PLANNING MALAYSIA:
Journal of the Malaysian Institute of Planners
VOLUME 20 ISSUE 4 (2022), Page 47 – 57

CHANGE OF FOREST LAND USE BASED ON CONSERVATION POLICY AND PRACTICE: A CASE STUDY IN DANUM VALLEY, MALAYSIA

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Abstract

Southeast Asia's forest and green areas are undergoing a fast and substantial experienced sudden change, depending on complex area management issues resulting in deforestation, including Danum Valley, Sabah, Malaysia. The study purposely to determine the land-use pattern at Danum Valley through a geospatial approach. GIS data was collected from government official departments such as the Sabah Forest Department and Urban and Regional Planning Sabah Department. Land-use changes analysis, namely Relative land use percentages and matrix analysis used to understand the changing pattern and current scenario of land use activity at Danum Valley. Preliminary findings indicate a change of forest land use from Class 2 Commercial Forest Reserve into Class 1 Protected Forest Reserve during the three times series within an area of influence near Danum Valley.

***Keyword**:* Conservation, Danum Valley, GIS

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INTRODUCTION

The change in land use refers to human activity on land (Abdul Latip et al., 2013). In contrast, land cover refers to the physical condition of the soil (Turner & Meyer, 1994), and Pacione (2005) affirmed that land-use change is more focused on human activities where people are involved in the transformation of non–urban land into urban land use. Land cover is a layer of soil and biomass that includes natural plants and artificial structures covering the soil surface. In contrast, land use refers to the purpose of human exploitation of the land cover, for example, several human activities such as agriculture, building construction, and forestry (Fresco, 1994). The change in land use and the land covered naturally or anthropogenic activities have led to the loss of biological diversity caused by deforestation, global warming, and increased natural disaster such as floods (Dwivedi et al., 2005). A monitoring mechanism is crucial (Latip et al., 2020) to avoid destructive forest resources. Effective management of forests is a critical element of future forest conservation that is essential for both long–term stability and the short–term productivity of the forest ecosystem (Andrew et al., 2000). Therefore, this study is to identify the patterns of land-use change occurring in Danum Valley, Sabah, based on the conservation management plan and policy

RESEARCH BACKGROUND

Land use is defined as a series of operations toward land area done by humans, with the reason to get product and benefits through using natural resources (Ryan, 2013). Land use refers to the purpose of the land functionality, for example, habitat for wildlife, agriculture, or recreation, which does not describe the surface cover on the ground. Land-use change is considered one of the foremost critical environmental problems globally (Veldkamp & Lambin, 2001). An understanding of land use theory and practice aided by strict rules and regulations ensures the effectiveness of actions and principles of an area to care for. As well as the Danum Valley. Many theories and practices of law dictated the conservation effort in the area.

- **Theory of Land Use Planning,** based on (Chapin, 1965), the land-use planning theories refer to a system of thought generated through logical utterance or systematic formulation that complements and explains land use. It covers the question of why it exists, how it develops, what changes in land use are taking place, and the basic structures and forms of components in land use activities. Theory often provides a rationale for making predictions. Observing similarities or determining behavioural phenomena in real life seeks to prove the future through these phenomena

based on behavioural assumptions. The theory can provide guidelines for implementing a choice between alternatives for planning decision-making.

- **Land Use Planning** is generally part of an overall process in urban and regional areas. Based on (Chapin, 1965), land use planning should emphasise the location, intensity, and development required for different spaces. Land use maps are significant for urban planning and management (Hu, Yang, Li, & Gong, 2016). Land Use Planning is a land governance instrument usually employed to safeguard land areas, restrict human activities toward natural areas, and strengthen the land systems to ensure land sustainability (Briassoulis, 2019). Land use planning is a crucial determinant for green spaces as it defines the land covers and performance of urban ecosystems. Therefore, the benefits for humans (Langemeyer et al., 2016)
- **Land Ordinance (Sabah Cap. 68**) as indicated by the (Land Ordinance, 1968); the Sabah Land Ordinance is the primary legislation in Sabah for land classification and allocation for owner rights and titles toward land. It also rules over revenue collection, land survey and delimitation, implementation of enforcement, and punishment toward related land and land ownership offences. Important legislation that the subsidiary passed under the Ordinance are such as Land Rules 1930, Land Rules (Temporary Planning Permit) 1948, Rent Revision Rules 1958, The Land Control (Control and Management of Sipadan Island) Rules 1996, and Land (Quarry) Rules 1997. 13. The Sabah Land Ordinance states that "State land" means all lands which have not been and may not hereafter be reserved for any public purpose, or which have not been and may not hereafter be leased or granted to, or are not and may not subsequently be lawfully occupied by any person. As well as forest land.

