Socio-ecological forest landscape of Peleng Island, Central Sulawesi

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Abstract. Socio-ecological landscape is formed by human activities in the physical environment shows customary, familial, collectivity and capital structure for sustainability. There are 3 types of socio-ecological landscape based on altitude: local wisdom-based agricultural landscapes at altitude 0-100 MASL, traditional ecological knowledge-based agroforestry landscapes at altitude 101-600 MASL, and customary law-based forest landscapes at altitude 601-1000 MASL. This study documents sacred places protected by indigenous community, customary law relevancies, and the perception of forest tenure. Quantitative and qualitative methods result encroachment often found in agroforestry landscapes (altitudes of 100-600 MASL) where forest garden road wage mobilization from settlement to forest area and there is a dominance of private-owned garden within state forest areas.

Keywords: Socio-ecological, agroforestry, Peleng island

1. Introduction

Indonesia’s forest is one of the highest biodiversity ecosystems on earth and is home to 17% of birds, 16% of reptiles and amphibians, 12% of mammals and 10% of the world’s plants [1]. One island in Indonesia that has a high diversity is Sulawesi. Sulawesi has the characteristics of flora and fauna with unique composition [2] and nearly 15% of the species are endemic species [3]. Sub-montana and lowland forests in Sulawesi have high endemic fauna and flora (in various taxa) [4]. The World Wildlife Fund USA Organization identifies tropical forest systems in Sulawesi as examples of areas that have high ecosystem diversity and become one of the 200+ priority targets for conservation actions [5]. The study area itself is an endemic Bird Area that is worth to be guarded because there are various birds that only exist in the area became the target of hunting.

FWI [6] noted Indonesia’s deforestation ranged from 1.13 million ha/year in the 2009–2013 period. Deforestation in the study area can be found after the accessibility of forests. Access is defined as the ability to benefit including objects, people, institutions, and symbols [7]. Access to forests in addition to views from natural physical factors (altitude, slope, terrain), also seen from roads. The negative impacts of road construction in forests is the loss of forest areas because their development is within the forest itself [8]. In the period of 1999–2002, there was a logging event as a phenomenon of the impact of forest policy post-reform, makes Indonesia should struggle with social and ecological forest tragedy [9]. Riggs et al. [10] states that it is accustomed in Indonesia to overcome complex social and
environmental problems. The approach is made as landscape changes can increase or inhibit the vital role of forests in providing for human living needs and preserving biodiversity [11].

2. Method
Field study was conducted on March 25 to April 23, 2017 in Peleng Island forest area precisely in Buko, Banggai Islands Regency, Central Sulawesi (figure 1). This study was conducted in Buko District covering 7 villages: Okulo Potil Village, Tatendeng, Leme-Leme Land, Malanggong, Eben Hezer, Olusi and Peleng Lalomo. Seven villages were chosen because the main livelihoods of their people came from forest gardens and resources, while other villages in Kecamatan Buko were not studied, most of the people worked as fishermen. Secondary data obtained from the United Stated Geological Survey (USGS) website: landsat 5 imagery of 1997; Landsat 7 imagery 2001 and Landsat 7 imagery 2016. 1: 50000 Rupa Bumi Indonesia map from Badan Informasi Geospasial (Geospatial Information Agency) is also used to assist in administrative and topographic divisions. Primary data were obtained through mapping (Taman Kehati conservation area, fire location, area perceived by the community as “customary forest” and road network), interviews and FGDs.

This study used the Explanatory Mixed Methods [12]. Quantitative data was obtained from secondary data (data from related institutions) then the findings obtained from the quantitative analysis will be reinforced by qualitative data (interview and observation data) through qualitative descriptive analysis. The socio-ecological landscape will be mapped based on the topography and the dominant land cover types based on several steps Alfieri et al. [13]. Topography as physical factors were then combined with dominant land use maps to produce maps and directories of socio-ecological landscapes. The socio-ecological landscape was classified according to altitude and slope, the type of road, the most dominant type of land use, supporting factors (local wisdom, traditional ecological knowledge and customary law) and disturbances (human activities).

