International Journal of GEOMATE, Aug., 2018 Vol.15, Issue 52, pp.99 - 107
Geotec., Const. Mat. & Env., DOI: https://doi.org/10.21660/2018.52.70807
ISSN: 2186-2982 (Print), 2186-2990 (Online), Japan

MODEL HABITAT QUALITY IN THE FUTURE IN PADANG CITY

*Yudi Antomi[1], Dedi Hermon[2], Erianjoni[3], Dasman Lanin[4], Indang Dewata[5], and Abdul Razak[6]

[1,2]Department of Geography and Environment Science, Universitas Negeri Padang, Indonesia
[3] Department of Sociology and Environment Science, Universitas Negeri Padang, Indonesia
[4] Department of Public Administration and Environment Science, Universitas Negeri Padang, Indonesia
[5] Department of Chemical and Environment Science, Universitas Negeri Padang, Indonesia
[6] Department of Biology and Environment Science, Universitas Negeri Padang, Indonesia

*Corresponding Author, Received: 20 May. 2018, Revised: 04 Jun. 2018, Accepted: 08 Oct. 2018

ABSTRACT: The loss of environmental services to humans results from a continuous change in land use. The purpose of this study is to predict the condition of current and future environmental services through the calculation of habitat quality based on the trend of land use change in Padang City. This research begins with an interpretation of Landsat's temporal image, field surveys, focus group discussions, and an analysis of the impacts of land-use change. To collect land use data is done by image interpretation. A field survey was also conducted to determine the impact of land use change and its solutions. In carrying out this model used the quality and rarity habitat tool released by the Natural Capital Project under the name of the Integrated Valuation Ecosystem Services and Tradeoff (InVEST) parent modeler. The results of this study show the condition of environmental services in the city of Padang at the time of the research conducted in 2017 in the aspect of habitat quality showed significant decline until 2030, the intervention of spatial pattern (RTRW) Padang city able to provide an increase in the area of excellent quality from 51.36% to 52.27%, so the role of RTRW is very significant in maintaining and improving the quality of habitat in Padang City.

Key Word: Habitat Quality, LCM, Padang, Land Use

1. INTRODUCTION

Taking into account the physiography of Padang City, from the east to the west coast consists of a complex ecosystem region with a unique landscape entity as a provider of environmental services for the people of Padang City [1]. Upstream all the rivers flowing is directed east with hilly topography, bumpy and dominated by forest as buffer area (buffer) [2]. Type of soil and rocks in this region is dominated by volcanic to an alluvial fan on the left-right of the river in sloping areas with the type of use of mixed garden land, fields, rice fields, and settlements. In the west more dominated by alluvial plains with the highest concentration of settlements in this area [3].

From the results of the identification of land use changes originating from Citra Landsat in 1989-2016, the direction of the development of residential areas has shifted from west to east on more sloping slopes to slopes [4] [5] [6]. This shift in development orientation needs attention since the eastern area of Padang City is a buffer zone with the status of forest areas that have been designated as Protected Forest and Conservation Area (SK 2382 / Menhut-VI / BRPUK / 2015). Such a development orientation is also pointed to be the cause of the high number of natural sediment and hydrological disasters in Padang City in at least the last 1 decade, besides caused by bad drainage system especially in new settlement areas in the east of Padang City [7] [8] [9] [10] [11]. While so far, there has been no comprehensive research involving multiple perspectives for such cases particularly in the study of environmental services with more integrative methods.

The specific objective of this study is to predict future land use scenarios in spatial perspectives and quantitatively quantify how habitat quality is calculated based on the weighting of land use types, carbon sequestration and hydrological balance in Kota Padang as part of environmental services. Through the development of some future land use scenarios, this study is expected to provide stakeholder input on how to design and alternative spatial or spatial management plans in Padang City in the face of changing trends in the development of residential areas friendly to ecosystem balance and environmental services in Padang City [12].

The development trend of land use in Padang City has shifted to the east with the function of the area that should be the buffer zone, not the cultivation area [13] [14] [15]. The narrowness of land availability in the west, coupled with high hazard levels for the earthquake and tsunami disaster, is allegedly the main cause of the shift in the development, although in the eastern region of Padang City itself will be directly adjacent to the Protected Forest and Conservation Area which is designated as a buffer zone to ensure the survival of makhuk life including human [16] [17] [18]. The development of increasingly eastern land use and approaching buffer zones may threaten the balance of environmental services and lead to environmental degradation if land use patterns do not show patterns that support habitat quality, promote good carbon sequestration and are unable to become an ideal land use for retaining the rate of erosion, ensuring water availability and food security [19]. Therefore, it is important to examine and develop modeling that can represent patterns and changes in temporal land use so that it can be used as a basis in making land use map in the future with several scenarios through quantification of habitat quality, carbon stock, and absorption as well as hydrological balance as an indicator of environmental services [20]. Thus can be formulated research questions as follows: (a) How is the land use trend in Padang City in the future?, (b) What is the condition of environmental services today and in the future through calculating the quality of habitat in Padang City?

