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RESEARCH ARTICLE

CHANGES IN LAND COVER OF THE MOUNT SIRIMAU PROTECTED GROUP, AMBON CITY MALUKU PROVINCE

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Abstract

Changes in land cover will always occur in forest areas either naturally or due to human intervention, changes for the better or damage. The Protected Forest Group Mount Sirimau is part of the Ambon City Protected Forest which was established in 1996, but there are still changes in land cover. The purpose of this study was to determine changes in the land cover before and after the establishment of the Protected Forest Group Mount Sirimau. The research method used is a descriptive research method that explains the results of the map overlay of land cover changes. Changes in the land cover before designation as protected forest (1990-1996) contained 4 (four) land cover classes of Primary Dryland Forest, Secondary Dryland Forest, Shrub Bush, and Shrub Dryland Agriculture. There are 7 (seven) land cover changes after designation as protected forest (2000-2019), namely Primary Dryland Forest, Secondary Dryland Forest, Shrub Bush, Savana, Dryland Agriculture Mixed with Shrubs, Dryland Agriculture and Settlements. Changes in land cover are strongly influenced by social, economic, cultural and political factors, so there must be synergy from the bottom up and top down for socialization and affirmation of forest functions and their use by applicable regulation. The nearby study analyses the solid waste management in Tamil Nadu. Solid waste comprised all the wastes arising from human and animal activities that are normally solid and that are discarded useless or unwanted. The increasing difficulty in managing wastes in different states in Tamil Nadu. On the basis of the results, it was recommended to increase public awareness through enlightenment campaign against danger of indiscriminate dumping of wastes as they affect human health.

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Introduction:-

Land cover is related to the types of features that exist on the earth's surface (Lillesland & Kjefer, 1979), the physical (visual) manifestations of vegetation, natural objects, and cultural elements that exist on the earth's surface without paying attention to human activities towards these objects (Townshend & Justice, 1981), the surface of the earth partly consists of natural features (land cover), for example, among others; vegetation, snow

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(Barrett & Curtis, 1982). Land cover is a significant problem in geographic analysis from physical geographic investigations to environmental inspection and spatial planning (Rujoiu-Mare and Mihai, 2016). Land cover is a parameter that is easy to detect because it reflects interactions between human socio-economic activities and regional ecological responses, it can be used to represent ecosystem services and livelihood support (Costa et al., 2017; Gilani et al., 2014; Kiswanto et al., 2018). Changes in land cover are also inseparable from changes in land use because they will affect the nature of the soil which will also affect the growing vegetation. Changes in land use pattern can affect the inputs and output of nutrients in soil system thus can influence available nutrients and soil physical quality (George, et al., 2013).

Land cover change is a change that occurs in the description of objects on the earth's surface obtained from selected data sources and grouped into classes of cover according to their needs (Forestry Planning Agency, 2004). Changes in land cover can occur naturally or due to human intervention. The practice of shifting cultivation involves slashing the land cover and burning the vegetation to clear the lands for subsistence agriculture (Cornelio & Bk, 2011). Human intervention occurs because the community around the forest area existed before the designation of the forest according to its function.

Land cover change reveals the effects of natural and human processes (Soffianian & Madanian, 2015) and affects local and regional climate, carbon, water, and biodiversity, which are major components of environmental change (Adhikari et al., 2017; Grimm et al., 2008; Turner et al., 2007; Yuet al., 2016).

One of the forest areas with a protected function, such as the Sirimau Mountain Forest Group, needs to know the condition of its closure to support its function as a support for human life. The protected forest is a forest area that has the main function of protecting life support systems to regulate water management, prevent flooding, control erosion, prevent seawater intrusion and maintain soil fertility (Law on Forestry No. 41/1999). Protected forest on Ambon Island consists of four forest groups, namely the Leihitu Forest Group and the Salahutu Forest Group covering an area of 13,750 ha which was stipulated by the Decree of the Minister of Forestry No. 192/Kpts-II /1993. The Sirimau Mountain Forest Group covering an area of 3,449 ha and the Nona Mountain Forest Group covering an area of 877.78 ha were stipulated by the Decree of the Minister of Forestry Number 430/Kpts-II /1996 as Permanent Forest Areas with Protected Functions.

The focus of this research is on the Sirimau Mountain Forest Group, which is part of the Ambon City Protected Forest covering an area of 3,449 ha stipulated by the Minister of Forestry Decree Number 430/Kpts-II/1996 as a Permanent Forest Area with a Protected Function. The research focused on the Sirimau Mountain Forest Group which has a strategic position, being close to the centre of Ambon City which will affect office and economic activities if the protected forest does not function optimally.

