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## A dynamic simulation of mangrove ecotourism management at the Lantebung of Makassar City

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**Abstract.** Mangrove ecotourism is one of the important tourism in the coastal area. Mangrove ecosystems not only have physical and biological functions, but also have socioeconomic functions, including tourism potential. Utilization of mangrove areas to be ecotourism areas is an alternative that is very likely and high strategic, considering that ecotourism activities can encourage conservation of mangrove ecosystems as a buffer zone in coastal areas in particular. This study aims to formulate a model of mangrove ecotourism management in Lantebung of Makassar City. The study was conducted with a dynamic system approach with Powersim software (student version). The study location is at Lantebung of Makassar City, especially in mangrove area. Data collection, consist of; literature study, interviews and field observations. The results study obtained two dynamic model scenarios related to the management of the Lantebung mangrove eco-tourism, it's known that the optimal level of management that can be done now is to encourage better tourism promotion. This can be seen from the dynamic model results obtained that scenario-2 (the strategy to increase tourism promotion is 10%) is more optimal than scenario-1 (the strategy to increase community empowerment is 10%). Even though the aspect of mangrove conservation scenario-1 is better where it can increase the extent of existing mangroves (20 Ha) to 28.54 Ha or an increase about is 42.70%. Whereas the mangrove scenarios only increased to 25.25 Ha or increased about is 26.25% in the same period. While from the economic aspect, the scenario-2 is able to generate income from ecotourism of 620.25 million, and scenario-1 only produces 588.81 million in the next 30 years.

### 1. Introduction

Coastal areas, if appropriately managed and correctly, can be a source of new economic growth that is sustainable and, at the same time, be a source of income for coastal communities and encourage the realization of an independent and soul-loving community. One of the coastal potentials that can be developed is the mangrove area. One of the mangrove areas can be used as ecotourism that can be managed professionally for the sustainability of mangroves' natural resources on the coast. The Ministry of Environment's Public Relations (2017) states that in 2015, the potential of mangroves in Indonesia amounted to 3,489,140.68 hectares, equivalent 23 percent of the world's mangrove ecosystems. Mangrove conditions in Indonesia are 1,671,140.75 Ha in good condition and



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1,817,999.93 Ha the rest are in damaged condition, based on this data it is necessary to manage a sustainable mangrove area in order to increase its area and reduce the negative impacts that cause a decrease in the mangrove area. Tseng (2019) approached Sustainable Development Goals (SDGs) to integrate resources, environment, and social economy. Special Issues (SI) are resolved through academic researchers, industry experts and practitioners to assess and evaluate various approaches used in solving the problem of natural resource sustainability [1]. The involvement of stakeholders in ecotourism activities currently tends to be consultative rather than collaborative [2].