The world has recognised the importance of forests for all life and prioritised the preservation of forests through many policies and practices. However, recent data show that forest area has declined despite acknowledging their importance for conservation (Keenan et al., 2015), including Sabah Forest. The Forest Enactment 1968 (Forest Enactment, 1968) is an enactment by Sabah Legislature in 1968 as the basis for forest law in Sabah. This enactment seeks to replace the law (Ordinance No. 11, Timber and Jungle Produce) relating to forest preservation, the regulation, control of all forest produce, and related and incidental matters. The Forest Enactment 1968 passed through amendments that contained 43 provisions with five sections. This enactment includes requirements for creating and abolishing forest reserves. The Sabah Forestry Department will carry out the implementation and management of the enactment. After being advised by the Chief of the Forest Conservation, the Minister may amend any regulations

considered appropriate, valuable, and necessary to carry out this enactment's provisions better.

Sabah has a vast forest area and resources, which the authorities divided into many types of forest reserves. The classification range below is based on Sabah Forest Department and The Forest Enactment 1968.

Table 1: Class and Types of Forest Reserves

Class	Forest Reserves
1	Conserved especially for protection and conservation of forest area. This forest is protected by law and rules by the state authorities from changing the use of the land into other land use or deforestation such as timber exploitation.
2	Commercial forest. This forest is used to produce timber supply or other products based on forest used to profit for the state's economy. The harvesting is based on the Sustainable Forest Management (SFM) principles.
3	Domestic Forest Reserves. This forest is reserved mainly for a minor harvesting forest supply for the local communities or natives living near the forest area where commercial use is not encouraged.
4	Amenity Forest Reserves that mainly used for general public recreational opportunities. This forest provided a public facility to attract the site for public use and usually reserves along roadsides.
5	Mangrove production activities. This forest supplies mangrove timber, and other forests mainly focus on mangrove products, such as firewood and charcoal.
6	Virgin Jungle Reserves. Like the class 1 protection forest where timber logging and deforestation are prohibited. Its primary purposes are to conserve forest research, including biodiversity and generic conservation.
7	It is strictly protected by law because it is known as a Wildlife reserve. Any logging activity is prohibited and used to conserve, protect, and research wildlife such as the Sumatran Rhinoceros.

Source: Sabah Forest Department, 2021

The Forest (Danum Valley Conservation Area) Rules (1996) and laws apply only to Danum Valley Forest Reserve. The enactment provided a list of Danum Valley Conservation Management Committee where they're assigned to advise the Director of Danum Valley about the area's development. The legislation shows the management committee list, each committee's role, and its powers and functions as a management committee. The government's effort to conserve the area is well demonstrated in policy, rules and regulations imposed on the Danum Valley forest reserve.

Study Area

Sabah is the second largest state in Malaysia, located north of Borneo. Sabah covers an area of 72 500 square kilometres with a coastline of 14 400 kilometres, with the South China Sea situated on the west coast, the Sulu Sea on the northeast, and the Celebes Sea on the South. Sabah is centred on latitude and longitude 5.420404° N and 116.796783° E and divided into five administrative divisions: Tawau, Sandakan, West coast, Kudat, and Interior, with each division consisting of several districts which total 27 districts. Sabah local governments are under the control of the state government. Danum Valley is located in Tawau Division with about 438 km^2. The nearest town to Danum Valley is Lahad Datu, about 82 km away with a 2-hour drive on the logging road.