Information about changes in the closure of protected forest in Ambon City since its establishment until now, is not yet available. Information on pattern and change of land use are crucial for the understanding of human activities in an area at a specific time period (Herwirawan, et al, 2017). Accurate, current, and long-term information on land cover is required for environmental studies, land management, appropriate development, change monitoring, carbon stock estimation and many other applications (Belward & Skøien, 2015); Chen et al., 2015; Congalton et al., 2014; Gómez et al., 2016; Huang et al., 2017; Jin et al., 2017; Xing et al., 2017). Detection of land cover change is necessary for a better understanding of landscape dynamics during a certain period in sustainable management (Rawat & Kumar, 2015). Therefore, this study was conducted to determine changes in the land cover before and after the determination of the Sirimau Mountain Forest Group as a Protected Forest Group in Ambon City, Maluku Province.

Materials and Methods :-

Research sites:-

The research location used as the location for the analysis of land cover change is the Mount Sirimau Protected Forest Group, Ambon City, Maluku Province, Indonesia. The location was chosen as the sample because it is a strategic location in the upstream part of the city, and there is a lot of population pressure.

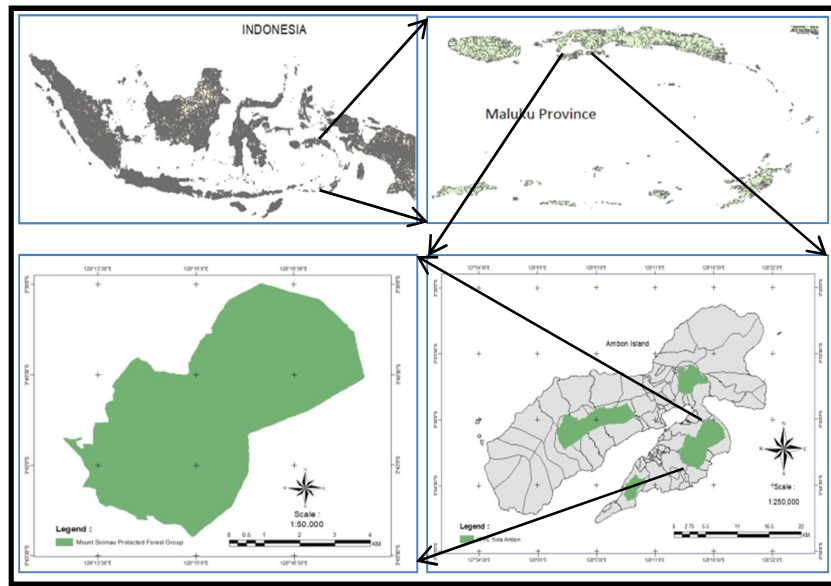


Figure 1:-Map of Research Locations for the Sirimau Mountain Forest Group, Ambon City, Province Maluku, Indonesia

Research Materials/Data:-

The research materials used in this research are:

- Map of Ambon City administration scale 1: 50,000
- Forest area function map Scale: 1: 50,000
- Forest land cover map Scale 1: 50,000
- Map of Protected Forest Management Units (KPHL) Ambon City Scale 1: 50,000

Analysis Method. Data processing flow as in Figure 2.

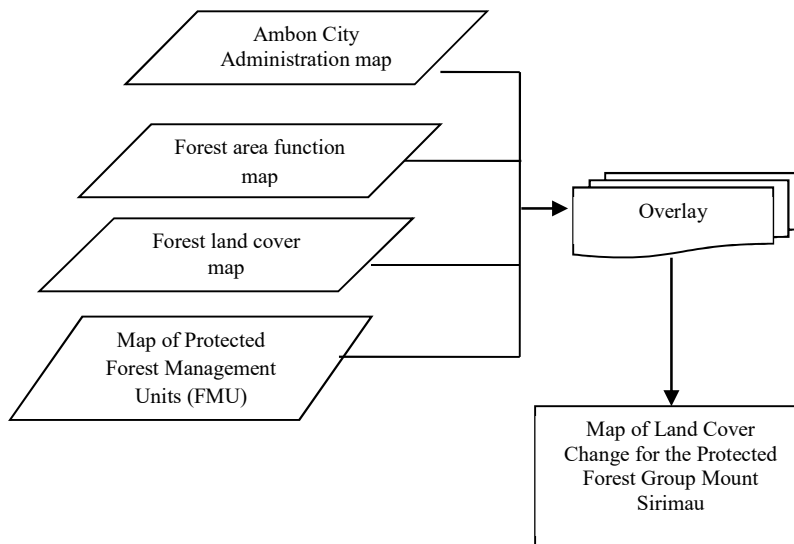


Figure 2:- Data processing flow.

