The Contribution of Forest Ecosystem Services Toward the Local Community Living Vicinity to The Forest Protected Area: The Case of Kawang Forest Reserve, Sabah Malaysia

Guptah VG Nair#, Andy Russel Mojiol, Kamlisa Uni Kamlun, Walter Lintangah

Faculty of Science and Natural Resources, University Malaysia Sabah, Jalan UMS 88400, Kota Kinabalu, Sabah, MALAYSIA.
Corresponding author. E-Mail: guptahnair61@gmail.com.

ABSTRACT Kawang Forest Reserve covered an area of 1,551 ha, located in the eastern part of Sabah, Malaysia. The Kawang forest was gazetted as a forest reserve since 1957 and was reclassified in 2014 from Class III (Domestic Forest) to Class I (Protected Forest). The reclassification of the forest area is an effort to preserve the main function of the area to sustain the immense amount of biodiversity of the protected area. Therefore, this study aims to evaluate the community perceptions' on the contributions of Kawang Forest Reserve to support their livelihood. The ecosystem services that are provided by the forest are categorized into three main services namely provisioning, regulating, and cultural services. The study was conducted using structural administered questionnaires in a Likert scale (scale of 1.00 – very low to 5.00 - very high) settings. Local community living vicinity to Kawang Forest Reserve were selected as the research respondents using convenient sampling. A total of 102 respondents were selected from villages located around the forest reserve namely, Tanaki, Mook, Tampasak, Kaiduan, Bisuang and Bolotikon to assess their perceptions on the forest ecosystem services contributing to their livelihood development. The regulating services based on soil fertility and erosion control shows the highest value with an average of 4.58 min score, followed by the provisioning services based on the 'source for clean water supply & filtration' sub-services with a min score of 4.48 and cultural services based on 'provides tourism area (interesting area, climbing, hiking and waterfall' with an average min score of 4.42. Hence, the conservation of Kawang Forest Reserve is vital to support the welfare of the local community residing within the protected area as well contributing to a more sustainable forest management by the decision makers.

KEYWORDS: Forest ecosystem services, local community, Kawang forest reserve, conservation.

Full Article - *Earth and Related Environmental Sciences*
Received 31 January 2018 **Revised** 26 February 2018 **Accepted** 3 March 2018 **Online** 28 March 2018

TRANSACTIONS ON SCIENCE AND TECHNOLOGY

INTRODUCTION

Ecosystem services are increasingly being encouraged as an approach of documenting human well-being, prudent ecosystem and evaluating the benefits derived from natural resources (Costanza *et al*., 1997; De Groot *et al*., 2002; Millenium Ecosystem Assessment, 2005). One of the basic categories of ecosystem services is the multitude of services that connect with human well-being. With the illustration of the issue, this scheme draws the distinction between three different categories of ecosystem services namely regulating services, provisioning services and cultural services (Benjamin Burkhard et al., 2014).

According to Pargan (2009), the total area of Sabah is 7,371 million ha and about 48.76% of the area is forest reserve consisting of Protection Forest, Commercial Forest, Domestic Forest, Amenity Forest, Mangrove Forest, Virgin Jungle Forest and Wildlife. While the rest is about 51.24% comprised of land use diversity. There are 7 classes of forests in Sabah based on their uses. Kawang Forest Reserve was reclassified into Class I (Protection Forest) in 2014.

The purpose of this study was to identify local communities' views of the importance and contribution of the forest to them, identifying the functions of the ecosystem services provided by the forest to the community and finally obtaining the perception of the local community regarding land use and the factors contributing to land use.

METHODOLOGY

Study Area

The study area is located in the Kawang Forest Reserve area in Papar area of 1,551 hectares gazetted as Domestic forest reserve (Class III) before being reclassified to Class I Forest in 2014. The area is located at 116° 01'- 116° 04 ' East Longitude and 05° 45'- 05° 47 'North latitude. This forest reserve also has a hilly terrain with an altitude of about 250-2000 ft. and the highest peak reaches 2010 ft. The type of land in the forest is from the Lokan and Crocker groups of the type of 'sandstone' and 'mudstone' (Husain, 2010).