3. Results
The socio-ecological landscape is a view of space structure resulting from the interaction between human activity and physical environment (figure 2). Elevation is the analysis unit in this study based on the community settlement. The altitude is divided into 3: 0–100 MASL, 101–600 MASL, 601–1000 MASL. Coastal areas is dominated by agricultural land and settlement at 0-100 MASL. Based on the field survey, 600 MASL is the boundary of the existence of settlements in the forest. Physical landscape consists of altitude, slope, terrain and geomorphology. Altitude in the study area is between 0–1000.4 MASL (meter above sea level). Coastal areas are dominated by altitude 0-100 MASL where most settlements are parallel to the coastline. The further east, the higher the area would be. At altitude 101-600 MASL, height difference is increasingly visible. The area of height 601–1000 MASL is the widest area compared to other altitude areas. Areas with steep slopes are located in the central part of Buko District, which is 44 %, is the highest slope in the study area. The low slopes are found in the coastal areas and around the primary forests directly adjacent to Bulagi sub-district. Morphology is varied from flat to steep hilly. The form of steep hilly terrain often found at 100–600 MASL. Geomorphology in the study area consists of hills and solutional karst mountains; Hills and structural mountains structural fault rock group metamorh skesis-gnesis; napal rocks and intrusive hills of old volcanic rocks of diorite and granodiorite groups.

Communities in the study area are Sea-Sea tribes that meet the needs of their lives from forest and marine products. Communities on the coast tend to do more activities in the sea. They usually leave in the afternoon or evening to find fish, sea cucumbers and other marine animals to sell or consume themselves (personal communication with Yoris, 2017). They use motorized wooden boats and armed with simple equipment such as nets or spears to fish. People who works in the forest usually go to forest in the morning at 6 o’clock and return home after noon or even night. Equipment carried in the form of
Figure 1. Distribution of man-made structure in the sub-district of Buko (Source: Field survey data of man-made structures, 2017).

bois (basket of rattan) to bring agriculture products: bete (Banggai’s yam), banana, leaf; machete or peda to cut the plant, and the provision of food in the form of rice or boiled bete for lunch (personal communication with Yeni, 2017). Protection of forest resources by communities in the research area can be found in the presence of certain restrictions on areas considered ‘sensitive’. Strict retreats are carried out on landslide-prone areas and springs. In addition to springs, other protected areas are sacred areas. The sacred and surrounding peaks are protected from forest deconstruction actions such as tree felling and animal hunting.

Human activities can be indicated from land use. Land use along the coast is dominated by wetland forests. Approaching the settlement is private owned gardens planted with food and spices. Above the dominant land use settlements and gardens are farms within the forest area. Based on interviews, there are several forms of forest and forest product utilization by indigenous peoples: food and clothing, building materials for fuel houses, handicrafts, traditional medicines and income sources. Human activities in the utilization of forest resources can provide disturbance to the forest. Some forest disturbances found in the study area: semi-permanent buildings and settlements in forests, grazing, hunting, gathering. Forest product gathering area is further, as forest land has been converted into agroforestry land, the distance between settlements and forest is increasing. Hunting area changes because the wildlife becomes further extinct or simply living in primary forest. Road type is used to see the community access to forests in this case land access. The roads in the study area can be divided into three main classes, namely main collector roads; village roads and forest garden roads. Community access to forests is highly dependent on the existence of roads. The availability of roads both types of road and other types of roads can increase the intensity of the community to the forest.

In the period of 1997 to 2016, there was a decrease in the use of forest cover in the study area and the increasing use of settlement and agricultural land. This is because the results of modifications
by human activities such as clearing forest for farmland and migration. Human activities on harnessing forest resources can provide disturbance to forests. Some of the forest disturbances found in the study area including: semi-permanent buildings and settlements in forests, grazing, hunting, and gathering. High deforestation found in coastal areas and collector roads. Significant changes in land cover are also found in areas close to the settlements. While low deforestation can be seen in forest areas located in the mountains (altitude above 600 MASL) bordering Bulagi District. Primary forests have not changed much on the slope of the ramps, high altitude, and at a great distance from the settlements and roads. In contrast to the study of Southworth and Tucker [14] states that the primary forest is exist on steep slope. This primary forest area in study area is considered as customary forest that must be maintained by communities, make them to not dare to cut trees in this region.

