Model of Ecotourism Development Heart Of Borneo (HoB) Through Dynamic Systems Approach

Erni Yuniarti, Rinekso Soekmadi, Hadi Susilo Arifin, Bambang Pramudya

Abstract— Many countries in the world are developing the tourism industry, including developing countries in Southeast Asia such as Indonesia. The purpose of this research is to design a model of sustainable HoB ecotourism in Kapuas Hulu District through dynamic system approach. Development of HoB ecotourism focuses on two national parks is located in Kapuas Hulu District, ie TNBK, and TNDS. The scenario simulation suggests that the increase of non-tax revenues which can encourage the building of infrastructure in Kapuas Hulu Regency. Based on the number of tourists and non-tax revenues obtained through the development of ecotourism HoB can illustrate that forest conservation activities can be an alternative solution in ecotourism based forest management methods in Kapuas Hulu District. Supported by optimistic scenario results shows that serious HoB ecotourism management can generate non-tax state revenues that can encourage better infrastructure development in the district. The policy direction to be implemented in TNBK and TNDS is to facilitate infrastructure development so that tourists are interested to visit the national parks. The online publication of the national and international TNBKDS ecotourism can make it an icon from West Kalimantan Province.

Index Terms— conservation, ecotourism, scenario, national park

1 Introduction

Heart of Borneo (HoB) is a program of conservation and sustainable development on the initiation of three countries, namely Indonesia, Malaysia and Brunei Darussalam. The HoB area is a forest area spread over the border of Indonesia, Malaysia and Brunei Darussalam. Background HoB is based on the idea that the current forest in the HoB area is still relatively good, but if not maintained and maintained it will become damaged. Management and utilization that does not prioritize conservation will make forest area in HoB area decreasing. The HoB forest area has a total area of 23 million hectares, and 13% of which is a border forest area of Indonesia-Malaysia is located in TNBK and TNDS. Both national parks are located in Kapuas Hulu District, West Kalimantan Province. The existence of TNBK and TNDS encourages the local government of Kapuas Hulu Regency to make it as a source of local revenue.

The HoB area in Kapuas Hulu Regency has many attractions, namely the biological, physical, and cultural attraction to visit. The forest in this HoB area has 40-50% species of flora and fauna in the world. HoB is also a unity of ecosystem and water (hydrological) which is very important for the community from upstream to downstream. HoB area in Kapuas Hulu District. One of the approaches to managing the national park is through responsible tourism development. The mainstreaming of ecotourism development and environmental services of national park areas in Kapuas Hulu Regency is very important for regional development and for the sustainability of the function and existence of national parks in this regency (BBTNBK 2009; BTNDS 2009).

Tourism has a very important role in increasing regional or state revenues because the tourism sector can increase employment. Many countries in the world are developing the tourism industry including developing countries in Southeast Asia such as Indonesia, Taiwan, Vietnam (Tsai *et al.* 2010). Double function (ecotourism and conservation) carried by a national park becomes a challenge for the country of Indonesia to develop it. Indonesia and Vietnam are included in developing countries are required to work hard to develop sustainable national park management (Ma *et al.* 2009).

There are several terms that are known in the concept of national park development namely national park sustainability, national park behavioral intention and national park satisfaction. Sustainable national park refers to the tourism industry that has environmental, economic and social sustainability. Tourist behavior indicates a tourist destination to visit a national park. The level of tourist satisfaction is related to the perception of tourists with expectations and trust before and after visiting the national park. A sustainable national park has no direct effect on the national park tourist behavior but has the direct influence on the level of tourist satisfaction with the national park (Mihanyar *et al.* 2016).

The place and natural conditions of a national park can affect the interest of tourists to visit the region. Well-maintained national park conditions can reduce the impact of climate change and keep ecological ecosystems maintained. Climate change in a national park has a significant effect on the number of tourist visits. This happens in all national parks located in Taiwan (Liu 2016). Infrastructure such as transportation facilities to the national park is also important to be studied in developing ecotourism of a national park. Adequate transportation will make a national park easier to

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access. However, overcapacity transportation can lead to congestion, decreased levels of security and reduced air quality. So it is necessary to optimize the potential of tourists with the needs of means of transport to get to a particular national park (Daniels *et al.* 2018).

Many factors become obstacles in the effort of ecotourism development in HoB area. Natural conditions that are still not managed optimally can threaten the existence of flora and fauna populations. In addition to the perception of the surrounding community who are not aware of the existence of the park. The number of tourism and the unknown infrastructure of its composition makes TNBKDS national park so vulnerable to damage in the next few years. Based on some of the main components above then the researcher will reduce other components and formulate a model of ecotourism management that can be more appropriate for the HoB area in Kapuas Hulu District.

The purpose of this study is to design a model of sustainable HoB ecotourism in Kapuas Hulu District through a dynamic system approach. Development of HoB ecotourism focuses on two national parks located in Kapuas Hulu District, TNBK, and TNDS. Development of this ecotourism focuses on the activity of the population and the original revenue of the region. The activity of the population becomes an important object of observation because it is the main actor in the development of the HoB ecotourism. The original revenue of the region also determines the direction of HoB ecotourism development as it is expected that this funding source can drive the improvement of existing infrastructure.