2. THE METHODS

This research was conducted in 2017, with a research area in Padang City.

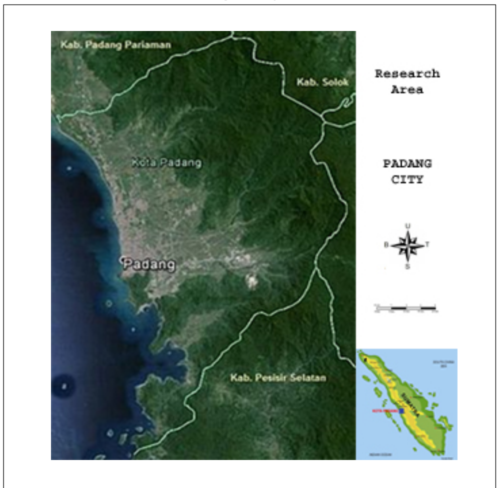

Fig.1. Map of Research Area

2.1 Land Use

Serial land use data obtained by interpretation of Landsat image 1989, 2006, 2016 and high-resolution image 2017. To be able to obtain information on actual land use and previously done an interpretation of Landsat satellite imagery in each year presented in the following diagram:

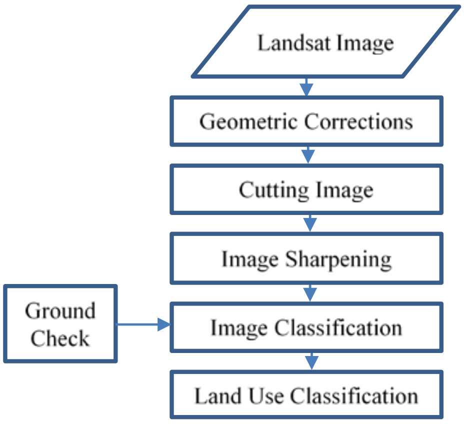

Fig. 2. Landsat Image Processing Flow

Landsat image interpretation is done through a supervised classification approach using e-Cognition rule set mode with multiresolution fragmentation and spectral differences. The types of land use are determined into four groups: forest, agriculture (moor, mixed plantation, and rice field), built-up areas (settlements and open land), and waters (rivers and lakes) [21] [22].

The accuracy of Landsat image interpretation results in 2016 was tested by Kappa index (accuracy) using 52 random sample points. The location and type of land use tested is determined through the appearance of land use types on high-resolution images and field survey results. Contingency matrices are used to calculate producer accuracy (omission errors), user accuracy (commission errors), and overall accuracy. The higher the accuracy value indicates that interpretation results are more accurate.

Land Use		Field Survey And High Resolution Image Imagery 2014						Total Reff.	Commision error
		Class 1	Class 2	...	...	...	Kelas n		
Land Use 2014 (Interpretation results)	Class 1	X_{i1j1}	X_{i1j2}	X_{i1j3}	X_{i1j4}	X_{i1j5}	X_{i1j6}	X_{i1}	$\frac{X_{i1j1}}{X_{i1}}$
	Class 2	X_{i2j1}	X_{i2j2}	X_{i2j3}	X_{i2j4}	X_{i2j5}	X_{i2j6}	X_{i2}	$\frac{X_{i2j2}}{X_{i2}}$
	...	X_{i3j1}	X_{i3j2}	X_{i3j3}	X_{i3j4}	X_{i3j5}	X_{i3j6}	X_{i3}	$\frac{X_{i3j3}}{X_{i3}}$
	...	X_{i4j1}	X_{i4j2}	X_{i4j3}	X_{i4j4}	X_{i4j5}	X_{i4j6}	X_{i4}	$\frac{X_{i4j4}}{X_{i4}}$
	...	X_{i5j1}	X_{i5j2}	X_{i5j3}	X_{i5j4}	X_{i5j5}	X_{i5j6}	X_{i5}	$\frac{X_{i5j5}}{X_{i5}}$
	Kelas n	X_{i6j1}	X_{i6j2}	X_{i6j3}	X_{i6j4}	X_{i6j5}	X_{i6j6}	X_{i6}	$\frac{X_{i6j6}}{X_{i6}}$
Total refference		X_{j1}	X_{j2}	X_{j3}	X_{j4}	X_{j5}	X_{j6}	N	
Ommision error		$\frac{X_{i1j1}}{X_{j1}}$	$\frac{X_{i2j2}}{X_{j2}}$	$\frac{X_{i3j3}}{X_{j3}}$	$\frac{X_{i4j4}}{X_{j4}}$	$\frac{X_{i5j5}}{X_{j5}}$	$\frac{X_{i6j6}}{X_{j6}}$		