The data analysis method used is descriptive method. The map output of the Protected Forest Group Mount Sirimau land cover map was analyzed descriptively based on the exported quantitative data from the Data Attribute Table to Excel.

Results and Discussion :-

The results of the analysis of land cover changes in 1990, 1996, 2000, 2006, 2011, 2015 and 2019 in the Protected Forest Group Mount Sirimau can be seen in Figure 3.

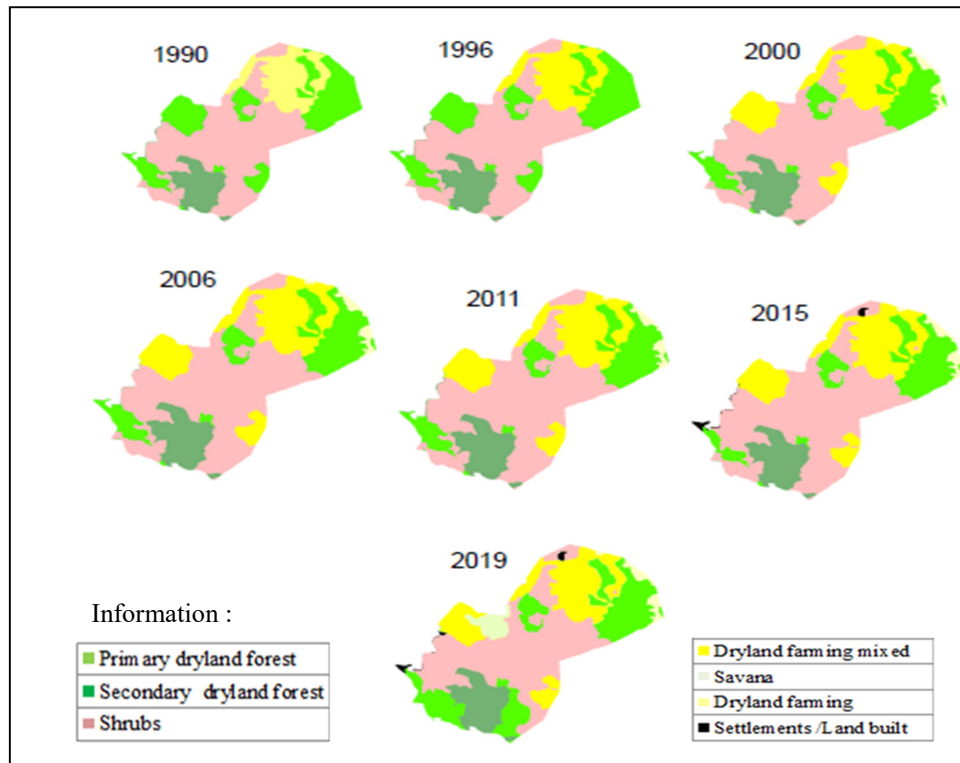


Figure 3 :- Changes in land cover in the Protected Forest Group Mount Sirimau Ambon City, Maluku Province, Indonesia

Changes in land cover up to 2019, there are 7 (seven) land cover classes with a description of land cover classes based on the Regulation of the Director General of Forestry Planning Number: P.1/VII-IPSDH/2015 concerning Guidelines for Monitoring Land Cover, (Director General of Forestry Planning, 2015). (Table 1)

Table 1:- Description of land cover classes based on the Director General of Forestry Planning Regulation Number: P.1 / VII-IPSDH / 2015 concerning Guidelines for onitoring Land Cover.

No	Class	Description
1	Primary dryland forest	All features of lowland, hilly and mountainous forests (highlands and subalpine) that have not shown logged-over, including card forest, clamps forest, forest on kapos rock, forest on ultra-alkaline rocks, needle leaf forest, deciduous forest, and forest moss
2	Secondary dryland forest	All features of lowland, hilly and mountainous forest that have seen logged-over (grooves and cutting marks) include dwarf forest, shell forest, forest on limestone, forest on an ultra-alkaline rock, needle leaf forest, deciduous forest, and forest moss. Slash-and-burn forest areas that are left behind, burnt, or that have grown back from degraded land are also included in this class. Severe logged areas are not Industrial forest areas, plantations, or agriculture, including savanna, scrub, or open land.