2 Research Method

2.1 Research Sites

The study was conducted from November 2015 to December 2016. The study sites are located in the 816693.40 hectare TNBK whose area extends at 112°15'EL-114°10'EL and 00°40 'NL-1°35'NL and TNDS which have an area of 130.940 hectares geographically located between 00°45'NL-01°02'NL and 111°55'EL-112°26'EL.

2.2 Research Procedure

The research phase begins by taking some data from TNBK and TNDS. Furthermore, the data in the validation and verified to be made a model. Applications used to develop a dynamic model is Powersim software. The dynamic model analysis is carried out on the variables that have been identified and done through 2 stages. Phase 1 is making a causal loop diagram. The causal loop diagram shows the relationship between the variables in the process of the system being studied. The basic principle of construction The causal loop diagram is the process as the cause that will produce a state, or otherwise, a state as the cause will produce the process. Flow diagrams are based on dynamic model equations that include state (level), flow (rate), auxiliary, and constant (Muhammadi *et al.* 2001). The model that has been built will be simulated to get the best ecotourism development model that can be applied in Kapuas Hulu District (Figure 1).

2.3 Model Validation

Model validation is carried out to test the accuracy of the simulation results by comparing the model behavior with the real system. The method for measuring the accuracy of a model is by using Root Mean Square Error (RMSE) (Equation 1) and Mean Absolute Percentage Error (MAPE) (Equation 2) (Pindyck and Rubinfeld 1991). The RMSE and MAPE values will show relative measurement that involves percentage errors. It is used to find out the conformity of the estimation data with actual data. The method was applied to validate the model of a national park visit (Chen *et al.* 2008) and to validate the forecasting model of a tourism object (Chen 2006).

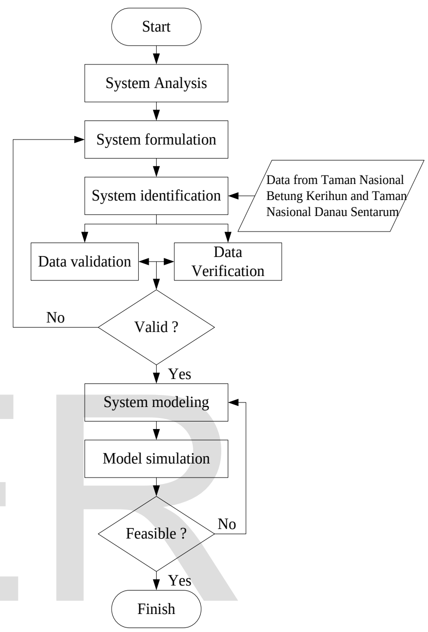

Fig. 1 Flowchart of the sustainable development model of HoB ecotourism through a dynamic system approach

$$MAPE = \frac{1}{n} \times \sum_{i=1}^{n} \left(\frac{|X_{mi} - X_{di}|}{X_{di}} \right) \times 100\% \quad (1)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n} (X_{mi} - X_{di})^2}{n}} \quad (2)$$

Where Xm is the simulated result data, Xd is the actual data to i and n is the number of data. Nearly zero RMSE and MAPE values will show a small model error from the forecasting model (Poudyal *et al.* 2013). This will show the performance of the model built has a high level of accuracy. If the MAPE result is <5% then the model is very accurate describing the real condition. If the MAPE result> 5% and MAPE <10% then the model is sufficiently accurate to describe the real condition. If the MAPE results> 10% then the model is not appropriate in describing the real condition (Nurmalina 2007; Somantri and Thahir 2007).

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3 Results And Discussion

3.1 Input-Output Diagram

The relationship between inputs and outputs in the development of ecotourism HoB is presented in Figure 2. Input from developing uncontrolled management of ecotourism is nature is a factor like the weather, climate and the factors of the number of population. The input can be controlled to achieve the goal is accommodation and lodging, means of transport, road infrastructure and public facilities. The uncontrolled input of identification results is to look for the output of the system in accordance with the objectives. For example, the number of inhabitants and the number of attractions that will grow constantly must be balanced with the enter the number of the infrastructure support of community activities. Existed, in reality, is in the form of improvements to roads and means of transport towards the tourist area.

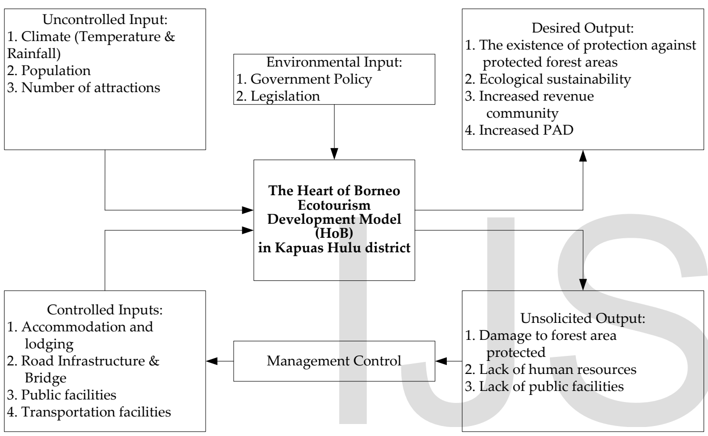

Fig. 2 Diagram of the input-output model of the development of ecotourism HoB Regency Kapuas Hulu

Another thing to consider in the diagram of Figure 2 is the output of the model. The expected output from this management is to conserve protected forest areas, conserving ecology, increasing community income and PAD. The unintended output from this management is the destruction of protected forest areas and the occurrence of conflicts of interest. For example, that with the management of ecotourism HoB can protect the protected forest area but on the other hand, the lack of human resources can threaten the area itself in the form of forest area damage. Likewise, with the existing ecological conservation area, HoB needs to be supported by adequate facilities.