Based on Sabah Structure Plan 2033 (Town and Regional Planning Department Sabah, 2016), there are three strategies for Sabah's development: provide for sustainable population growth in the north and the interior areas of Sabah, develop functional distribution growth centres, and create Special Economic Zones. There are three sectors of the Special Economic Zone, namely the tourism zone, industrial zone, and agriculture zone. Danum Valley is a tourism zone and falls under Tawau division development strategies with one municipal council and three districts: Tawau, Semporna, Kunak, and Lahad Datu. Based on Sabah Structure Plan 2033, Danum Valley is developing the tourism sector. Danum Valley is under Sabah Development Corridor (SDC) investment and development for Entry Point Projects (EPP) to drive economic growth in Sabah. For the existing situation, Danum Valley has become ecotourism with a rainforest experience product based on Malaysia's premier ecotourism destination promoted.

METHODOLOGY

A Geographical Information System or GIS, as indicated by Noor et al., 2013; Ibrahim et al., 2016), is a method of marking the mapping of an area based on geospatial data on the existing topography or for future planning. It uses the overlay technique method that details the categories of information according to geographical taxonomy, such as plants, rocks, buildings, soil, soil layers and minerals, including the movement of life on earth. According to current needs and activities, it facilitates development planning and control of strategic areas such as cities, states, borders, forest reserves, mining industry, coastal areas, etc. In general, the basic requirements of GIS are the current map of the area under study and the input and production output integration information according to the needs of individuals, groups, non -government and government. This study focuses on the Danum valley's current condition of forest reserves. The geographic data of Danum Valley land use were obtained from government agencies such as the Sabah Forestry Department and the Urban and Regional

Planning Sabah Department. GIS ArcMap 10.4 software (Chang K. T., 2008) is used as an instrument, with metadata, namely the overlay method using vector data and matrix method using raster data.

As for land use changes analysis, the formula of the land-use changes (Hu et al., 2007; Narimah et al., 2010) indicates changes from year to year. The procedure is shown below:

$$\%B_{i.j}^{t\to t+n} = \left(\frac{B_{i.j}^{t+n} - B_{i.j}^{t}}{B_{i.j}^{t}}\right) \times 100$$

Which

$\%B_{i.j}^{t\to t+n}$: Percentage of land use change from time t and time t + n,
$B_{i.j}^{t+n}$: Size of development area from time t + n, and
$B_{i.j}^{t}$: Development area from time t

ANALYSIS AND FINDING

The discussion of this analysis is divided into sections: land use analysis through the GIS overlay method, the percentage change of land use by using the percentage change of land use formula and matrix analysis. Based on Reynolds et al. (2011), Danum Valley has become a Class 1 Protection Forest Reserve since 2010, showing no change in Danum Valley land use. Therefore, this study will include the change in land use based on two-zone of influence (100 km^2 and 200 km^2) near the Danum Valley area.

Overlay Method using GIS

Relative land use percentages were conducted in three-time series in 2010, 2014, and 2018 as shown in Table 5.1. Based on table 5.1 analysis of the year 2010, the Class 2 Commercial Forest Reserve had the most dominant land use size, which had about 1, 669.56 km^2 (74.13 %), followed by the Class 1 Protection Forest Reserve with 465.16 km^2 (20.65 %) which is the Danum Valley area, 62 while the district boundary is 95.49 km^2(4.24 %). Timber plantation land use is 21.95 km^2 (0.98 %).