No	Class	Description
3	Shrubs	Areas of former dryland forests that have grown back or areas with sparse tree cover (natural) or areas dominated by low vegetation (natural). This area usually doesn't show any log marks anymore
4	Dryland farming mixed with shrubs	All types of dryland agriculture were intermittent with scrub, scrub, and logged-over forests. Often appears in shifting cultivation areas, and karst planting locations. This class also includes a mixed garden class
5	Savana	The non-natural appearance of a forest is grass, sometimes with few shrubs or trees. This appearance is natural in parts of Southeast Sulawesi, East Nusa Tenggara, and southern parts of Papua. This appearance can occur on dry land or swamp (swamp grass)
6	Dryland farming	All agricultural activities on dry land such as moor, mixed culture, and fields
7	Settlements /Land built	Residential areas, both urban, rural, industrial, and others that show a tight flow pattern.

Source : Director General of Forestry Planning, 2015

The area of land cover change can be seen in Table 2 and the fluctuation of the change can be seen in Table 2 and Figure 3.

Table 2:- Changes in land cover in 1990, 1996, 2000, 2006, 2011, 2015 and 2019.

Land Cover	1990		1996		2000		2006	
	Large	(%)	Large	(%)	Large	(%)	Large	(%)
Primary dryland forest	322,99	9,97	322,99	9,97	318,89	9,84	322,35	9,95
Secondary dryland forest	871,65	26,90	871,87	26,91	569,92	17,59	572,22	17,66
Shrubs	1.555,54	48,01	1.554,99	48,00	1.560,98	48,18	1.558,42	48,10
Dryland farming mixed with shrubs	489,56	15,11	489,89	15,12	730,99	22,56	730,94	22,56
Savana	0	0,00	0	0,00	0	0,00	0	0,00
Dryland farming	0	0,00	0	0,00	58,96	1,82	55,81	1,72
Settlements /Land built	0	0,00	0	0,00	0	0,00	0	0,00
Amount	3.239,74*	100,00	3.239,74*	100,00	3.239,74*	100,00	3.239,74*	100,00

Table 2:-Change in land cover year 1990, 1996, 2000, 2006, 2011, 2015 and 2019.

Land Cover	2011		2015		2019	
	Large	(%)	Large	(%)	Large	(%)
Primary dryland forest	319,26	9,85	319,26	9,85	310,92	9,60
Secondary dryland forest	570,67	17,61	532,64	16,44	737,62	22,77
Shrubs	1.559,46	48,14	1.583,73	48,88	1.310,43	40,45
Dryland farming mixed with shrubs	732,89	22,62	731,44	22,58	683,33	21,09
Savana	0	0,00	0	0,00	120,06	3,71
Dryland farming	57,46	1,77	57,46	1,77	57,46	1,77
Settlements /Land built	0	0,00	15,21	0,47	19,92	0,61
Jumlah	3.239,74*	100,00	3.239,74*	100,00	3.239,74*	100,00

Source: Spatial analysis, 2020.

Information : Decree of the Minister of Forestry No. 430/Kpts-II/1996 as a Forest Area Stay with Protect Function (3.449 ha).

* Digitized results (BPKH Maluku & North Maluku Region, 2010)

The land cover classes in 1990, 1996, 2000 consist of Primary Dryland Forest, Secondary Dryland Forest, and Scrub Bush. In 2000, 2006, 2011, 2015, and 2019 there was a land cover class, namely Dry Land Agriculture. Residential land cover classes exist in 2015 and 2019 and savanna in 2019. So that by 2019 there are 7 (seven) land cover classes in the Protected Forest Group Mount Sirimau. The broadest land cover class was scrub with a change in cover of 48.01% (1990); 48.00% (1996); 48.18% (2000) 48.10% (2006); 48.14% (2011); 48.48% (2015); 40.45% (2019). Secondary Dryland Forest cover class from 1990 - 2019 percentage of area for each period of the year

26.90% (1990); 26.91% (1996); 17.59% (2000); 17.66% (2006); 17.61% (2011); 16.44% (2015); 22.77% (2019). Cover class of dry land mixed with bushes with an area percentage of 15.11% (1996); 15.12% (1996); 22, 56% (2000, 2006 and 2011); 22.58% (2015) and 21.09 (2019). Cover class of dryland agriculture in 2000 with an area percentage of 1.82% (2000); 1.72% (2006); 1.77% (2011, 2015 and 2019). Savana land cover class with an area percentage of 3.71% (2019). Percentage of settlement area 0.47% (2015) and 0.61% (2019). The appearance and fluctuation of land cover change can be seen in Figures 3 and 4.