3.2 Causal Loop Diagram

The dynamic system approach requires knowledge of the interrelationships or causalities between sub-systems within the system or between elements in the sub-system and the nature of the relationship, positive or negative. In general, causal diagrams in the development of sustainable HoB ecotourism are built on causal diagrams through a dynamic system approach (Figure 3).

The causal loop diagram considers the dimensions of ecology, economic dimension, and social dimension. The development of ecotourism development must be done ecologically in the long term as well as economically, ethically and socially equitable to society (Yusdasmara 2010; Peng *et al.* 2017). In the causal loop diagram developed in TNBK and TNDS it was found that there were 7 components included in the economic dimension, 7 components included in the social dimension and 10 components belonging to the ecological dimension. These three dimensions interact through their respective components. For example, the ecological dimension will be influenced by the social dimension, one of which is through the population component of flora and fauna with the number of tourists. The relationship is the increasing number of tourists can threaten the flora and fauna population but not vice versa. This Hungan is obtained through the results of the study in TNBK and TNDS itself.

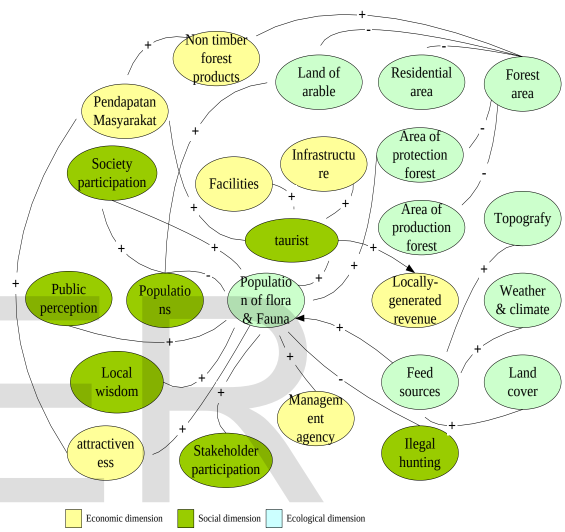

Fig. 3 Causal Loop Diagram of HoB ecotourism development model

The existence of sustainable ecotourism concept can be an alternative choice for managing protected forest area. This activity is managed with a conservation approach so that not only the economic and social aspects of society are highlighted but also aspects of education and conservation of natural resources and the environment. This ecotourism form of tourism is more developed in areas that are relatively unspoiled.

3.3 Modeling of HoB Ecotourism Development

The modeling is based on the defined causal loop diagram, then translated and inputted into the Powersim Simulation V.70 application and the system model results from the causal diagram are constructed (Figure 4). The built model consists of ecological, economic and social dimensions.

Validation is done to find the difference of simulation value with actual data. In building the model used data from 2009-2012. Calibration is performed using data from 2013-2015 and prediction simulations are conducted from 2015-2030. The average error rate of the model for the attribute of the population number from 2009-2015 is 0.33% (Table 1). This value indicates that the constructed modeling is highly

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accurate describes the real condition because the MAPE value is close to zero (Pindyck and Rubinfeld 1991; Chen 2006; Chen *et al.* 2008; Poudyal *et al.* 2013; Ford 1999).

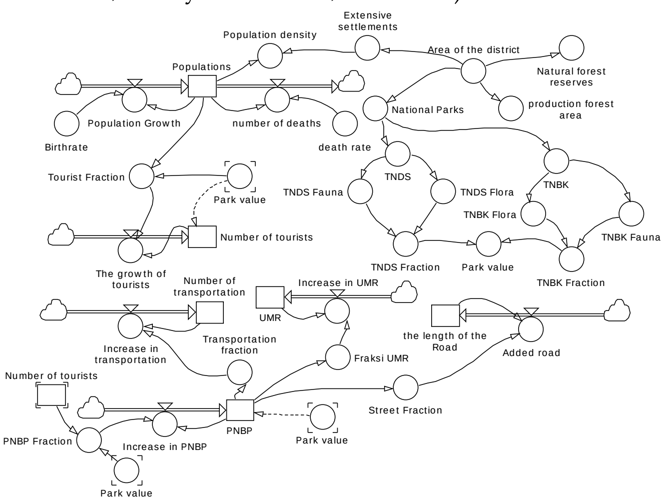

Fig. 4 HoB ecotourism development modeling through dynamic system approach

Table 1 Validation of population data

Years	Actual population	Simulation population	Error (%)
2009	220043	220043	0.0
2010	222160	224004	0.8
2011	227424	228036	0.2
2012	231512	232140	0.2
2013	236136	236319	0.0
2014	240410	240573	0.0
2015	245998	244903	0.4

PNBP modeling shows average model error values from TNBK and TNDS in 2009-2015 are 18.42% and 5.90%, respectively. The value of PNBP model error in TNBK tends to be greater. This is influenced by the number of tourists visiting from 2009-2015 have no tendency to increase or decrease every year. The number of tourists who do not have a pattern since 2015 is suspected to occur because of the condition that TNBK is still trying to improve infrastructure facilities for tourists who visit. In contrast to the model error values of PNBP in TNDS that tend to be smaller ie 5.90%. Some research results indicate that the error value is sufficiently accurate to describe the actual condition of an object (Pindyck and Rubinfeld 1991; Poudyal *et al.* 2013).