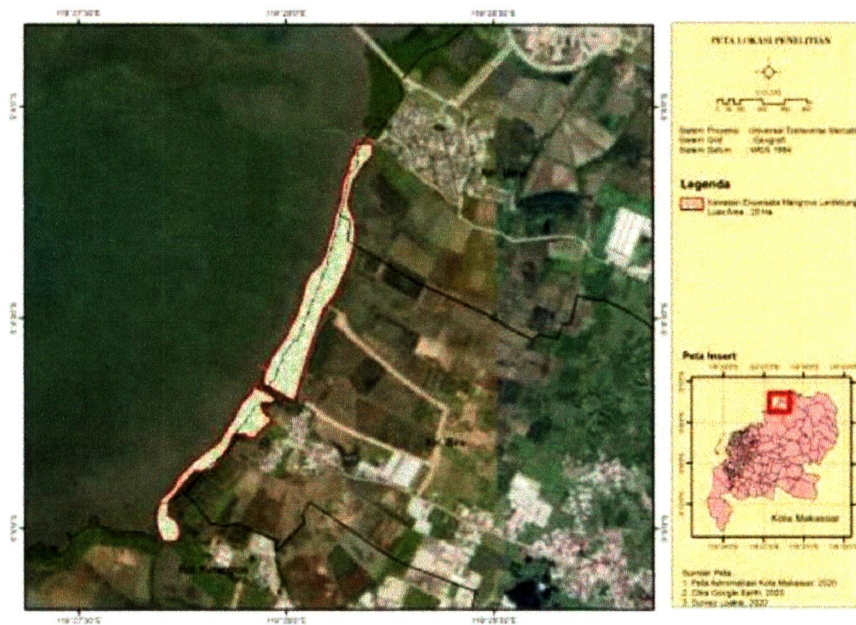
The biggest motivation for urban communities in conducting tours is to release fatigue and add insight. This motivation becomes very meaningful for urban communities because of the busyness of work routines that make people tired so that they need refreshing in their lives to return to work in a state of enthusiasm to improve their performance [3]. Makassar City's population of 1,526,677 inhabitants with the characteristics of urban communities who have a short time for a vacation can potentially be a potential for tourism in the city. Lantebung Mangrove Ecotourism, which is located in the coastal area of Makassar City, has a Mangrove Area of 20 hectares (Figure 1) and is currently an alternative tour for the people of the city of Makassar and the surrounding area. Lantebung mangrove ecotourism is one of the cornerstones of work and community income in the Bira Village, with a population of 11,743 people. Specifically, in the coastal area of Lantebung included in RW 6 of Bira Village, 235 families directly linked to the Lantebung mangrove ecotourism in terms of supporting their work fishermen and fishers as well as jobs created to support the ongoing ecotourism activities.

With a suitability index value of 66.67%, the Lantebung mangrove ecotourism area is included in the appropriate category (S2) to be developed into a mangrove ecotourism area, with a carrying capacity of 182 tourists per day while in fact, tourists visit an average of 274 people per day so that it exceeds carrying capacity [4]. The development of mangrove ecotourism continues to be done with the addition of tracking and several visitor facilities to increase the number of tourists who come, this, of course, has an impact on the mangrove ecosystem. This has become a challenge for the management of the Lantebung mangrove ecosystem today so that it does not negatively impact natural resources and remains an alternative for empowering Lantebung coastal communities. With the continuous development of the area carried out by the manager, it is essential to formulate a management simulation to find out an appropriate management model for the Lantebung mangrove ecotourism area that is suitable for the next 30 years. This study aims to determine an appropriate management model for the lantebung mangrove ecotourism area of Makassar City. Hopefully, this research can become a recommendation for the government and management institutions in managing the coastal area of Lantebung as an ecotourism area.

## 2. Materials and methods

### 2.1. Study area

This research was conducted in the Lantebung Mangrove Ecotourism Area, located in Bira Village, Tamalanrea District, Makassar City, South Sulawesi, Indonesia. Lantebung mangrove ecotourism activities began in 2016 with the current potential of mangroves covering 20 hectares. Lantebung mangrove is the last mangrove in Makassar City, so it is essential to research the impact and appropriate management methods. Figure 1 shows a map of the Lantebung mangrove area, which is the location of the study.



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**Figure 1.** Map of the Lantebung Mangrove Area

## 2.2. Data collection technique

Data collection is done through field observations, structured interviews using questionnaires, and literature studies. Field observations carried out by looking at the current condition of mangrove ecotourism, namely mangrove resources, human resources, community activities, and institutions. Other data collection techniques are interviews using questionnaires, which provide questions to local communities and also managers of mangrove ecotourism with questions about demographics, including employment and the amount of income from various work sources, ecotourism governance, number of visitors and income from visitors. Data collection was also carried out through library research, which is getting information from several studies that have been carried out in the Lantebung mangrove area or in other areas that can be used as a reference.

## 12 2.3. Data analysis

Data analysis in this study was carried out with a dynamic system approach using the Student version of Powersim Studio 10 Express software. According to Rad and Rowzan (2018), using a dynamic system can integrate various multi-objective decisions in project selection applied to the model using four primary dimensions: technology, complexity, time, and innovation [5]. This becomes very important for planning and control in a maximized project to overcome changes that occur in a certain period.