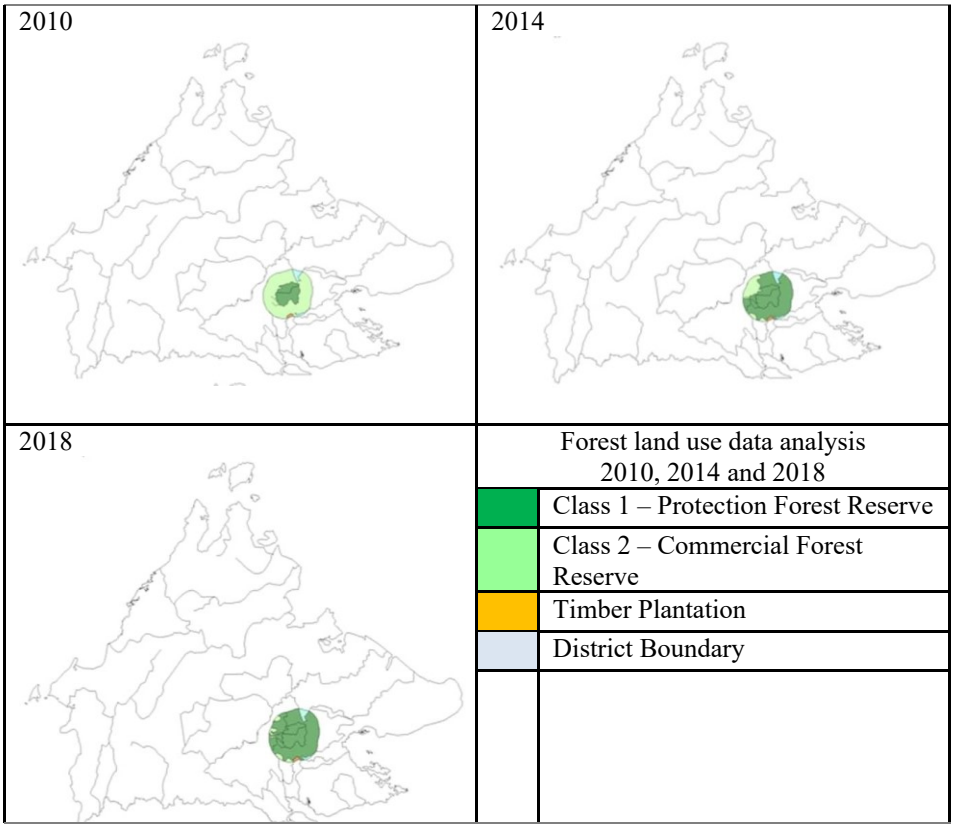

Figure 1: Changes in Land Use in Danum Valley, Sabah in Years 2010, 2014, and 2018
Source: Author, 2022

In 2014, there was a significant change in forest land use, which has experienced a substantial increase and is dominated by Class 1 Protection Forest Reserve with 1 785.23 km^2(79.27 %) area. Next, the second with a vastly reduced change in the size of forest land use is the Class 2 Commercial Forest Reserve with 349.49 km^2(15.52 %) size area, followed by the district boundary is 95.49 km^2(4.24 %), and timber plantation land use is 95.49 km^2(4.24 %) which does not change for both land use.

Meanwhile, for the year 2018, the Class 1 Protection Forest Reserve slightly increased to 006.52 km^2(89.09 %), while the Class 2 Commercial Forest Reserve had another small reduction to 128.20 km^2(5.69 %). However, both the district boundary and timber plantation do not have a land-use change which stays at 95.49 km^2(4.24 %) and 95.49 km^2(4.24 %). From the analysis, a significant increase in land use is between 2010 and 2014 with a growth of 1, 320.07 km^2(+58.62 %) area size for the Class 1 Protection Forest Reserve, while a sign

of a decrease in land use also happens between 2010 and 2014 that reduce 1, 320.07 1, 320.07 km^2(-58.62 %) for the Class 2 Commercial Forest Reserve. However, there is no land-use change toward timber plantation and district boundary size area for the three times.

Table 2: Change of Land Use in Danum Valley in Years 2010, 2014, and 2020

Forest Land Use	2010 km^2	%	2014 km^2	%	2018 km^2	%	Changes by Types of Land Use -km2		Percentage Changes (%)	
							2010-2014	2014-2018	2010-2014	2014-2018
C1	465.16	20.65	1785.23	79.27	2006.52	89.09	+1320.07	+221.29	+58.62	+9.82
C2	1669.6	74.13	349.49	15.52	128.20	5.69	-1320.07	-221.29	-58.62	-9.82
TP	21.95	0.98	21.95	0.98	21.95	0.98	0	0	0	0
DB	95.49	4.24	95.49	4.24	95.49	4.24	0	0	0	0
Total	2252.6	100	2252.16	100	2252.16	100				

Source: Author, 2022

Matrix Analysis

The matrix analysis shows the existing type of land use into other land use based on two different studies that will show how much the size of the area has changed during each year and the cause of the change.