Fig. 3. Contingency to Calculate Accuracy Level

Kappa accuracy = $[(N \sum_{i=1}^{j} X_{ij} - \sum_{i=1}^{j} X_i X_j)/(N^2 - \sum_{i=1}^{j} X_{ij} - \sum_{i=1}^{j} X_i X_j)] \times 100\%$ (1)

$$\textbf{Users accuracy} = \left(\frac{X_{ij}}{X_j}\right) \times 100\% \quad (2)$$

$$\textbf{Producers accuracy} = \left(\frac{X_{ij}}{X_i}\right) \times 100\% \quad (3)$$

$$\textbf{Overall accuracy} = \left[\left(\sum_{i=1}^{j} X_{ij}\right)/N\right] \times 100\% \quad (4)$$

Where N is the number of reference samples; X_i is the number of references in the i-th row; X_j is the number of references in the j th column; X_{ij} is the value in the confusion matrix row i and column j where $i = j$.

2.1. PREDICTED LAND USAGE

Land use prediction is done using Land Change Modeler (LCM) module in IDRISI TerrSet ver software. 6 PM. The process is as follows (Figure 4)

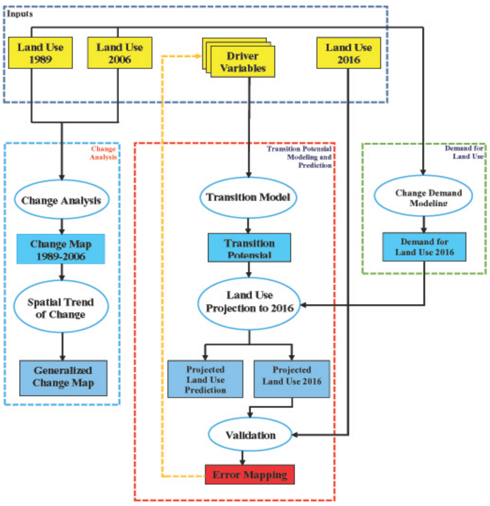

Fig. 4 Prediction Analysis of Land Use

2.2. QUALITY AND HABITAT SCARCITY

In the modeling also required data that is a threat to the integrity of habitat. In general, LULC type of cultivation is the cause of fragmented, distant, and degraded habitats. For example, roads are a threat to the integrity of forest habitat quality due to the opening of access to the utilization and transportation of forest products. The effect of threats to habitat is mediated by four factors. The first factor is the relative influence of the threat. One threat can be devastating, others can be less damaging, and so on. For example, the settlements could have twice as many impacts on habitat as compared to agricultural areas even though they had the same distance. Therefore, for each threat is given the weight corresponding to the destructive power. The weight of the settlement is certainly higher than the agricultural area.

The second factor is the distance between the habitat and the source of the threat and how quickly that influence propagates into the habitat. In general, the closer the habitat spacing to the source of the threat the greater the source of the threat to habitat degradation. However, the same distance from the two threat source types is also highly determined by the rapidity of the propagation reflected by the linear or exponential decay rates. The effect of the threat located in cell y, ry to the habitat in cell x, is presented *irix* which follows the equation:

$$\text{if lenear: } \boldsymbol{i_{rxy} = 1 - \left(\frac{d_{xy}}{d_{r\,\max}}\right)} \quad (5)$$

$$\text{if exponensial: } i_{rxy} = \exp\left(-\left(\frac{2.99}{d_{r\,\max}}\right) d_{xy}\right) \quad (6)$$

Where d_{xy} is the distance from the habitat in pixel x to the source of the threat in pixel y, and d_r *max* is the maximum effective threat distance from the threat source r.

To determine the decay rate and maximum distance of each threat source are done by calculating the determinant coefficient between the distance interval from the source of the threat with the percentage of habitat change to non-habitat. The determinant coefficient decreases with increasing distance. The maximum distance is determined at the point where the coefficient of determination shows the smallest value.

The third factor is the dampening factor for the destructive source of threats to habitat. Silencers can be natural factors such as steep slopes, altitude, wide and deep sugai, and policy factors such as spatial layout. In the model, accessibility is assumed to be a damper to habitat degradation. Accessibility is the level of ease of access to the place, the better the accessibility the easier access to habitat, the more easily the habitat is degraded. A habitat protected by spatial planning, for example, will have difficult access that is difficult to degrade.