## 3. Results

Based on the results of dynamic simulations using the Student version of the Powersim Studio 10 Express software, which began from May 2020 to May 2050, the policy scenario was made into two parts: the first scenario by conducting a policy strategy to increase community empowerment by 10 percent and the second scenario is the policy strategy of increasing tourism promotion by 10 percent. Figure 2 shows the causal loop diagram in this study.

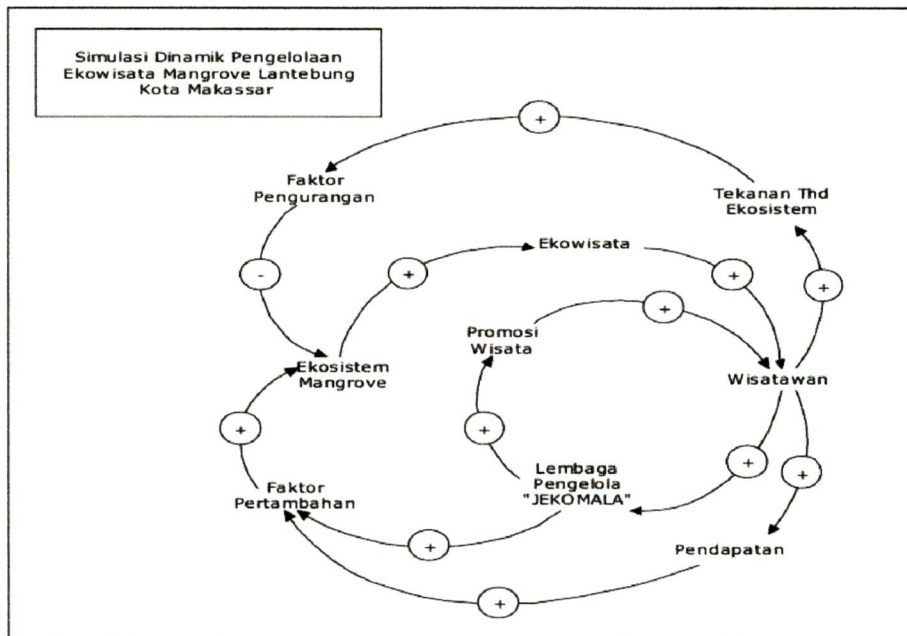


Figure 2. Causal Loop Diagram

Based on the results of the causal loop diagram, it can be seen that the current mangrove ecotourism activities have a positive impact on the extent of the mangrove ecosystem and the addition of tourists who come to visit. Existing tourism activities are photography, mangrove tracking, bird watching, mangrove observation education tour, boat tour, and enjoying the sunset. The increase of tourists will have a positive effect on the factor of increasing income from the people who are managing Lantebung mangrove ecotourism, namely the JEKOMALA management agency. Along with the increase in income, it also has a positive effect on the mangrove ecosystem's growth factor because it can be managed well by the community. The tourism promotion carried out by the JEKOMALA management agency also had a positive impact on increasing tourist visits. In line with the increase in tourist visits, it can put pressure on mangrove ecosystems, which has the potential to be a factor in reducing the area of mangrove ecosystems.

Management agency planning becomes essential in mangrove ecotourism management's success so that all preparations starting from planning, development, and supervision must involve more people, not just a group of people so that the level of participation is more maximal [6]. Based on the conditions that have been described in the causal loop diagram (figure 2), the simulation process is then illustrated in the form of a stock-flow diagram, as shown in figures 3 and 4.