Table 3; Matrix Analysis Method of Land Use Change Years 2010 - 2014

Year	2014 (km^2)					
	Forest Land Use	Class 1	Class 2	TP	NRF	Total (2010)
2010 (km^2)	Class 1	465.1				465.1
	Class 2	1320.07	349.49			1669.56
	TP			21.95		21.95
	DB				95.49	95.49
	Total (2014)	1785.23	349.49	21.95	95.49	2252.16

Source: Author, 2022

Table 3 indicates that during 2010 – 2014, about 1 320.07 km^2 had Classommercial Forest Reserve land use hugely changed into Class 1 Protection

Forest Reserve. This change caused the reduction of class 2 forest land use as it became 349.49 km^2 in 2014 from the total area of 1 669.56 km^2 in 2010. However, there is no land-use change for timber plantation and district boundary between that two different year

Table 4; Matrix Analysis Method of Land Use Change Years 2014 – 2018

Year	2014 (km^2)					
	Forest Land Use	Class 1	Class 2	TP	NRF	Total (2014)
2010 (km^2)	Class 1	1785.23				1785.23
	Class 2	221.29	128.20			349.49
	TP			21.95		21.95
	DB				95.49	95.49
	Total (2018)	2006.52	128.20	21.95	95.49	2252.16

Source: Author, 2022

Table 4 shows only the correct change in land use between class 1 and class 2 forest land in the year 2014 - 2018. The class 1 forest land use increased by about 221. 29 km^2 into 2, 006.52 km^2 which changed from class 2 forest land use. This change caused only 128.20 km^2 area left for class 2 in 2018. However, the timber plantation and district boundary stay the same as there is no change in land use.

CONCLUDING REMARK

Generally, there is no land-use change in Danum Valley in the three times series. However, there is a change in land use in the zone of influence near Danum Valley. The difference is because of the increase of Class 1 Protection Forest Reserve in Sabah. Plus, the study also indicates the direction of Danum Valley development from the year 2010 to 2018. The main focus of land use in Danum Valley is on conservation areas with minimal tourism activity and more emphasis on research and education. Therefore, this study can clearly show the direction of development and land use in Danum Valley, Sabah.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Borneo Institute for Indigenous Study (BorIIS), University Malaysia Sabah (UMS), for providing the financial support to conduct this research.

REFERENCES

Abdul Latip, N., Badarulzaman, N., Marzuki, A., & Umar, M. U. (2013). SUSTAINABLE FOREST MANAGEMENT IN LOWER KINABATANGAN,

SABAH: ISSUES AND CURRENT PRACTICES. *PLANNING MALAYSIA*, 11(3). Retrieved from https://doi.org/10.21837/pm.v11i3.108

Abdul Latip, N., Jaafar, M., Marzuki, A., Roufechaei, K. M., & Umar, M. U. (2020). SPECTACLE OF CONSERVATION AND TOURISM IN PROTECTED AREAS: ANALYSIS OF MANAGEMENT, ISSUES AND TOURIST SATISFACTION. *PLANNING MALAYSIA*, 18(4). Retrieved from https://doi.org/10.21837/pm.v18i14.847

Andrew Young, David Boshier, & Timothy Boyle. (2000). *FOREST CONSERVATION GENETICS: Principles and Practice*. (A. Young, D. Boshier, & T. Boyle, Eds.) (1st ed., Vol. 1). CSIRO Publishing.

Briassoulis, H. (2019). Combating Land Degradation and Desertification: The Land-Use Planning Quandary. *Land*, 8(2), 27. Retrieved from https://doi.org/10.3390/land8020027

Chang K. T. (2008). *Introduction to geographic information systems* (5th ed., Vol. (Vol. 4).). Boston: McGraw-Hill.

Chapin, F. S. (1965). A MODEL FOR SIMULATING RESIDENTIAL DEVELOPMENT. *Journal of the American Institute of Planners*, 31(2), 120–125. Retrieved from https://doi.org/10.1080/01944366508978153

Dwivedi, R. S., Sreenivas, K., & Ramana, K. v. (2005). Cover: Land-use/land-cover change analysis in part of Ethiopia using Landsat Thematic Mapper data. *International Journal of Remote Sensing*, 26(7), 1285–1287. Retrieved from https://doi.org/10.1080/01431160512331337763

Forest (Danum Valley Conservation Area) Rules. Forest Enactment 1968 (No. 2 of 1968), Forest (Danum Valley Conservation Area) Rules 1996 (1996).

Forest Enactment. Forest Enactment, 1968 (Sabah No. 2 of 1968) (1968).