The fourth factor is the sensitivity of each habitat to the threat factor. This factor is used to establish the total degradation value in each habitat pixel. Habitat sensitivity is the opposite of habitat resistance. Determined $S_{jr} \in [0.1]$ is the sensitivity of the habitat type *j* to the threat of *r* which is nearing the value of 1 is more sensitive. The most degraded habitats are then assumed to be attributable to habitat sensitivity values to the highest threat source.

The total of the threat level in pixel *x* with habitat type *j* is then determined by *Dxj* following the equation:

$$\boldsymbol{D_{xj}} = \sum_{r=1}^{R} \sum_{y=1}^{Y_r} \left(\frac{w_r}{\sum_{r=1}^{R} w_r} \right) \boldsymbol{r_y i_{rxy} \beta_x S_{jr}} \quad (7)$$

Where *y* is the index of all pixel grids in raster *r* and Y_r is the set of pixel values in raster *r*. The W_r value is the weight of the degradation sources indicating the relative damage to the source of the threat to all the habitats; *ry* is the effect of the threat of r derived from pixel *y;* i_{rxy} is the effect of the threat of *r* derived from pixel *y* on the habitat in pixel *y;* β_x is the accessibility level in pixel *x*; and S_{jr} is the sensitivity of LULC (habitat type) *j* to the threat of *r*.

The value for each pixel in the degraded region is translated as the habitat quality value using the "half saturation" function with the specified value. D_{xj} degradation values will increase in decreased Q_{xj} habitat quality, following the equation:

$$\boldsymbol{Q_{xj}} = \boldsymbol{H_j} \left(\boldsymbol{1} - \left(\frac{D_{xj}^z}{D_{xj}^z + k^z} \right) \right) \quad (8)$$

In the equation, the value of *z* is equal to 2.5 whereas *k* is the "half saturation" constant. Thus k equals *D* where; $1 - \left(\frac{D_{xj}^z}{D_{xj}^z + k^z} \right) = 0.5$; Therefore the default value of k = 0.5.

The resulting score has a range from 0 (zero) to 1 (one) where a score of 1 indicates the highest habitat quality, and 0 indicates the lowest habitat quality. In the context of the conservation world, biodiversity models have an orientation that high-quality habitat is a habitat that can support all levels of biodiversity in areas represented by land use type. Therefore, the following criteria are required in preparing the data for habitat quality analysis:

2.2.1. Preparation of land use data, where each type of land use that can support habitat (natural category, not cultivation) from forest to grassland has a value> 0 which means that the type of land use can support the sustainability of habitat, while the type the use of the remaining land (anthropogenic) from settlement to agriculture is categorized as non-habitat with a value of 0 (zero).

2.2.2. Preparation of threat data collected through focus groups (FGD) from environmental experts, stakeholders interested in land, forest, and conservation. This discussion will give rise to the formulation of variables that pose a threat to the quality of habitats from different perspectives. The compilation of the hierarchy of weights performed using Analytical Hierarchy Process (AHP) with the final product of value 1 represents the highest threat, and 0 is not a threat.

2.2.3. Preparation of threat sensitivity data, also from FGD. This formula is further compiled with the topic of sensitivity value of each type of land use to the formulation of threats discussed in point (b). Sensitivity indicates that the value of 1 (one) is the highest sensitivity and 0 (zero) is not sensitive. This value is important in the model as a basis for determining the analytical weight given input by the expert team.

2.2.4. Compilation of the relative distance of threat influence. These weights are also formulated through FGDs with expert teams, where each of the threat variables is defined as the maximum range/impact that is given, the lower the distance value the higher the resulting impact, and the further the distance is formulated the lower the threat impact.

In carrying out this model used the quality and rarity habitat tool released by the Natural Capital Project under the name of the Integrated Valuation Ecosystem Services and Tradeoff (InVEST) parent modeler.

3. RESULT AND DISCUSSION

3.1. PROJECTION OF LAND USE CHANGE

Land use is extracted from earth surface objects recorded on satellite images. In this study, the type of land use used consists of eight classes namely primary forest, secondary forest, built area, mixed garden, open land, rice field, shrubs, and body water. Data sources from land use classes were derived from Landsat image classification results in 1989, 2001 and 2017 reinforced by classification testing using the sampling method. The number of samples of 50 points was sampled on 14-17 September 2017.

The prediction of land use change implements land use allocations and changes to meet demand (demand) based on the mechanism of the attraction of the region (market mechanism) without any limitation in the utilization of space.