Table 2 Validation of non-tax state revenue (PNBP) data

Years	Betung Kerihun National Park			Danau Sentarum National Park		
	PNBP		Error	PNBP		Error
	Actual	simulasi	(%)	Actual	simulasi	(%)
2009	1180516	1180516	0.0%	7445000	7445000	0.0%
2010	2031668	2018682	0.6%	9552000	10066148	5.4%
2011	3496500	3451946	1.3%	14454000	13610118	5.8%
2012	6369000	5902828	7.3%	18403107	18401807	0.0%
2013	19650000	10093836	48.6%	24880500	24880498	0.0%
2014	20662500	17260459	16.5%	43827500	33640129	23.2%
2015	21675000	29515385	36.2%	45067899	45483748	0.9%

The modeling of tourist numbers in TNBK and TNDS shows an average error rate of 44.19% and 8.68%, respectively. The error rate for the tourist numbers model in TNBK is likely to be largely due to the absence of data trends from the number of tourists. This condition is related to the number of tourists visiting TNBK from 2009-2015 have no tendency to increase or decrease every year. Meanwhile, for the error model, the number of tourists in TNDS tends to be smaller. This shows that the built model is sufficiently accurate to be able to describe the real condition of an object. The difference in error rates for each of these national parks is influenced by data trends in each national park. This indicates that the model constructed is appropriate enough to be used for both national parks although it needs to be adjusted in its use (Yin 2003).

Table 3 Validation of the number of tourist data

Years	Betung Kerihun National Park			Danau Sentarum National Park		
	Actual tourist	Simulation tourist	Error (%)	Actual tourist	Simulation tourist	Error (%)
2009	20	20	0.0	98	98	0.0
2010	134	24	81.9	124	148	19.3
2011	62	29	52.7	205	223	9.0
2012	36	35	1.5	410	337	17.7
2013	91	43	52.8	500	509	1.9
2014	37	52	40.2	723	769	6.4
2015	314	63	80.0	1241	1162	6.3

The result of validation of UMR model error value from 2009-2015 is 9.65%. This value indicates that the modeling constructed has good enough accuracy to describe the real condition.

Table 4 Validation of UMR data

Years	UMR actual (Rp)	UMR simulation (Rp)	Error (%)
2009	934900	934900	0.0
2010	934900	974166	4.2
2011	934900	1015081	8.5
2012	986500	1057714	7.2
2013	1100000	1102138	0.1
2014	1475000	1148428	22.1
2015	1600000	1196662	25.2

The error value of road infrastructure model in Kapuas Hulu District from 2009-2015 is 2.74%. This value indicates that the modeling constructed has excellent accuracy to describe the real condition.

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Table 5 Validation of road length data

Years	Actual road length (km)	Simulasi road length (km)	Error (%)
2009	941.85	942	0.00
2010	934.52	950	1.69
2011	1060.70	959	9.59
2012	1186.87	1187	0.00
2013	1178.88	1198	1.59
2014	1176.72	1208	2.69
2015	1176.71	1219	3.62

The model error value for the number of means of transportation in Kapuas Hulu District from 2009-2015 is 2.15%. This value indicates that the modeling constructed has an excellent accuracy to describe the actual condition of the existing transportation facilities in Kapuas Hulu District.

Table 6 Validation of the amount of transportation

Years	Actual amount of transportation	amount of transportation of simulations	Error (%)
2009	104	104	0.00
2010	104	106	1.52
2011	104	107	3.07
2012	108	109	0.77
2013	111	111	0.45
2014	118	112	4.92
2015	125	114	8.87

3.4 Simulation of HoB Ecotourism Development Projection

A model of the HoB ecotourism development has been designed. The built model has also gone through a calibration stage with a small error value to make predictions. Model estimation can be done for potential population, PNBP, number of tourists, regional minimum wage (UMR), road length and transportation amount.

The simulation results of the estimation are conducted from 2016-2030. All value data in 2016-2030 is obtained through simulation prediction. Prediction simulation results using Powersimp application with dynamic system method. The data entered into the application is the data that has validated the error value. The value of tax revenues from TNBKDS will be different to predict the number of tourists who will visit the national park.

The simulation results of the estimates for TNBK from 2016-2030 are shown in Table 7. In 2030, it is predicted PNBP will be Rp 93124736408 from TNBK with the number of tourists reaching 1095 people. The 2030 PNBP results from this national park can also predict the length of roads that will increase in Kapuas Hulu Regency to 1139 km and the number of available land transportation to 143 units. Based on the results of this study indicate that developments in the park can boost infrastructure and PNBP based on the number of tourists in Kapuas Hulu District.