3.1. Agriculture (Agriculture and mosaics) based on local wisdom
High access characteristics (main roads and village roads), including into women's and men's roaming spaces, and utilized by communities as horticultural crops, firewood, and semi-permanent buildings. The application of local wisdom in agriculture includes: the use of leguminous crops using burning remains to increase soil fertility as well as planting food crops. In agriculture, the practice of customary rituals has begun to dwindle like the provision of sacrificial animals, only a few communities still do so.

3.2. Agroforestry (other dominant natural land cover) based on traditional ecological knowledge
Access characteristic of this region is moderate. This area includes into women's and men's roaming spaces, semi-permanent building construction, landslide-prone areas and usually a fire-prone or burnt-out area. Community forest management is based on traditional ecological principles. The management of these forest gardens includes: restoration with local trees, new land clearing with management fire, ecological principles of planting, protection against landslide prone areas.
3.3. Forest based on customary law

Forests are used by communities for their livelihoods. The characteristics of these areas are low access (almost no roads), including into the male roaming spaces (including within the range of women but with intensity visited monthly or yearly), and utilized by the community as a place for gathering, semi-permanent building, hunting, and customary rituals. Forest landscapes are protected and managed based on adat beliefs. This indigenous belief is well preserved because in this landscape there are sacred sites of customary Law, certain customary rules are still adhered to by the people, especially for forest areas considered to be customary forests.

4. Conclusion

The type of socio-ecological landscape in the study area consists of local wisdom-based agricultural landscape at altitude 0–100 MASL, traditional ecological knowledge-based agroforestry landscape at altitude 101–600 MASL, and customary law-based forest landscape at altitude 601–1000 MASL. The socio-ecological landscape of the forest still has adat, kinship, collectivity and social capital for sustainability.

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References

[1] Sari A P, Butarbutar R N, Maulidya M and Rusmantoro W 2007 *Indonesia and Climate Change: Current Status and Policies* available at https://siteresources.worldbank.org/INTINDONESIA/Resources/Environment/ClimateChange_Full_EN.pdf
[2] Kessler M, Keßler P J A, Gradstein S R, Bach K, Schmull M and Pitopang R 2005 *Biodiversity and Conservation* 14 547-60
[3] Whitten A J, Mustafa M and Henderson G S 1987 *The Ecology of Sulawesi* (Yogyakarta: Gadjah Mada University Press)
[4] Armitage D R 2003 *Environ. Conserv.* 30 79-90
[5] Olson D M and Dinerstein E 1998 *Conserv. Biol.* 12 502-15
[6] FWI Februari 2015 *Intip Hutan* (Bogor: Forest Watch Indonesia) available at https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwjVmamtfjXI1AhWRiH0KHQCzCVEQFjAAegQIARAC&url=http%3A%2F%2Ffwi.or.id%2Fwp-content%2Fuploads%2F2015%2F03%2Fin tip_hutan HR.pdf&usg=AOvVaw1DU6U-F70BUgPgUYcKKgE
[7] Potocnik I 2003 *Ekologia* (Bratislava) 22 298-304
[8] Safitri M A, Muhsi M A, Muhajr M, Arizona Y, Sirait M and Santosa H 2011 *Menuju Kepastian dan Keadilan Tenurial Jakarta* available at http://epistema.or.id/wp-content/uploads/2015/07/Menuju_kepastian_dan_keadilan_tenurial-edisi_revisi.pdf
[9] Ribot J C and Peluso N L 2003 *Rural Sociology* 68 153-81
[10] Riggs R A, Sayer J, Margules C, Boedihartono A K, Langston J D and Sutanto H 2016 *Land Use Policy* 57 241-9
[11] Maginnis S and Jackson W 2003 The role of planted forests in forest landscape restoration In *UNFF Intersessional Experts Meeting on the Role of Planted Forests in Sustainable Forest Management New Zealand* pp. 87-99
[12] Ivankova N V, Creswell J W and Stick S L 2006 J. Field Methods 18 3-20
[13] Alfieri A, Clarke D, Havinga I and Weber J L 2011 Definitions of socio-ecological landscape unit, SELU classification and its policy application In Expert Meeting on Ecosystem Accounting Denmark (Copenhagen: European Environmental Agency) available at https://unstats.un.org/unsd/envaccounting/seearev/meetingMay2011/lod.htm
[14] Southworth J and Tucker C Mountain Study and Development 21 276-83