Predicted land use in 2030 in Padang City using business as usual and spatial-limited scenario (RTRW) difference is not significant in each class. The area of the primary forest using the free scenario is 84,136.86 ha while using the bound scenario.

The primary forest area is 84,141.81 ha. Furthermore, to predict the area of the secondary forest using a free scenario that is 31,811.31 ha, whereas by using scenarios bound by the area of secondary forest 31,806,72 ha. To predict the built area using the free scenario that is 10,493,73 ha, while using the bound scenario of the area built 10,494 ha.

Furthermore, the prediction of the area of mixed plantation using the free scenario is 17,081.01 ha, while using the bounded scenario of the mixed garden area is 10,493.73 ha. To predict the area of open land using the free scenario of 1,397.79 ha, while using the bound scenario 1,397.97 ha. To predict the area of the wetlands using the free scenario is 7,040.16 ha while using the scenario bounded wetland area of 7,039.98 ha.

To predict the extent of semah, Imperata using free scenario is 18,809.46 ha, whereas by using scenario of wide bounded grass, along-along 18,808.38 ha, whereas for prediction of water body area from both scenario remain that is 54,976.68 ha. The prediction of land use pf the two scenarios is given in Table 1.

Table 1 Prediction of Land Use With Two Scenarios

LC	2030 (BaU)	2030 RTRW)
Information	Large (Ha)	Large (Ha)
Prim. Forests	84,136.86	84,141.81
Sec. Forests	31,811.31	31,806.72
Built Area	10,439.73	10,494
Mixed Garden	17,081.01	17,081.46
Open Field	1,397.79	1,397.97
Rice Fields	7,040.16	7,039.98
Bush	18,809.46	18,808.38
Woter Body	54,976.68	54,976.68

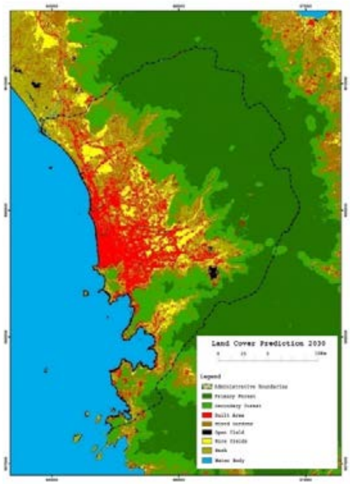

Fig. 5. Predicted Map of Land Use Change from 2017-2030
Source: LCM Analysis Results

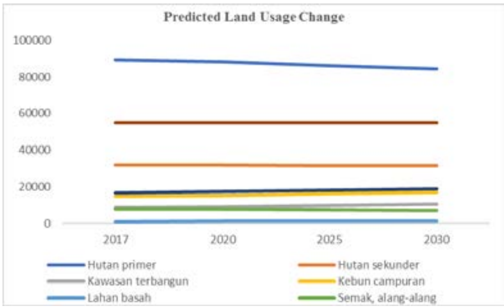

Fig. 6 Graph of Predicted Land Usage Change

3.2. LAND USE AND HABITAT AREA

The result data of the Forum Group Discussion (FGD) was then analyzed using a spatial approach to measure how the conformity between the opinions of people and the trends generated in spatial analysis. Past land use maps (in 1989, hereinafter referred to as baselines) are first classified into 2 classes, where information is obtained where types of land use are classified as natural and man-made (anthropogenic) areas (Table 3). The result of classification will produce a map of land use change from natural area to anthropogenic area which is analyzed with a distance map from each threat variable.

Table 2 Type of Land Use and Habitat Area

Land Use	Type
Primary Forests	Natural
Secondary Forests	Natural
Built Area	Anthropogenic
Mixed Garden	Anthropogenic
Open Field	Natural
Rice Fields	Anthropogenic
Bush	Natural
Water Body	Natural

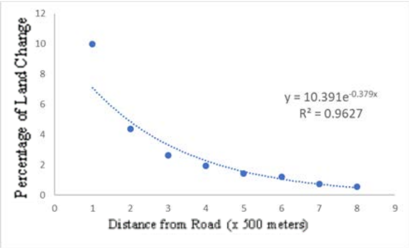

Fig. 7. The relationship between Land Use Change and Distance from the Road

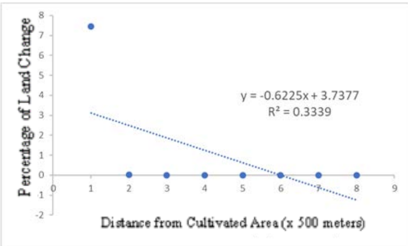

Fig. 8. The relationship between Land Use Change and Distance from Cultivation Area