The forest is also drained by several streams and its main river is the Tanaki River used by nearby villagers as water catchment areas. It has also become one of the places of tourism and recreation around Kota Kinabalu and Papar. Among the nearby settlements are Kaiduan village, Bisuang village and Bolotikun village. Data collection for the village area is divided into two parts (see Figure 1 below) namely the Kaiduan area (Kaiduan, Bisuang and Bolotikon villages) and the Mook area (i.e, Mook, Tampasak and Tanaki villages).

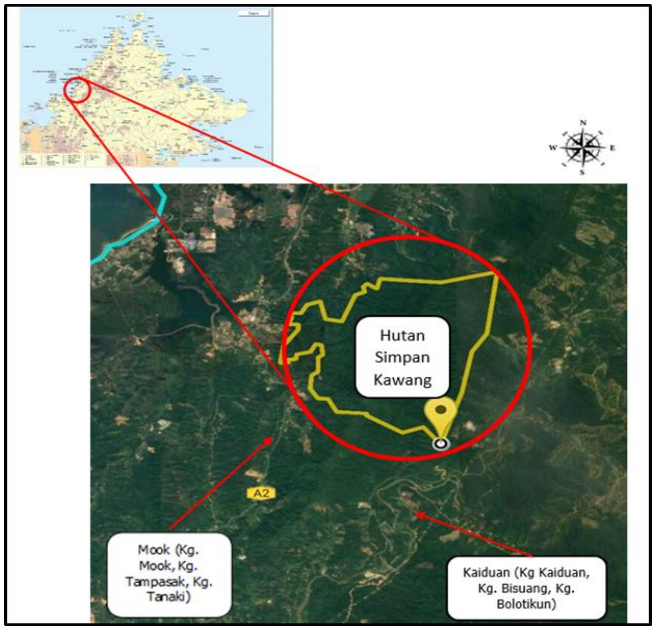

Figure 1. Map of Kawang Forest Reserve, Papar
(Source: Google Image and GPX Viewer 2017)

Sampling design

The research method uses convenient sampling method (Krippendorff, 2004). The study was conducted using a survey form and was carried out in January 2017 until June 2017. The questionnaires was distributed around the village of Kawang Forest Reserve in the Kaiduan area (i.e, Kaiduan, Bisuang and Bolotikun villages) and the Mook area (i.e consists of Mook, Tampasak and Tanaki villages).

The questionnaire consists of a set of section comprising three parts: the socio-demographic, the dependence and use of forest to the village and the functions of forest ecosystem services to the population. The use of Likert scale is a psychometric scale commonly involved in a study using a questionnaire. It is used extensively in monitoring and for scale responses in research studies. When, in relation to the responses of the selected types of Likert questionnaire form, the respondents are more specific in determining whether or not agreeing on the symmetry scale agree-disagree on each statement. A total of 100 respondents interviewed each member representing one home.

RESULTS AND DISCUSSION

Respondents' knowledge of forest ecosystem services in the study area is divided into three parts namely provisioning, regulating and cultural services. For the provisioning services, most of the respondents chose the forest as a source of filter and clean water supply and majority of the communities living vicinity of the Kawang Forest Reserve has been using the clean water channeled from the forest reserve. These result also supported by the provisioning services in regard to clean water research by Mojiol *et al.* (2017) in their study entitled "Visitors' Willingness To Pay (WTP) at Kionsom Recreation Centre, Kota Kinabalu Sabah". Table 1 shows the types of provision services in mean score where the source for clean water supply and filtration is 4.48 and the source of traditional medicines by the local community is 4.44. Meanwhile, the source of food from the forest is 4.12 and the source of raw materials (bark, fuel and others) is 4.30. The genetic source type (genetic tubes) is 4.04. In addition, the hydro power source is 2.49 which is very low. The type of decorative source (beauty and decoration) is 4.05. Studies by Mojiol *et al*. (2016) that most of the communities agreed and aware on the fact that activities such as cultivation and gathering of forest products and encroaching the forest reserve are strictly prohibited where amples of signboards was visible along the forest boundary.