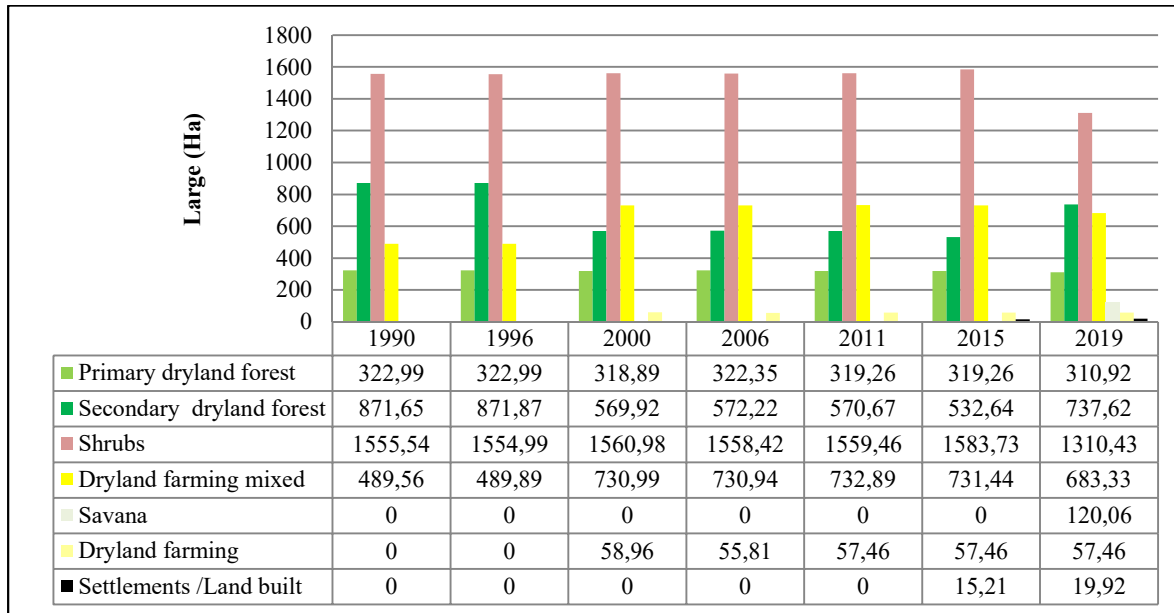


Figure 4:- Graph of Changes in Land Cover of the Protected Forest Group Mount Sirimau

Land cover with initial conditions in 1990 before the establishment of the Protected Forest Group Mount Sirimau in 1996 and 2000 there was dry land agriculture, Savana and even settlements in 2015. Changes in fluctuating vegetation cover due to fire and encroachment by the community due to agriculture dry land and dryland farming mixed with shrubs, there are even settlements. The existence of settlements due to the sale of land for settlement by the community who claim it as their customary right and the local government policy to relocate the community due to social conflicts. The main factors that influence land cover change are population growth, socio-economic conditions, the direction of local government policies (Lidiawati et al., 2019). The land cover will change as a result of fire, logging, shifting cultivation, from forest conditions with original and natural climax vegetation to damaged which will often be replaced by reeds (Pudjiharta, 2008; Maulana & Darmawan, 2014). The community has already made use of forest resources according to their function before the stipulation. Many communities around the forest meet their daily needs such as food, clothing and building materials from inside the forest area (Putiksari et al., 2014). These practices are often invisible to the state, outside state control and/or simply ignored (Scott, 1998; Soriaga and Walpole, 2006; Moeliono et al., 2017). At the same time, people can choose to be on the edge of the forest (or fringes) to avoid State controls such as tax administration or land tenure (Scott, 2009; Moeliono et al., 2017). As the state claims rights and control over forests, people in remote forest areas continue to practice traditional ways of using forests and land (Arnold, 2001; Moeliono et al., 2017).

Besides, the increasingly tight economic conditions have triggered the conversion of forest land to agricultural land or other land uses; In fact, the most common alternative source of income for forest communities is through resource extraction from within the forest area (Scricciu, 2006; Prasetyo et al., 2009; Lindström et al., 2012). These socio-economic conditions and situations have led to a reduction in forest area and forest degradation which is then exacerbated by forest encroachment, forest fires and other destructive (destructive) activities (Dwipayanti et al., 2009). Encroachment occurs due to communities around the area claiming forest land areas to be privately owned (BTNWKS, 2008; Maulana & Darmawan, 2014). This also happened to the Protected Forest Group Mount Sirimau. The community has used its land from generation to generation because it claims to be customary

territory (ulayat rights). The people around the Protected Forest Group Mount Sirimau claim that the protected forest is their customary territory (ulayat rights), so they are active in the protected forest, and some even sell land for settlement.