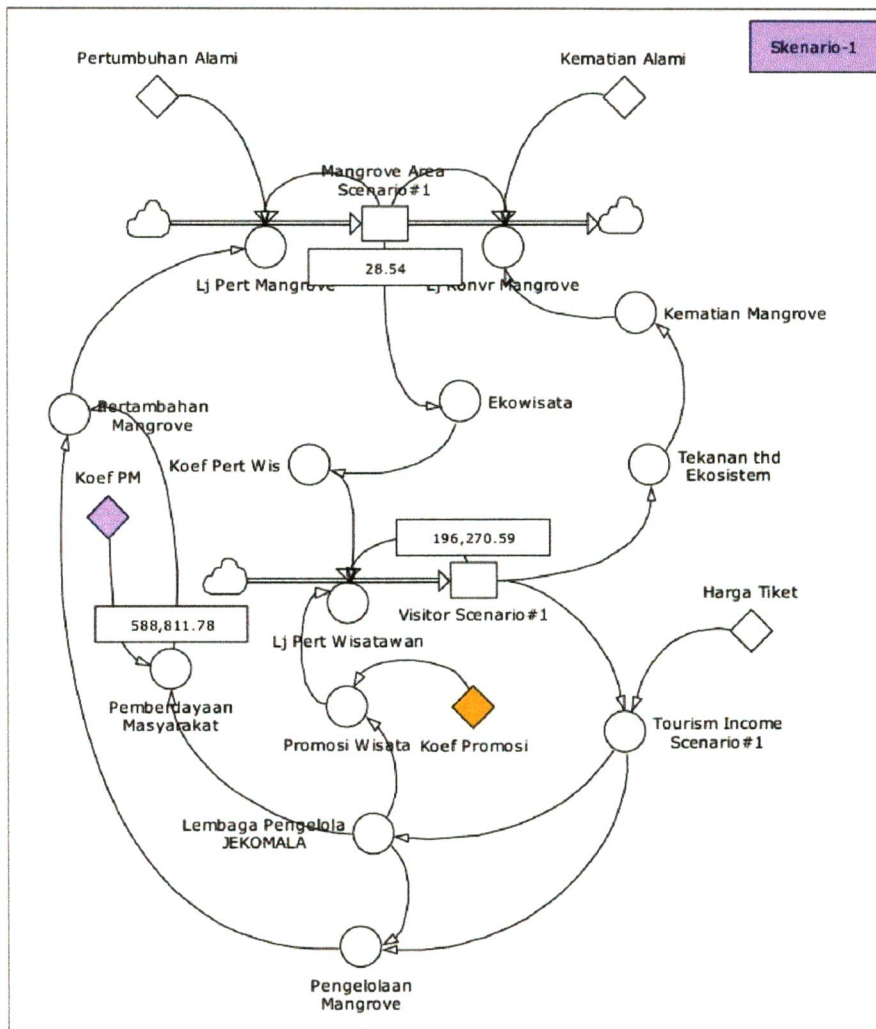


Figure 3. Scenario 1 Stock Flow Diagram

The stock-flow diagram in scenario 1 (figure 3) shows that the pattern of the first policy scenario with an increase in the coefficient of community empowerment by 10% and the promotion coefficient still produces 588,811.78 with an increase in visitors by 196,270.59 and an additional mangrove area of 28.54 Ha.