Fresco, L. O. (1994). Imaginable futures: a contribution to thinking about land use planning. In The future of the land. In *The future of the land* (pp. 1–8). John Wiley and Sons.

Hu, T., Yang, J., Li, X., & Gong, P. (2016). Mapping Urban Land Use by Using Landsat Images and Open Social Data. *Remote Sensing*, 8(2), 151. Retrieved from https://doi.org/10.3390/rs8020151

Hu, Z-L, Du, P-J, & Guo D-Z. (2007). Analysis of Urban Expansion and Driving Forces in Xuzhou City Based on Remote Sensing. *Journal of China University of Mining & Technology*, 17(2), 267–270.

Keenan, R. J., Reams, G. A., Achard, F., de Freitas, J. v., Grainger, A., & Lindquist, E. (2015). Dynamics of global forest area: Results from the FAO Global Forest Resources Assessment 2015. *Forest Ecology and Management*, 352, 9–20. Retrieved from https://doi.org/10.1016/j.foreco.2015.06.014

Land Ordinance. Land Ordinance, 1968 (Sabah Cap. 68) (1968). Retrieved May 21, 2022 from https://sagc.sabah.gov.my/?q=en/content/land-ordinance-cap-68

Langemeyer, J., Gómez-Baggethun, E., Haase, D., Scheuer, S., & Elmqvist, T. (2016). Bridging the gap between ecosystem service assessments and land-use planning through Multi-Criteria Decision Analysis (MCDA). *Environmental Science & Policy*, 62, 45–56. Retrieved from https://doi.org/10.1016/j.envsci.2016.02.013

Mohd Noor, N., Abdullah, A., & Manzahani, M. N. H. (2013). LAND COVER CHANGE DETECTION ANALYSIS ON URBAN GREEN AREA LOSS USING GIS AND REMOTE SENSING TECHNIQUES. *PLANNING MALAYSIA*, 11. Retrieved from https://doi.org/10.21837/pm.v11i3.111

Narimah Samat, Rosmiyati Hasni, Yasin Abdalla, Eltayeb Elhadary, & Samer Radad. (2010). Evaluating Land Use Land Cover Changes in Seberang Perai, Malaysia Between 1990-2007. In *The Proceedings of the 4th International Conference on Built Environment in Developing countries*. George Town Penang Malaysia.

Pacione, M. (2005). Dubai. *Cities*, 22(3), 255–265.

Reynolds, G., Payne, J., Sinun, W., Mosigil, G., & Walsh, R. P. D. (2011). Changes in forest land use and management in Sabah, Malaysian Borneo, 1990–2010, with a focus on the Danum Valley region. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 366(1582), 3168–3176. Retrieved from https://doi.org/10.1098/rstb.2011.0154

Ryan, C. (2013). The difference between "land use" and "land cover".

Sabah Forest Department. (2021). Classification of Sabah Forest Reserves. Retrieved May 21, 2022, from https://www.data.gov.my/data/dataset/classification-of-sabah-s-forest-reserves

Town and Regional Planning Department Sabah. (2016). *Sabah Structure Plan 2033* (1st ed., Vol. 1). Town and Regional Planning Department Sabah. Retrieved May 22, 2022 from https://www.yumpu.com/en/document/read/61068183/ssp2033-english

Turner, B. L., & Meyer, W. B. (1994). *Global land-use and land-cover change: an overview. Changes in land use and land cover: a global perspective,* (3rd ed., Vol. 4(3)). Cambridge University Press. Retrieved May 13, 2022 from

Veldkamp, A., & Lambin, E. F. (2001). Predicting land-use change. *Agriculture, Ecosystems & Environment*, 85(1–3), 1–6. Retrieved from https://doi.org/10.1016/S0167-8809(01)00199-2

Wan Ibrahim, W. Y., & Muhamad Ludin, A. N. (2016). SPATIOTEMPORAL LAND USE AND LAND COVER CHANGE IN MAJOR RIVER BASINS IN COMPREHENSIVE DEVELOPMENT AREA. *PLANNING MALAYSIA*, (4). Retrieved from https://doi.org/10.21837/pm.v14i4.160

Received: 23rd September 2022. Accepted: 23rd November 2022