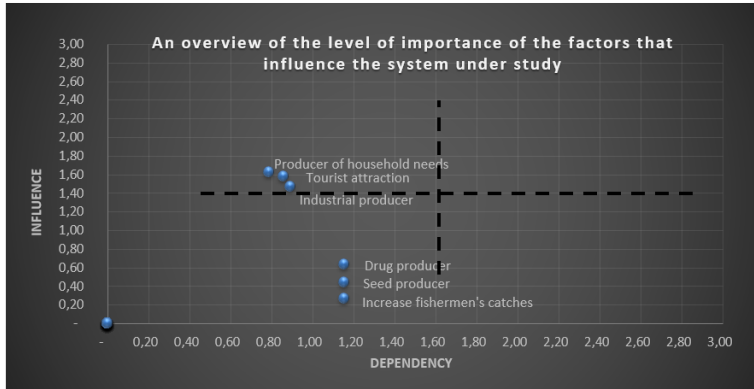
Mangrove leaves that fall and enter the water will be decomposed by microorganisms. The results will become food for larvae and small animals. Then it continues to the marine food chain system. So in other words, mangrove forests provide benefits for creating food chains in the marine ecosystem and its surroundings. The role of mangroves in supporting coastal fisheries activities can be summarized in two ways. First, mangroves play an important role in the life cycle of various types of fish, shrimp and molluscs [17], because the mangrove environment provides protection and food in the form of organic materials that enter the food chain. Second, mangroves are suppliers of organic material, so they can provide food for organisms that live in the surrounding waters [22]. Mangrove litter production plays an important role in the fertility of coastal waters and mangrove forests are considered the most productive among coastal ecosystems. In Indonesia, mangrove litter production ranges from 7 – 8 tonnes/ha/year [1]. Mangrove forests capture and collect sediment carried by tidal currents from land via river flows. Apart from protecting the coast from waves and wind, mangrove forests are also places filled with other life such as mammals, amphibians, reptiles, birds, crabs, fish, primates, insects and so on. Apart from providing biodiversity, the mangrove ecosystem also acts as a genetic pool and supports the entire living system around it. The mangrove habitat is a feeding ground for these animals and as a nursery ground, spawning ground and safe haven for various fish and shellfish larvae from predators [10].

## **Seawater intrusion filter**

Mangrove forests can also act as a filter from sea and land influences and can prevent sea water intrusion onto land. The ability of mangrove forests is also thought to act as a barrier to seawater intrusion onto land. Mangrove plants have a high correlation with the level of sea water intrusion. The existence of mangroves plays an important role in water management, including preventing sea water intrusion. The role of mangroves is explained in two ways, namely their role in maintaining the stability of ground water levels and reducing the entry of sea waves into river channels [23]. Mangrove ecosystem can control the occurrence of intrusion through four mechanisms, namely chemical prevention through exudate released by mangrove roots, reducing water salinity by organic material resulting from the decomposition of litter, the role of roots which

physically inhibit wave crashes. sea towards land, and improving the physical and chemical quality of the soil through litter decomposition [19].

The results of the prospective analysis from the economic aspect showed six policy directions, namely producer of household needs, industrial producer, tourist attraction, drug producer, seed producer and increase fishermen's catches (See Fig. 3).



**Fig. 3.** Economic policy direction.

The results of the prospective analysis of the six policy directions showed that there were three policy directions in the first quadrant, namely Producer of household needs, Industrial producer, and Tourist attraction.

### **Producer of household needs**

Mangrove forests experience changes caused by community activities such as pond activities, settlements, firewood collection and rubbish disposal. The community does this because they have no other choice to meet household needs [1]. Based on observations, the activities carried out by the community are carried out continuously, this is due to weak supervision by the relevant parties.

### **Industrial producer**

Mangrove tree trunks are used as fuel by processing them into charcoal for industrial needs. Apart from that, the tree trunk can also be used as building material. If the size is large enough, the plant can also be used as the main mast or keel of a ship [2]. These wooden sticks are strong and water resistant, making them suitable for building materials and strengthening soil.

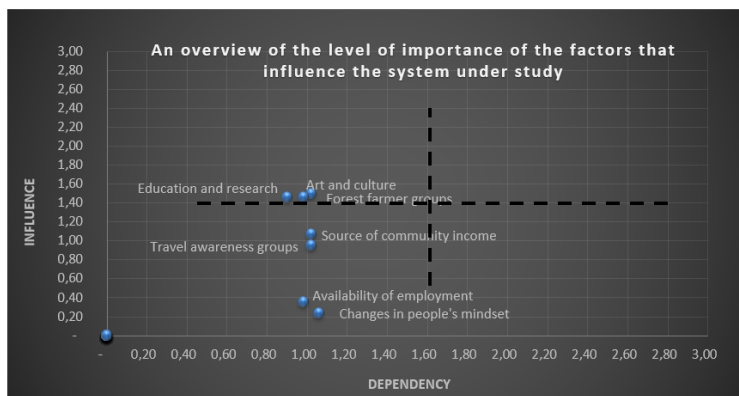
Mangrove wood products include charcoal, firewood, wood chips and pulp. Non-mangrove forest products include tannin, nipah products, honey, food and drink ingredients and batik materials. The highest value of processed mangrove wood is charcoal. Charcoal production is an export commodity, including to Japan, Korea and Europe. Processed mangrove charcoal is also said to be the best food for livestock [22].