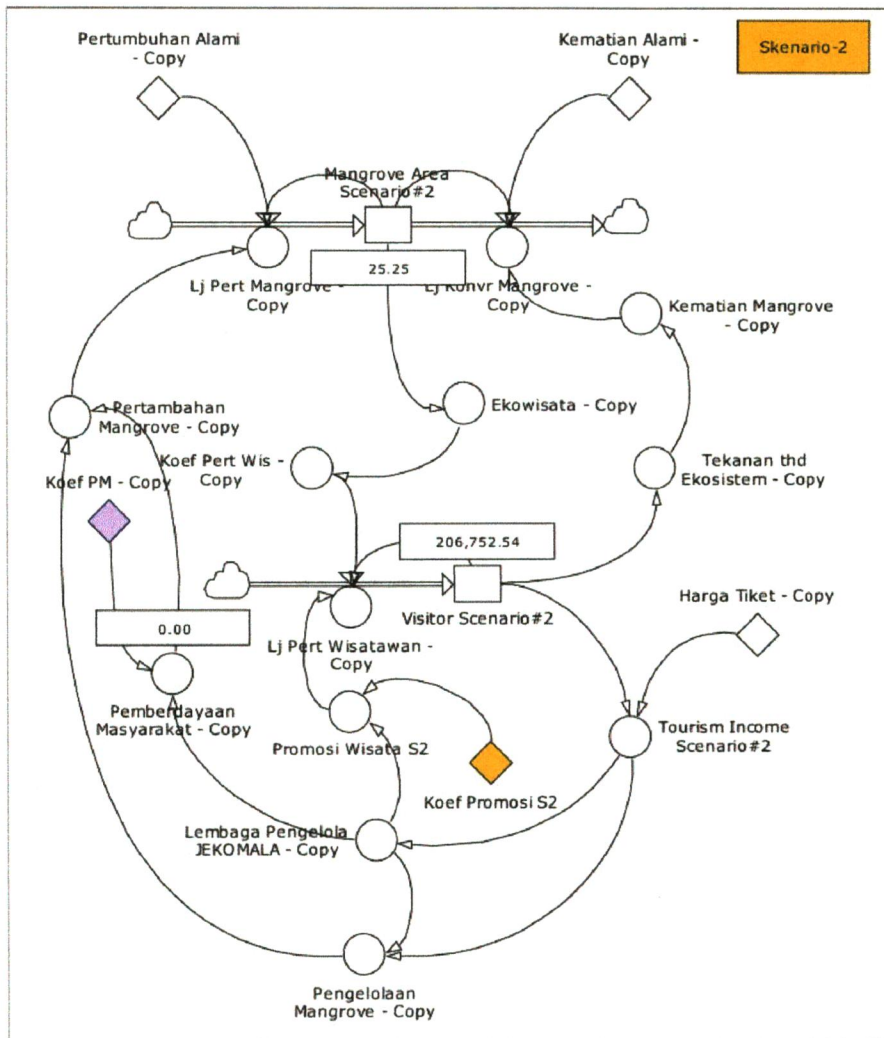


Figure 4. Scenario 2 Stock Flow Diagram

For the second scenario seen in Stock Flow Diagram scenario 2 (figure 4), by increasing the promotion coefficient by 10% and the community empowerment coefficient is permanent, it can increase visitors by 206,752.54 with the addition of mangrove area by 25.25 Ha.

Nature tourism has a significant influence on visitor satisfaction. Most tourists want to vacation with a family and friends by looking for places related to scenery and weather [7]. The promotion of nature tourism strongly supports information for natural tourism alternatives that can be visited by tourists as practiced by the Lantebung mangrove ecotourism manager. Simulation results based on stock-flow diagrams are presented in figures 5-7 and tables 1-3.