Table 7 Simulation results for estimation in TNBK

Years	Population	PNBP	Number of tourists	UMR (Rp)	Road length (km)	Transportation amount
2016	249311	50983673	76	1248597	1003	116
2017	253799	87172527	92	1301571	1012	118
2018	258367	149274125	111	1356786	1022	119
2019	263018	255000445	135	1414423	1031	121
2020	267752	435580972	163	1474449	1040	123
2021	272572	745253289	197	1536955	1050	125
2022	277478	1275256436	238	1602146	1059	127
2023	282473	2179942553	288	1670149	1069	129
2024	287557	3728559738	349	1741014	1079	131
2025	292733	6373320735	422	1814903	1089	133
2026	298002	10896508379	511	1891897	1099	135
2027	303366	18629294719	618	1972144	1109	137
2028	308827	31852744946	748	2055778	1119	139
2029	314386	54460537503	905	2142950	1129	141
2030	320045	93124736408	1.095	2233805	1139	143

Source: Processed data (2016)

Table 8 Simulation results for estimation in TNDS

Years	Population	PNBP	Number of tourists	UMR (Rp)	Road length (km)	Transportation amount
2016	249311	61528274	1754	1247063	1003	116
2017	253799	83192136	2649	1299466	1012	117
2018	258367	112483050	4000	1354072	1021	119
2019	263018	152085989	6039	1410974	1031	121
2020	267752	205631033	9120	1470268	1040	123
2021	272572	278026460	13770	1532053	1049	125
2022	277478	375911113	20793	1596435	1059	127
2023	282473	508257182	31398	1663522	1068	129
2024	287557	687198177	47411	1733428	1078	131
2025	292733	929138214	71591	1806272	1088	133
2026	298002	1256257605	108102	1882177	1098	135
2027	303366	1698545666	163234	1961272	1107	137
2028	308827	2296549332	246484	2043690	1117	139
2029	314386	3105091580	246484	2129572	1128	141
2030	320045	3829067987	246484	2219063	1138	143

Source: Processed data (2016)

The estimates for TNDS from 2016-2030 are presented in Table 8. In 2030, it is predicted that there will be PNBP Rp 3829067987 from TNDS with 246484 tourists. The value of tourist in TNDS has reached its capacity since 2028. The 2030 PNBP result from this national park can also predict the length of road that will increase in Kapuas Hulu regency to 1138 km and the number of available transportation to 143 units. This indicates that the development of TNDS can encourage the improvement of non-tax state infrastructure and revenues (PNBP) from the number of tourists in Kapuas Hulu District.

The simulation results of the estimation indicate that, the potential increase of tourists will have a positive impact on PNBP. This large amount of PNBP can be utilized to maintain forest conservation in Kapuas Hulu Regency and can run eco-tourism in the two national parks. Prevention of large-scale logging activities and the transfer of functions of forest areas can be implemented. The failure to prevent this deforestation will lead to degradation of forest quality as a buffer for the region's life and the deterioration of forest conditions due to deforestation caused by the increased transition of forest areas into settlements, plantations and shifting cultivation. In addition, every year there is no control over illegal logging. This problem will be resolved by looking at the PAD picture that can continue to increase while maintaining the condition of TNBK and TNDS forests by developing the HoB ecotourism.

The development of HoB ecotourism on TNBK and TNDS sustainable should be fully supported by the local government. Participation of the government in this management in addition to obtaining local revenue can also be one of the media to promote Kapuas Hulu District. One form of government support is by providing an efficient regulatory system for managing the park. The regulatory system is important because it can assess the participation of stakeholders in the management of the Victorian National Park in Australia. An efficient regulatory system can increase the level of trust and support of stakeholders to participate in managing a sustainable national park (Randle and Russell 2016).

3.5 The scenario of HoB Ecotourism Development

The model scenario aims to see the change (increase or decrease) of PNBP from the development of HoB ecotourism in each national park. Non-tax state revenues are the object of observation because these attributes are highly potential to drive improvements in tourist infrastructure in Kapuas Hulu District. The change is strongly influenced by the number of tourists visiting so that the number of tourists will be used as a modifier object in the scenario of developing the HoB ecotourism.

The scenario is done by changing the number of tourists visiting. The assumptions used are pessimistic scenarios (100% tourist decline from 2009 conditions), moderate scenarios (50% increase in tourist arrivals in 2009) and optimistic scenarios (100% increase in tourist arrivals from 2009). The observed items of each scenario are PNBP, number of tourists, UMR, length of road and number of transport. Scenarios are performed for each national park.

The change in the number of tourists for each scenario in TNBK and TNDS is presented in Figure 5. It can be seen that the number of tourists in TNDS is greater than that of TNBK. The existing condition in TNBK indicates that the increase of tourist number can reach 1095 in 2030. On the other hand with the optimistic condition, the number of tourists can reach 2191 in 2030. This phenomenon will still continue to increase until reaching a limit of carrying capacity of TNBK that is equal to 272224 soul/year. In contrast to TNDS which tends to have reached its carrying capacity limit in 2027 for each scenario where the carrying capacity of TNDS is 218084 persons/year.

The results of scenario simulations showing PNBP from TNBK are presented in Figure 6. It can be seen that in the current condition to achieve maximum carrying capacity from the management of TNBK will not be achieved if there is no intervention, where PNBP TNBK in 2030 is Rp 93124736408. This will be better if the development in ecotourism where PNBP from TNBK can reach Rp 116986320003 in 2030 if optimistically managed. The moderate scenario also demonstrates that

PNBP from TNBK will reach Rp 130677764845 in 2030. This phenomenon shows that the intensive development of TNBK can accelerate the increase of PNBP up to 8 years with the difference of Rp 23861583595. The positive relationship between the number of tourists with PNBP and disruption of infrastructure development is also one of them is caused by optimal PNBP (Ernayani *et al.* 2016, Styawan and Arief 2017).