## Tourist attraction

Mangrove forests have their own beauty so they often become tourist attractions in the surrounding community [14]. Mangroves have great potential for ecotourism development because of the unique conditions of mangroves and model areas that can be developed as tourism facilities while maintaining the beauty of the forest and the organisms in the mangrove area [13]. The potential environmental services of mangrove forests as ecotourism destinations must be optimized as a more environmentally friendly alternative for forest management or ecotourism. The research location is known as the Bandar Bakau Ecoedutourism with its characteristic arts and culture, the legend of the Seven Princesses, which is very famous in Dumai City and its surroundings.

The results of the prospective analysis from the social aspect showed seven policy directions, namely education and research, art and culture, forest farmer groups, travel awareness groups, sources of community income, availability of employment, and changers in people's mindset (See Fig. 4).



**Fig. 4.** Directions of social policy.

The results of the prospective analysis of the six policy directions showed that there were three policy directions in the first quadrant, namely Education and research, Art and culture and Forest farmer groups.

## Education and research

Realizing the urgency of education and the urgency of research in mangrove forest areas, it is deemed necessary to instill knowledge, understanding and awareness of the importance of the functions and benefits of mangrove forests, through formal education [6]. By formalizing knowledge about mangrove forests, it is hoped that awareness of mangroves can stick throughout each student's life until they grow up and become actors in environmentally sound development. Realizing that mangrove sustainability is largely determined by socio-cultural factors such as perceptions, attitudes, thought patterns and lifestyles of the community, it is also necessary to work on the sociological and cultural side of society to form a society that loves and preserves mangroves. This is achieved

through character education from an early age, including by developing local content on mangrove-themed environmental education and mangrove school programs. Mangrove-themed Environmental Education aims to shape the character of future generations into citizens who love their country, actors and guardians of sustainable and environmentally conscious development. Environmental Education is considered important and still relevant to be taught to students from an early age, in order to form good human character. love the homeland and the environment so that in the future they can play an active role as actors and guardians of sustainable and environmentally sound development. Local content includes the mandatory curriculum for basic education. The choice of the mangrove theme as local content is namely that local content is study material or subjects in educational units which contain content and learning processes about local potential and uniqueness which are intended to form students' understanding. regarding the excellence and wisdom of the area where he lives. The target of the educational unit implementing the local content of Mangrove Thematic Environmental Education is elementary school grades 4, 5 and 6. Elementary school is an educational facility for teaching environmental education that is very appropriate, by teaching environmental awareness as early as possible to the younger generation [24].

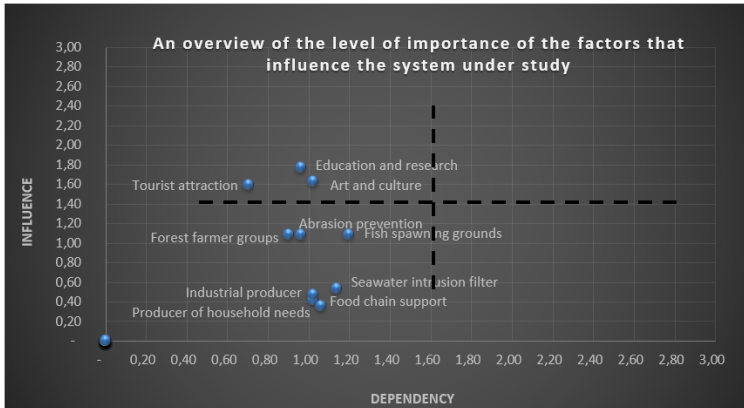
### **Art and culture**

The Dumai community's perception of performances at Alam Mangrove is influenced by an understanding of the nature of art which is part of a culture that is always developing, paying attention to, and maintaining its values so that it is not mixed with other cultures that do not conform to the cultural values in Dumai [4]. According to them, the presence of this work of art has provided an understanding for the people of Dumai that art can be an alternative in seeing the message behind a work which has the essence of criticism in it. Poetry, poetry, dance, singing and other artistic performances always decorate the mangrove forest area in Dumai City. Various competitions are offered to tourists, starting from coloring, batik and photo competitions.

### **Forest farmer groups**

The existence of forest farmer groups in the mangrove area really helps preserve and protect the mangrove area from the threat of degradation from nature and humans [18]. This group has developed and formed small groups that focus on businesses such as cafes, mangrove nurseries, artists, cultural figures and other micro business groups.

The results of a prospective analysis from ecological aspects, economic aspects and social aspects obtained ten policy directions for developing the mangrove area. Of the ten policy directions, a prospective analysis was carried out again to obtain the priority policy directions in developing the Bandar Mangrove area. This is known as combined prospective analysis (See Fig. 5).



**Fig. 5.** Policy direction for Bandar Bakau ecosystem development.

The results of the combined prospective analysis showed three policy directions for developing the mangrove area of Bandar Bakau, Dumai City, which are in the first quadrant, namely education and research, art and culture, and tourist attraction. These three policy directions direct the development of the Bandar Mangrove area to the development of ecotourism policies in accordance with the concept of ecotourism [25], namely paying attention to environmental sustainability by maintaining and combining art, culture, education, research and tourist attractions in the mangrove area.

## 5 Conclusion

The policy for developing mangrove areas in Bandar Bakau, Dumai City, from a prospective analysis, can be developed through aspects of education and research, art and culture, and tourist attraction which leads to policies for developing mangrove ecotourism by paying attention to ecological aspects, economic aspects and social aspects. Even though policy direction has been obtained through education and research, art and culture, and tourist attraction, other aspects need to be considered and maintained to maintain the stability of the mangrove ecosystem in Bandar Bakau, Dumai City, especially aspects that are almost close to the center line in prospective analysis such as abrasion prevention, forest farmer groups, and fish spawning grounds.

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