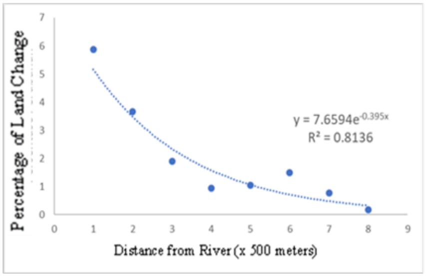

Fig. 9. The relationship between Land Use Change and Distance from River

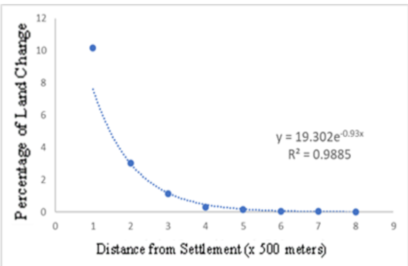

Fig. 10. The relationship between Land Use Change and Distance from Settlement Area

The results of the analysis are presented (Fig.7-10), where there is a strong positive relationship between land use change from the natural area to the anthropogenic area with the distance from the road with the coefficient of determination (R-square) 0.96, as well as the distance from the settlement area with the R value -square 0.96. The strong positive relationship indicates that the closer the distance to roads, residential areas, and rivers, the change of land use from natural areas to anthropogenic areas is higher. Therefore, these variables can be incorporated into the habitat quality model.

The habitat quality map shows the biodiversity represented in a map of habitat quality modeling results (Fig.10) with index values ranging from 0 (not qualified) to 1 (best quality). In the discussion, the index is classified into 5 classes namely; (0-0.2), low quality (0.2-0.4), medium quality (0.4-0.6), good quality (0.6-0.8) and excellent quality (0.8-1). By 2017 (Fig.12) the best habitat-quality areas are scattered on the plateau in the eastern city of Padang located in areas with a certain distance from human (anthropogenic) land use, this is also influenced by physiography that inhibits human activity such as the lack of access, slope, and distance from each of these factors.

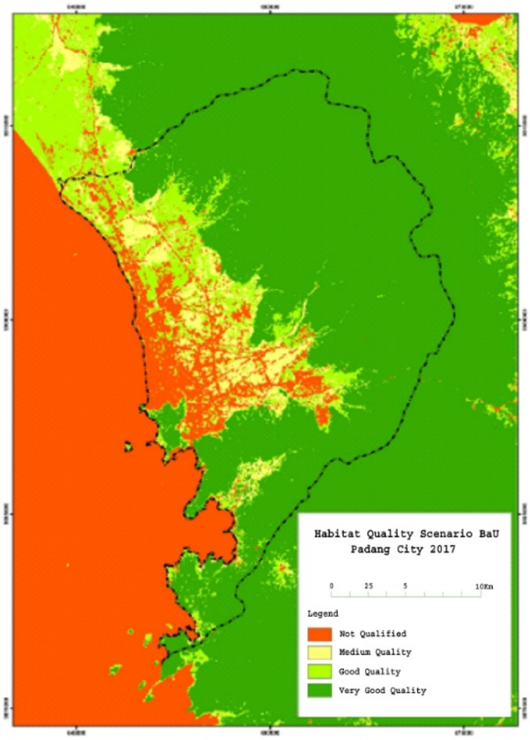

Fig. 10. Habitat Quality Map of Padang City The year 2017

Table 3 Habitat Quality Classification

Habitat Quality Classification	Percentage of Area (%)		
	2017	2030 (BaU)	2030 (RTRW)
Not Qualified	28.71	29.62	28.71
Weak Quality	0.00	0.00	0.00
Medium Quality	3.88	3.12	2.88
Good Quality	9.76	15.89	16.14
Very Good Quality	57.65	51.36	52.27

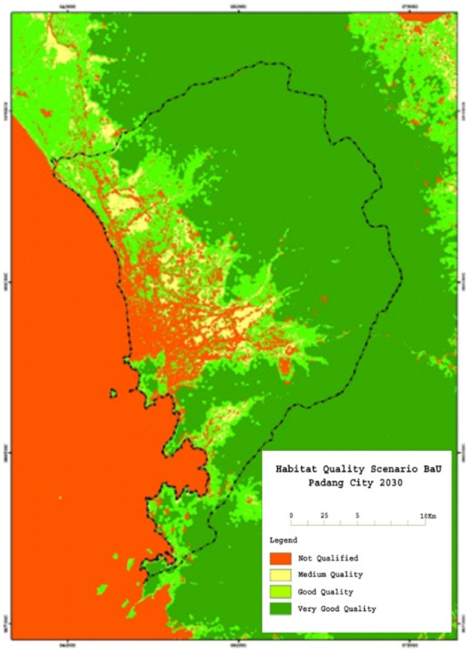

Fig. 11. Map of Habitat Quality of Padang City The year 2030 Business as Usual (BaU) Scenario