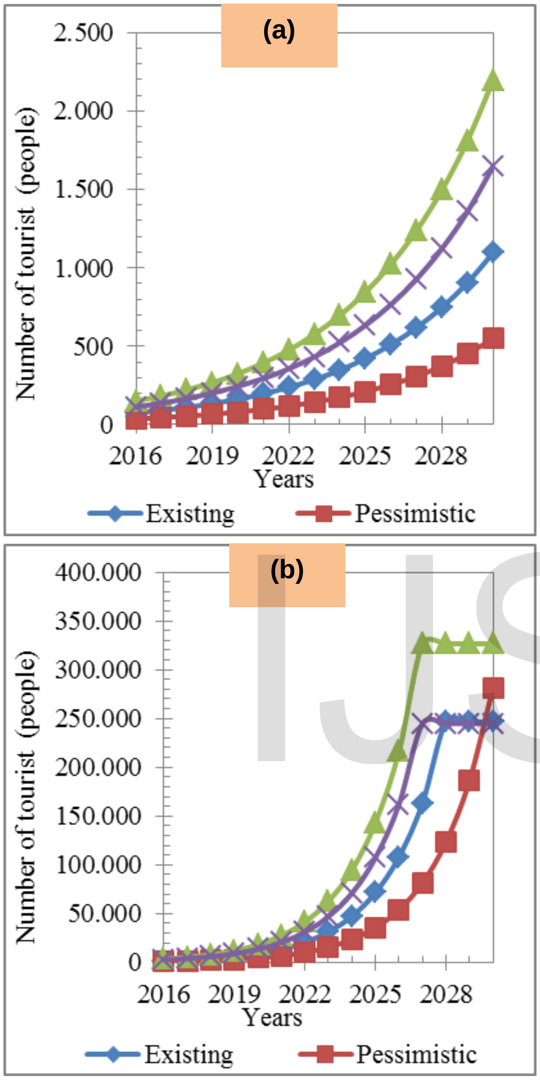

Fig. 5 Simulation scenario of the number of tourists (a) TNBK (b) TNDS

The simulation result of TNDS PNBP scenario is presented in Figure 7. The simulation results show that there will be an increase of PNBP from TNDS if it is managed intensively. It can be seen that in 2030 the development of intensive TNDS can generate PNBP amounting to Rp 12980875076. This trend will be stable when the number of tourists has reached the limit of carrying capacity in 2023. When compared to optimistic scenario results with existing conditions, PNBP can increase up to 70.50% in 2030.

The simulation results of the national park UMR scenario are presented in Figure 8. It can be seen that with optimistic scenario can increase the UMR of Kapuas Hulu Regency from both national parks. TNBK will reach a maximum UMR of Rp 3624393 in 2017. On the other hand, if not done the development of HoB ecotourism tends to UMR in Kapuas Hulu Regency will be in the range Rp 2233805 in 2030. In line with that, in TNDS also found the same trend with TNBK in every scenario. It can be seen that the value of UMR in the optimistic scenario is already Rp 3573210 in 2019 if done intensive ecotourism development. The predicted value of UMR in TNBK and TNDS tends to be different. This is due to the data error rate of 9.65% per year.

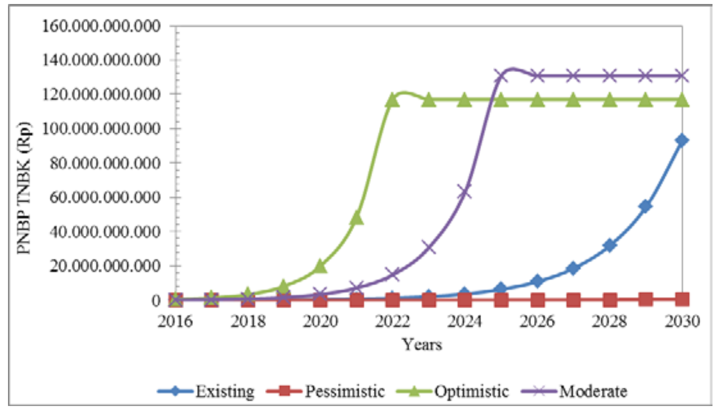

Fig. 6 PNBP Scenario simulation from TNBK

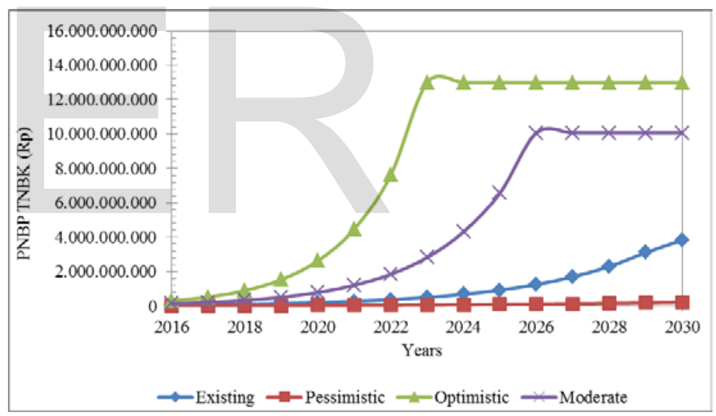

Fig. 7 PNBP Scenario simulation from dari TNDS

The simulation result of long road scenario built around the national park is presented in Figure 9. It can be seen that the trend of road construction in Kapuas Hulu Regency as a result of better ecotourism development. The optimistic scenario from TNBK shows that there will be 26415 km of roads to be built from this ecotourism development. 25.276 km greater value than the existing condition. So also with the development of TNDS that can road construction up to 4378 km if implemented optimistic scenario. This value is also greater than 2440 km when compared with the existing condition at this time.