The land cover class of dry land mixed with shrubs and dryland agriculture indicates the use of protected areas for cultivation, indicating that there has been population pressure on protected areas to meet or maintain the survival of communities around protected areas (Istanto et al., 2018). If this condition is not controlled, it will reduce the function of protected areas (Istanto et al., 2018). Meanwhile, the use of protected forests is only the use of environmental services, as in Government Regulation Number 3 of 2008 concerning amendments to Government Regulation Number 6 of 2007 that the utilization of environmental services in protected forests as referred to in Article 23 paragraph (1) letter b is carried out, among others, through business activities. : a. utilization of water flow; b. water utilization; c. natural tourism; d. biodiversity protection; e. rescue and environmental protection; or f. carbon sequestration and/or storage (Article 25 (1)). Furthermore, paragraph 2 states that the business activities for the use of environmental services in protected forests are carried out provided that they do not: a. reduce, change or eliminate its main function; b. changing landscapes; and c. destroy the balance of environmental elements (Article 25 (2)) (Government of the Republic of Indonesia, 2008). Meanwhile, the condition that occurs is the use of agricultural land and even settlements and forest fires, thereby reducing and changing the main functions and landscapes that may damage the balance of environmental elements. The ideal protection forest should have good vegetation to support the main function of the protected forest as a protection for life support systems to regulate water system and prevent flooding. Changes in land cover caused by human intervention indicate inconsistencies in implementing regulations on the use of protected forests. The dualism of government policies, which on the one hand seeks to protect protected areas and establishes rules to preserve them, but on the other hand opens the opportunity for these protected forest areas to be exploited (Ginoga et al., 2005).

Conclusions:-

The condition of land cover in the Protected Forest Group Mount Sirimau was dominated by Shrub Bush. Primary dryland forest tends to decline, while secondary dryland forest has increased in 2019, although in the previous year it tended to decrease and was less than in 1990. There were 7 (seven) land cover classes in the Protected Forest Group Mount Sirimau, namely Land Forest, Primary Dry, Secondary Dryland Forest, Shrub/Scrub, Shrub-Mixed Dryland Agriculture, Savana, Dryland Agriculture, Dryland Agriculture and Settlements. Changes in land cover in the Protected Forest Group Mount Sirimau have experienced significant degradation and deforestation.

Recommendation:-

Changes in land cover resulting from human intervention should not occur if there is confirmation and socialization of the rules that protected forests are only used for environmental services and protection of natural resources so that the main functions of protected forests can run well. Naturally, it can carry out intensive rehabilitation to reduce degradation and improve land cover. If a human intervention can be eliminated by socialization and affirmation of protected forest and its benefits and how it is managed to the community.

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References:-

1. Adhikari, S., Fik, T., & Dwivedi, P. (2017). Proximate Causes of Land-Use and Land-Cover Change in Bannerghatta National Park: A Spatial Statistical Model. *Forests*, 8(342), 1–23. <https://doi.org/10.3390/f8090342>
2. Arnold, J.E.M. (2001). *Forests and people: 25 years of community forestry*. Rome, Italy: Food and Agriculture Organizations of the United Nations. <http://www.fao.org/docrep/012/y2661e/y2661e00.pdf>
3. Balai Taman Nasional Way Kambas.2008. *BukuZonasi Taman Nasional Way Kambas*.Lampung.
4. Barrett, E.C. and Curtis, L. . (1982). Introduction to environmental remote sensing. In *Book Reviews: Vol.second* (Second, pp. 293–294). London: University of Pittsburgh.