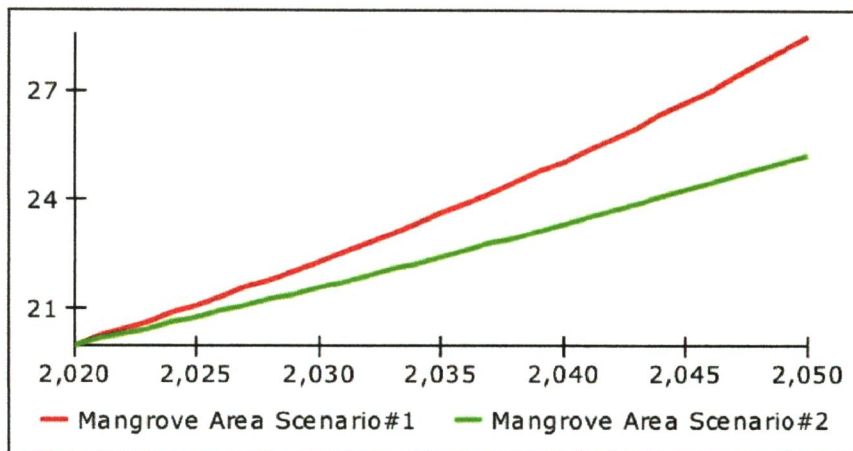


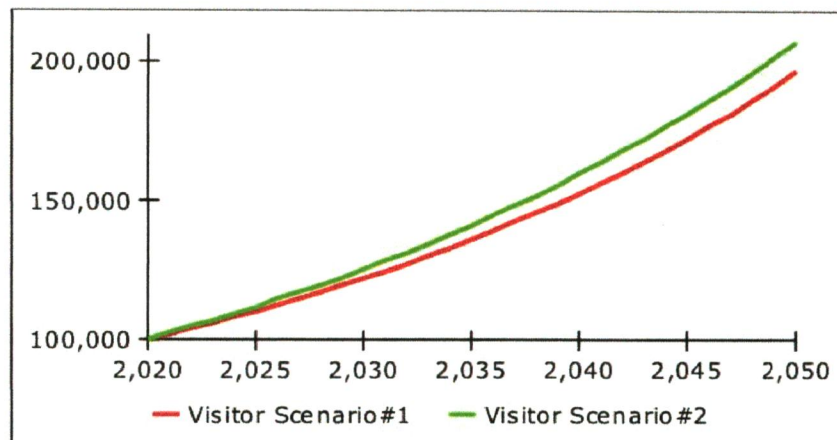
Figure 5. Mangrove extent chart

Table 1. Results of policy scenarios for mangrove areas

	Initial	Scenario Results	Increase
Scenario #1	20 Ha	28.54 Ha	42.70 %
Scenario #2	20 Ha	25.25 Ha	26.25%

The first policy scenario with a 10 percent increase in community empowerment has a positive impact on the addition of mangrove areas (figure 5) of 20 hectares in 2020, resulting in an increase of 28.54 hectares in 2050 or an increase of 42.70%. This refers to because by empowering the community, the mangrove area can be maintained because the community continues to make conservation efforts that can have a positive impact on the mangrove area. Scenario 1 has a positive impact on community empowerment and the extent of mangrove cover. When people have the awareness to protect the environment, they will automatically manage, not cut down because there is a function of the mangrove forest that they get so that they are aware of protecting it, one of which is an ecotourism function that can bring visitors to increase their income. The results analysis of the second scenario (figure 5), namely, an increase in tourism promotion by 10%, can impact the area of mangroves from 20 hectares in 2020 to 25.25 hectares or an increase of 26.25%. The conclusions in Figure 5 and Table 1 that scenario 1 is better in terms of adding mangrove area or better in conservation aspects because it can increase mangrove area by 42.70% compared to scenario two, which only increases mangrove area by 26.25% in 2050.

Research on Community-Based Mangrove Management (CBMM) has been carried out in the Central Java region of Indonesia, resulting in that technological assistance, various sources of income, strengthening local institutions can support the sustainability of natural resources and become an alternative community-based mangrove ecotourism [8].



**Figure 6.** Graph of number of tourists

**Table 2.** Results of policy scenarios for the number of tourists

	Initial	Scenario Results	Increase
Scenario #1	100,000	196,271	96.27%
Scenario #2	100,000	206,753	106.75%

Figure 6 shows a graph of the number of tourists in scenario one and scenario two. The first scenario with a 10% increase in community empowerment has an impact on increasing the number of visitors from 100,000 people in 2020 to 196,271 people or an increase of 96.27%. As for scenario two, by increasing tourism promotion by 10%, it can increase the number of visitors from 100,000 people in 2020 to 206,753 people or an increase of 106.75%. The results from Figure 6 and Table 2 conclude that scenario two is better in terms of the number of tourists or has a positive impact on increasing visitors because it can increase the number of visitors by 106.75% compared to scenario one who only gave an increase in tourist numbers of 96.27% in 2050.