In support of ecotourism development should be followed by improvement of transportation facilities. The means of transportation to TNBK and TNDS currently available are land, river and air transportation. To get to TNBK the third number of transportation facilities with optimistic scenario has reached its peak of 18262 units in 2030 (Figure 10). In line with that TNDS also has reached its peak in the year 2030 that is as many as 1286. Unlike the case with if the pessimistic scenario, the amount of transportation needed will not be too large because the number of tourists who attend is also not much. Existing current conditions indicate that there will be an increase in the number of transportation requests with the maximum Batak in TNBK and TNDS respectively 144 units, 143 units by 2030.

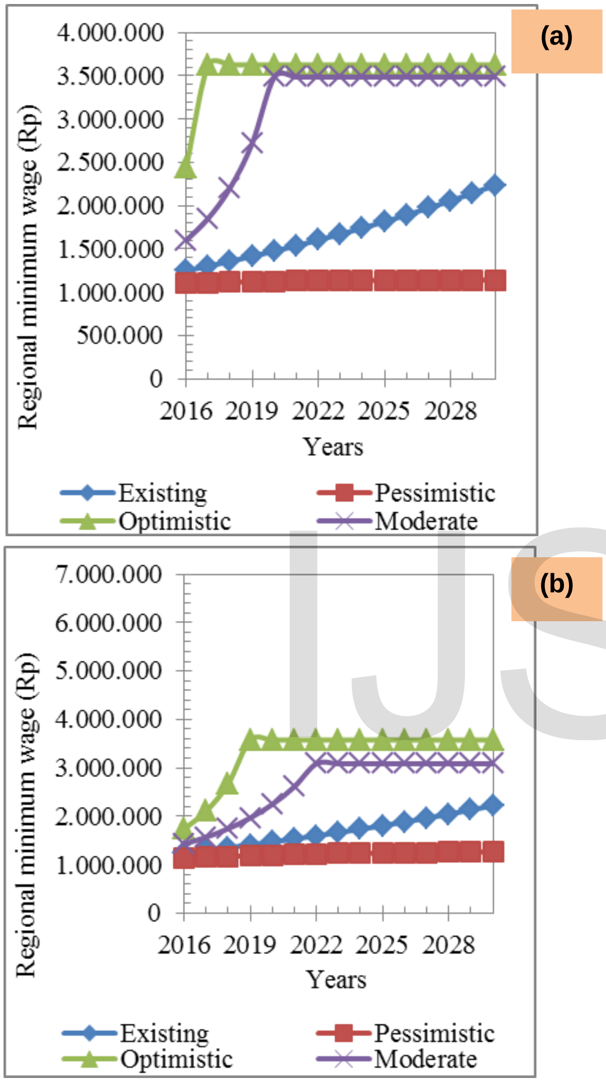

Fig. 8 UMR scenario simulation (a) TNBK (b) TNDS

The development of a national park must be carefully planned and must go through several stages to achieve a sustainable national park (Peng *et al.* 2017). Huangshan National Park in China, for example, must go through four stages to become a sustainable national park. The four stages are the initial inefficient stage, the rapid growth stage, the mature efficient stage, and the downside risk stage that has been started since 1981. In Indonesia, especially in West Kalimantan province has a region called HoB. Kapuas Hulu regency is one of the few districts in Indonesia with two national parks in its administrative area. These two national parks are important to be developed because the park area is close to cross a country border, Lanjak Entimau wildlife reserve and Batang Ai National Park '(Sarawak, Malaysia). In addition, there is Badau State Border Entity (PLBN) so that this national park has a strategic location to develop its ecotourism potential.