5. Belward, A. S., & Skøien, J. O. (2015). Who launched what , when and why ; trends in global land-cover observation capacity from civilian earth observation satellites. *ISPRS Journal of Photogrammetry and Remote Sensing*, 103, 115–128. <https://doi.org/10.1016/j.isprsjprs.2014.03.009>
6. Chen, J., Chen, J., Liao, A., Cao, X., Chen, L., Chen, X., ... Mills, J. (2015). Global land cover mapping at 30 m resolution : A POK-based operational approach. *ISPRS Journal of Photogrammetry and Remote Sensing*, 103, 7–27. <https://doi.org/10.1016/j.isprsjprs.2014.09.002>
7. Congalton, R. G., Gu, J., Yadav, K., Thenkabail, P., & Ozdogan, M. (2014). Global Land Cover Mapping: A Review and Uncertainty Analysis. *Remote Sensing*, 6, 12071–12092. <https://doi.org/10.3390/rs61212070>
8. Costa, H., Foody, G. M., & Boyd, D. S. (2017). Remote Sensing of Environment Using mixed objects in the training of object-based image classifications. *Remote Sensing of Environment*, 190, 188–197. <https://doi.org/10.1016/j.rse.2016.12.017>
9. Cornelio, D. L., & Bk, R. R. (2011). Land Use Effects on Soil Erosion in the Lowland Humid Tropics of Papua New Guinea. *Jurnal Manajemen Hutan Tropika*, XVII(April), 17–23.
10. Direktur Jenderal Planologi Kehutanan. (2015). *Peraturan Direktur Jenderal Planologi Kehutanan Nomor : P.1/VII-IPSDH/2015 tentang Pedoman Pemantauan Penutupan Lahan*. Jakarta: Direktur Jenderal Planologi Kehutanan
11. Dwipayanti, U., Kastaman, R., & Asdak, C. (2009). Model Dinamika Sistem Kerusakan Hutan di Kecamatan Ciemas Kabupaten Sukabumi. *Prosiding Seminar Nasional Himpunan Informatika Pertanian*, pp. 978–979. Bogor: Institut Pertanian Bogor– Departemen Pertanian Republik Indonesia
12. Gilani, H., Lal, H., Murthy, M. S. R., Phuntso, P., Pradhan, S., Bajracharya, B., & Shrestha, B. (2014). Decadal land cover change dynamics in Bhutan. *Journal of Environmental Management*, 1–10. <https://doi.org/10.1016/j.jenvman.2014.02.014>
13. Ginoga, K., Lugina, M., & Djaenudin, D. (2005). Kajian Kebijakan Pengelolaan Hutan Lindung. *Jurnal Penelitian Sosial & Ekonomi*, 2(2), 203–232
14. Gómez, C., White, J. C., & Wulder, M. A. (2016). Optical remotely sensed time series data for land cover classification : A review. *ISPRS Journal of Photogrammetry and Remote Sensing*, 116, 55–72. <https://doi.org/10.1016/j.isprsjprs.2016.03.008> 0924-2716/Crown
15. Grimm, N. B., Faeth, S. H., Golubiewski, N. E., Redman, C. L., Wu, J., Bai, X., & Briggs, J. M. (2008). Global Change and the Ecology of Cities. *Science*, 319 (February), 756–760
17. George, N., Rao, R., Killur, B., & Cornelio, D. L. (2013). Land Use Conversion and Soil Properties in a Lowland Tropical Landscape of Papua New Guinea. *Jurnal Manajemen Hutan Tropika*, XIX(April), 39–45. <https://doi.org/10.7226/jtfm.19.1.39>
18. Herwirawan, F. X., Kusmana, C., & Suhendang, E. (2017). Changes in Land Use / Land Cover Patterns in Indonesia ' s Border and their Relation to Population and Poverty. *Jurnal Manajemen Hutan Tropika*, 23(August), 90–101. <https://doi.org/10.7226/jtfm.23.2.90>
19. Huang, H., Chen, Y., Clinton, N., Wang, J., Wang, X., Liu, C., ... Zhu, Z. (2017). Remote Sensing of Environment Mapping major land cover dynamics in Beijing using all Landsat images in Google Earth Engine. *Remote Sensing of Environment*, 1–11. <https://doi.org/10.1016/j.rse.2017.02.021>
20. Istanto, Kelik, Raharjo, I., & Zulkarnain, I. (2018). Aplikasi Sistem Informasi Geografis (SIG) untuk Analisis Tekanan Penduduk Terhadap Kawasan Lindung di Hulu Waduk Batutegei. *Prosiding Seminar Nasional Pembangunan Teknologi Pertanian, 08 Oktober*, 381–391
21. Jin, S., Yang, L., Zhu, Z., & Homer, C. (2017). A land cover change detection and classification protocol for updating Alaska NLCD 2001 to 2011. *Remote Sensing of Environment*, 195, 44–55. <https://doi.org/10.1016/j.rse.2017.04.021>
22. Karmini, Karyati, & Widiati, K. Y. (2020). The role of tropical abandoned land relative to ecological and economic aspects. *Forest and Society*, 4(April), 181–194. <https://doi.org/10.24259/fs.v4i1.8939>
23. Kiswanto, Tsuyuki, S., Mardiany, & Sumaryono. (2018). Completing yearly land cover maps for accurately describing annual changes of tropical landscapes. *Global Ecology and Conservation*, 13(2018 e00384), 1–12. <https://doi.org/10.1016/j.gecco.2018.e00384>
24. Lidiawati, I., Hasibuan, R. S., & Wijayanti, R. (2019). Perubahan Penutupan Lahan Kota Bogor. *TALENTA Conference Series*, 2(1). <https://doi.org/10.32734/anr.v2i1.572>
25. Lillesland, T. M. & Kjefer, R. W. (1979). Remote Sensing and Image Interpretation. In *Geological Magazine* (pp. 305–306). <https://doi.org/10.1017/S0016756800030636>
26. Lindström, S., Mattsson, E., & Nissanka, S. P. (2012). Forest cover change in Sri Lanka : The role of small scale farmers. *Applied Geography*, 34, 680–692. <https://doi.org/10.1016/j.apgeog.2012.04.011>