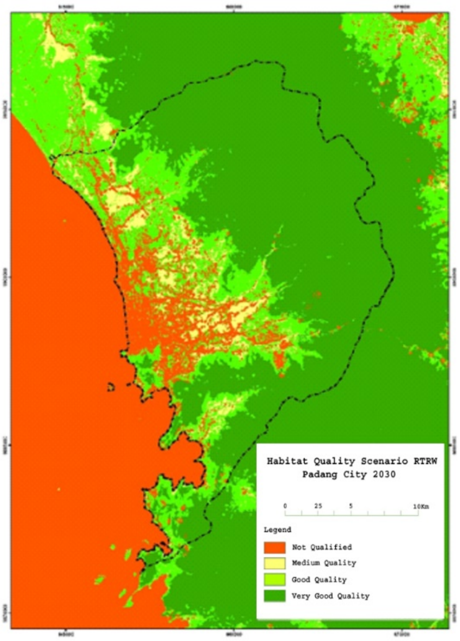

Fig. 12 Habitat Quality Map of Padang City The year 2030 (RTRW) Scenario

Habitat quality modeling results show that from the conditions of 2017 to 2030 as the final year in the planning of the RTRW there is a trend of environmental degradation in the non-intervening scenario (BaU). Table 3 shows the non-qualified region having an insignificant increase from 28.71% to 29.62%. Unlike the case of the region with very good quality, relatively decreased significantly from 57.65% to 51.36%. In the scenario with intervention (RTRW), although decreased from 2017, but not too low compared with no intervention (RTRW). The results of this analysis at the same time prove that protected areas (RTRW spatial pattern map) when applied properly can give a significant influence in reducing the rate of land use change that directly affect the quality of habitat. Some of the protected areas are protected forest areas and natural reserve areas located east of Padang City.

It is very clear that land use change patterns have a strong relationship to the habitat quality degradation modeled in this study. The current trends in land use change are not balanced by the land use planning strategy (through spatial pattern of RTRW) that is structured and based on the interests of the local population or in this study referred to as the BaU scenario will have a significant impact on the degradation of the quality of environmental services in the aspect of habitat quality.

4. CONCLUSION

Predicted land use deliberately displayed predicted results in 2030 because in that year is the year used for the validity of RTRW Padang. From the prediction result, it can be concluded that in Padang City using business as usual scenario of primary forest 84,136,86 ha, secondary forest area 31,811,31 ha, wide of build area 10,493,73 ha, mixed garden area 17,081,01 ha , the area of open land is 1,397,79 ha, the wetland area is 7,040.16 ha. extensive shrubs and reeds 18,809.46 ha. For predictions with scenarios limited by RTRW, the primary forest area is 84,141.81 ha, the area of secondary forest is 31,806,72 ha, the area is 1,0494 ha, the area of the mixed garden is 10,493,73 ha, the land is 1,397.97 ha. the wetland area is 7,039.98 ha. As well as the area of shrubs and reeds 18,808.38 ha. So it can be concluded that the wide difference in land use prediction using free scenario and the bound scenario is not very significant.

The condition of environmental services in Padang City at the time of the research conducted in 2017 in the aspect of habitat quality showed significant decline until 2030, the intervention of spatial pattern of RTRW Kota Padang able to give an improvement on the very good quality area from 51.36% to 52.27% RTRW is very significant in maintaining and improving the quality of habitat in Padang City.

5. ACKNOWLEDGMENTS

The suggestion that can be given is in determining or choosing an appropriate alternative land use pattern or representing the condition of sustainable environmental services required an integrative and comprehensive measurement instrument, able to accommodate all inputs from various circles and interests. In this study used the Integrated Valuation Ecosystem Services and Tradeoffs (InVEST) instrument to measure and obtain some of the zonation-related inputs of spatial pattern that is being applied in Padang City. This instrument can be developed and analyzed further for the more complex interests, especially in formulating and simulating how the role of zonation has been prepared, the extent of its influence, and what deficiencies.