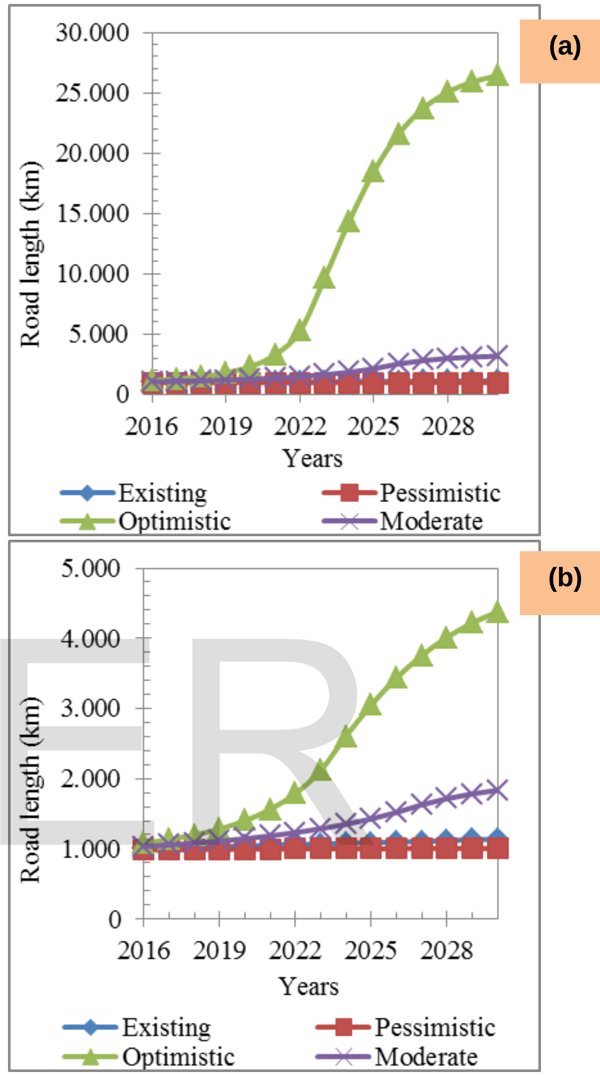

Fig. 9 Simulation of road length scenarios (a) TNBK (b) TNDS

The HoB ecotourism development model has been designed with the findings that the increase in non-tax revenues has important factors in the conservation of parks and parks. It can be seen that adequate infrastructure in TNBK and TNDS can trigger the change of PNBP which in turn can improve the living standard of the people around the national park. Increasing the standard of living is also supported by the sustainability of the national park. This is in accordance with the development model undertaken by Liu (2016) which focuses on the conservation of fauna and flora but does not calculate the social impact. So also with the results of research Ma et al. (2016), which focuses on the model of utilization of national parks into tourist attractions. In addition, some researchers (Peng *et al.* 2017, Ma *et al.* 2009, Ly and Xiao 2009, Tsai et al., 2010) mentioned that well-managed and sustainable national parks should be published nationally and internationally. This can be a reference for the management of ecotourism development of HoB Kapuas Hulu District is to publish both nationally and internationally.

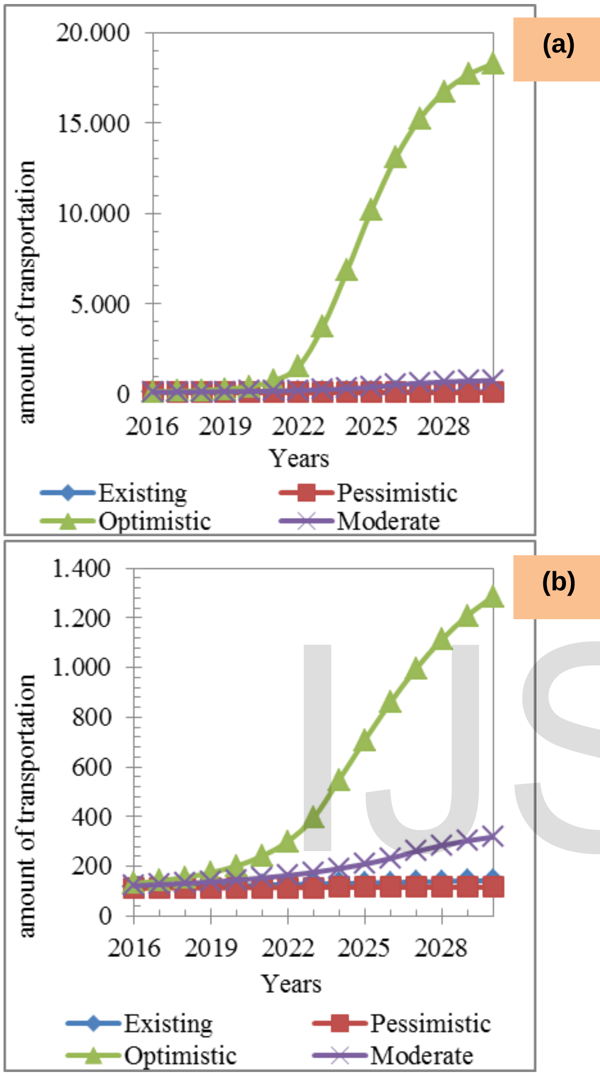

Fig. 10 Simulation result of scenario of transport amount (a) TNBK (b) TNDS

The scenario of the model has been tested with a pessimistic, moderate and optimistic scenario. The results of this scenario show that the optimistic scenario gives a very real picture that with the development of HoB ecotourism of Kapuas Hulu Regency has a positive impact on the national park. This optimistic scenario is followed by a policy to attract more tourists to TNBK and TNDS. This can be done by publishing the national park with online media. This activity is in line with tourist attractions in Taiwan country where the information system applied is website-based (Tsai *et al.* 2010).

4 Conclusion

Model simulation results show that the ecotourism of HoB area in Kapuas Hulu Regency is feasible to be developed based on the potential of human resources and PNBP that can encourage the improvement of road infrastructure and transportation facilities. Simulation estimates show that by 2030 the number of tourists can increase significantly up to 2191 people in TNBK and 326468 people in TNDS. The number of tourists in TNDS has reached its carrying capacity of 218084 people/year. But unlike the TNBK that has not reached the carrying capacity if the scenario is 272224 people/year.

The results of scenario simulation give an idea that the number of tourists is important to encourage the increase of non-tax revenues. This can encourage the building of infrastructure in Kapuas Hulu District. Based on the number of tourists and PNBP obtained through the development of ecotourism HoB can illustrate that forest conservation activities can be one alternative solution in ecotourism based forest management methods in Kapuas Hulu District. Supported by optimistic scenario results shows that planned management of TNBK and TNDS can generate PNBP so as to encourage better infrastructure development in the district. The policy direction that must be implemented in the HoB area is to facilitate infrastructure development so that tourists are interested to visit the two national park. In addition, with the online publication of HoB ecotourism development nationally and internationally so that it can become an icon from West Kalimantan Province.

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