27. Maulana, D. A., & Darmawan, A. (2014). Perubahan Penutupan Lahan di Taman Nasional Way Kambas. *Jurnal Sylva Lestari*, 2(1), 87–94
28. Moeliono, M., Thuy, P. T., Bong, I. W., & Wong, G. Y. (2017). Social Forestry - why and for whom? A comparison of policies in Vietnam and Indonesia. *Forest and Society*, 1(November), 78–97. <https://doi.org/10.24259/fs.v1i2.2484>
29. Pemerintah Republik Indonesia. (2008). *Peraturan Pemerintah Republik Indonesia Nomor 3 tahun 2008 tentang Perubahan atas Peraturan Pemerintah Nomor 6 tahun 2007 tentang Tata Hutan dan Penyusunan Rencana Pengelolaan Hutan, serta Pemanfaatan Hutan*. Jakarta: Sekretaris Negara Republik Indonesia
30. Prasetyo, L. B., Kartodihardjo, H., Adiwibowo, S., Okarda, B., & Setiawan, Y. (2009). Spatial Model Approach on Deforestation of Java Island , Indonesia. *Jifs*, 6, 37–44
31. Pudjiharta, A. (2008). Pengaruh Pengelolaan Hutan pada Hidrologi. *Info Hutan*, V(2), 141–150
32. Rawat, J. S., & Kumar, M. (2015). Monitoring land use / cover change using remote sensing and GIS techniques : A case study of Hawalbagh block , district Almora , Uttarakhand , India. *The Egyptian Journal of Remote Sensing and Space Sciences*, 18(1), 77–84. <https://doi.org/10.1016/j.ejrs.2015.02.002>
33. Scrieciu, S. S. (2006). Can economic causes of tropical deforestation be identified at a global level ? *Ecological Economics*, 62, 603. <https://doi.org/10.1016/j.ecolecon.2006.07.028>
34. Scott, J.C. (2009). *The art of not being governed: An anarchist history of upland Southeast Asia*. Yale University Press
35. Scott, J.C. (1998). *Seeing Like a State. How Certain Schemes to Improve the Human Condition Have Failed*. Connecticut, USA: Yale University.
36. Soffianian, A., & Madanian, M. (2015). Monitoring land cover changes in Isfahan Province , Iran using Landsat satellite data. *Environ Monit Assess (2015)*, 187(543), 1–15. <https://doi.org/10.1007/s10661-015-4442-5>
37. Soriaga, R., & Walpole, P. (2006). Forests and Poverty Reduction: Opportunities in Asia-Pacific Region. Paper Presented during the Asia-Pacific Forestry Commission Pre-Session Workshop, 15 April 2006. Dehradun, India: Asia Forest Network. <http://www.asiaforestnetwork.org/pub/pub77.pdf>
38. Townshend, J., & Justice, C. (1981). Information extraction from remotely sensed data . *International Journal of Remote Sensing*, 2(4), 313–329. <https://doi.org/http://dx.doi.org/10.1080/01431168108948367>
39. Turner, B. L., Lambin, E. F., & Reenberg, A. (2007). The emergence of land change science for global environmental change and sustainability. *PNAS*, 105(128), 20690–20695. <https://doi.org/10.1073/pnas.0704119104>
40. Putiksari, V., Dahlan, E. N., & Prasetyo, L. B. (2014). Analisis Perubahan Penutupan Lahan dan Faktor Sosial Ekonomi Penyebab Deforestasi di Cagar Alam Kamojang. *Media Konservasi*, 19(2), 126–140
41. Xing, H., Meng, Y., Hou, D., Song, J., & Xu, H. (2017). Employing Crowdsourced Geographic Information to Classify Land Cover with Spatial Clustering and Topic Model. *Remote Sensing*, 9(602), 1–20. <https://doi.org/10.3390/rs9060602>
42. Yu, W., Zhou, W., Qian, Y., & Yan, J. (2016). A new approach for land cover classification and change analysis : Integrating backdating and an object-based method. *Remote Sensing of Environment*, 177, 37–47. <https://doi.org/10.1016/j.rse.2016.02.030>.