The provision of tourists' facilities and needs in natural resource conservation activities can give visitors satisfaction so motivated to come to tourist sites. Therefore, managers need to make an appropriate plan so that the number of tourists can increase and maintain a stable [7].

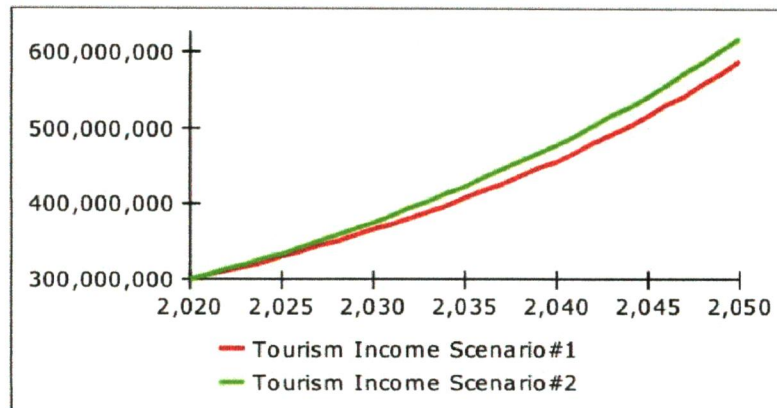


Figure 7. Chart of ecotourism revenues

Table 3. Results of policy scenarios for ecotourism revenues

	Initial	Scenario Results	Increase
Scenario #1	300 million	588.81 million	96.27%
Scenario #2	300 million	620.25 million	106.75%

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Based on the results obtained for ecotourism revenue can be seen in Figure 7, which shows a graph of ecotourism income. With an increase in community empowerment by 10%, Scenario one, affects ecotourism income from 300 million in 2020, increasing to 588.81 million or an increase of 96.27% in 2050. Scenario 2, with a scenario policy of adding 10% tourism promotion, can increase ecotourism revenue from 300 million in 2020 to 620.25 million in 2050 or an increase of 106.75%. The conclusion from the results of scenario one and scenario two illustrated in graph 7 and table 3 that scenario two is better in terms of income (economic aspects) because it can increase income by 106.75%, more significant than scenario one which only gives an increase in income of 96.27%.

Ecotourism is not always able to increase the income of local people. This can be seen in research Ma (2019), who examined in the Qinling region of China, which shows that nature reserves and ecotourism have a controversial impact on the economy of local communities. His research shows that local communities show high poverty rates and low incomes due to ecotourism activities; this is because agricultural land is converted to conservation land [9]. In Ethiopia, interactions, and collaboration between stakeholders that do not work well impact the degradation of natural resources and neglect community interests [10]. In the Lantebung ecotourism area, pond land is not converted into conservation land because it is an alternative for local community work, precisely with the existence of mangrove ecotourism that can increase the area of mangroves, supporting them in getting crab seeds quickly. This makes their income increase because apart from the cultivation of ponds, they are also active in mangrove ecotourism activities with various alternative work that they do to support ecotourism.

#### 4. Conclusion

The optimal management model of the Makassar City Mangrove Lantebung Ecotourism can be achieved through the second scenario: the strategic policy scenario to increase tourism promotion by 10%. This scenario will increase mangrove expansion to 28.54 hectares or increase by around 42.70% and increase tourism revenue to 620.25 million or increase by around 106.75%. Thus the optimal management of mangrove lantebung ecotourism can be done by encouraging better tourism promotion. Lantebung mangrove ecotourism activities can be done with several empowerments approaches through tourists to influence the ecosystem through mangrove nursery tourism and mangrove planting tours. Lantebung mangrove ecotourism can develop well if carried out in tourism activities combined with educational tours that are socialized at the time of ecotourism promotion. Educational tourism by inviting visitors to learn more about mangrove ecosystems through conservation activities, namely nurseries and planting mangroves directly. Involving visitors directly in conservation activities can positively impact the addition of mangrove areas in ecotourism locations and the increasing interest of tourists visiting who can have an impact on increasing community income.

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