6. REFERENCES

[1] Hermon, D., Aprizon, P., Olivia, O., 2018. Suitability Evaluation of Space Utilization Based on Environmental Sustainability at the Coastal Area of Bungus Bay in Padang City. International Journal of GEOMATE. Vol. 14. Issue 41: 193-202

[2] Balvanera, P., Uriarte, M., Almeida-Le˜nero, L., Altesor, A., DeClerck, F., Gardner, T., Hall, J., Lara, A., Laterra, P., Pe˜na-Claros, M., 2012. Ecosystem services research in Latin America: the state of the art. Ecosyst. Serv. 2, 56–70.

[3] Baral, H., Keenan, R.J., Sharma, S.K., Stork, N.E., Kasel, S., 2014a. Spatial assessment and mapping of biodiversity and conservation priorities in a heavily modified and fragmented production landscape in north-central Victoria, Australia. Ecol.Indic. 36, 552–562.

[4] Bennett, E., 2005. Drivers of Change in Ecosystem condition and services. In: Current State & Trends Assessment, Chapter 7

[5] Bennett, E.M., Balvanera, P., 2007. The future of production systems in a globalized world. Front. Ecol. Environ. 5, 191–198.

[6] Antomi, Y., D.M. Hartono., M. Suparmoko, R Koestoer., 2016. Water Quality Index in Lake Maninjau as a Parameter to Determine the Optimum Economic Growth of Floating Net Cages and Land-Based Livelihood. OIDA International Journal of Sustainable Development, Vol. 09, No. 02, pp. 51-62, 2016.

[7] Koshi Nepal. Int. J. Biodivers. Sci. Ecosyst. Serv. Manage. 11, 145–155.

[8] Brown, Sandra, 1997. Estimating Biomass and Biomass Change of Tropical Forests: a Primer. (FAO Forestry Paper - 134). FAO, Rome.

[9] Clark III, A. 1979. Suggested procedures for measuring tree biomass and reporting free prediction equations. Proc. For. Inventory Workshop, SAF-IUFRO. Ft. Collins, Colorado: 615-628

[10] DeFries, R.S., Foley, J.A., Asner, G.P., 2004. Land-use choices: balancing human needs and ecosystem function. Front. Ecol. Environ. 2, 249–257.

[11] Hall, L.S., P.R. Krausman, and M.L. Morrison. 1997. The habitat concept and a plea for standard terminology. Wildl. Soc. Bull.

[12] Hidayat, Benny., 2014. Understanding Flood Disaster in Padang City with Content Analysis News Articles. Proceedings of the Annual Scientific Meeting (PIT) HATHI XXXI, vol 1

[13] MEA, 2005. Ecosystems and Human Well-Being. Island Press, Washington, DC.

[14] Nassl, M., Löffler, J., 2015. Ecosystem services in coupled social-ecological systems: closing the cycle of service provision and societal feedback. Ambio 44,737–749.

[15] Raudsepp-Hearne, C., Peterson, G.D., Bennett, E., 2010. Ecosystem service bundles for analyzing tradeoffs in diverse landscapes. Proc. Natl. Acad. Sci. 107,5242–5247.

[16] Swetnam, R., Fisher, B., Mbilinyi, B., Munishi, P., Willcock, S., Ricketts, T.,Mwakalila, S., Balmford, A., Burgess, N., Marshall, A., 2011. Mappingsocio-economic scenarios of land cover change: a GIS method to enableecosystem service modelling. J. Environ. Manage. 92, 563–574.

[17] Wollenberg, E., Edmunds, D., Buck, L., 2000. Using scenarios to make decisionsabout the future: anticipatory learning for the adaptive co-management ofcommunity forests. Landscape Urban Plann. 47, 65–77.

[18] Woodley, S., Bertzky, B., Crawhall, N., Dudley, N., Londo˜no, J.M., MacKinnon, K.,Redford, K., Sandwith, T., 2012. Meeting Aichi Target 11: what does successlook like for protected area systems. Parks 18, 23–36.

[19] Zarandian, A., Baral, H., Yavari, A.R., Jafari, H.R., Stork, N.E., Ling, M.A., Amirnejad,H., 2016. The anthropogenic decline of ecosystem services threatens the integrity of the unique hyrcanian (Caspian) forests in northern Iran. Forests 7, 51.

[20] Hermon, D., Ganefri., Aprizon, P., Olivia, O., 2018. The model of mangrove land cover change for the estimation of blue carbon stock change in Belitung island-Indonesia. International Journal of Applied Environmental Sciences. Vol. 13. Issue 2: 191-202

[21] Hermon, D., 2017. Climate Change Mitigation.

Radjawali Pers
[22] Hermon, D., 2016. Estimate of changes in carbon stocks based on land cover changes in the Leuser Ecosystem Area (LEA) Indonesia. Forum Geografi. Vol. 29. Issue 2: 188-196