Table 1. Provisioning Services

Optional answer	Very high	High	Moderate	Low	Very low	(Mean-Score)
• Source for clean water supply & filtration	72.55%	11.76%	8.82%	4.90%	1.96%	4.48
• Source ethno-medicines	69.61%	14.71%	8.82%	3.92%	2.94%	4.44
• Source of fuelwood & raw materials	65.69%	12.75%	11.76%	5.88%	3.92%	4.30
• Food resources	53.92%	16.67%	20.59%	4.90%	3.92%	4.12
• Source of beauty & decoration	51.96%	20.59%	16.67%	1.96%	8.82%	4.05
• Genetic resources (genetic pool)	53.92%	20.59%	10.78%	4.90%	9.80%	4.04
• Source energy (Hydro power)	18.63%	7.84%	18.63%	13.73%	41.18%	2.49

(Mean-score: 5 = Very high; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low)

Table 2 shows the types of regulating services related to the average (mean-score). Respondents chose very high for prevention of soil erosion and soil fertility by 4.58. The second is to stabilize the extreme weather (disaster and flood) by 4.52 and treated water and clean water 4.52. Regulating local climate and local air quality (heat and pollution) by 4.46 and regulates carbon sequestration by reducing carbon dioxide by 4.27. According to the statement (Blanco-Canqui & Lal,

2009) it supports that forest ecosystem that provides basic services such as soil erosion control, ecosystem stabilization, and climate simplicity and flux energy. Additionally, it helps to pollinate (insects and winds for important trees for pollination) and biological control (ecosystems regulate pests and diseases through predatory and parasitic activities), respectively 3.91. The decomposition of waste and detoxification (detoxification) was 3.88. Based on the study's findings, locals are less concerned with managing waste and detoxification, most of which use insecticides in controlling pests damaging their crops. Studies quoted from Thongsanit & Imkarajang (2015), smokes or haze from forest fires and dust fall especially during drought seasons with high concentration affect human health, the presence of the tree canopy help in filtering and absorb those particulates. Based on the study by Suardi et al. (2016) opined that carbon sequestration acting on forest reserved is the highest compared to monoculture plants or plantation forest.

Table 2. Regulating Services

Optional answer	Very high	High	Moderate	Low	Very low	(Mean-Score)
• Prevention of soil erosion and soil fertility.	76.47%	10.78%	8.82%	1.96%	1.96%	4.58
• Stabilize extreme weather (disasters and floods).	75.49%	8.82%	8.82%	5.88%	0.98%	4.52
• Treating water and clean air.	73.53%	12.75%	7.84%	3.92%	1.96%	4.52
• Regulating local climate and local air quality (heat and pollution).	72.55%	8.82%	13.73%	1.96%	2.94%	4.46
• Regulate and acting as carbon sequestration	68.63%	8.82%	11.76%	2.94%	7.84%	4.27
• Biological control; ecosystems control pests and diseases through predatory and parasitic activities.	49.02%	10.78%	28.43%	5.88%	5.88%	3.91
• Pollination; insects and winds for trees pollination.	47.06%	11.76%	31.37%	4.90%	4.90%	3.91
• The decomposition of toxic waste and decryption (detoxification).	50.98%	16.67%	14.71%	4.90%	12.75%	3.88

(Mean-score: 5 = Very high; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low)

For cultural services, respondents chose to provide tourist areas (attractive areas, climbing, hiking and waterfalls). According to the statement by Han *et al*. (2011) that the society living near to the forest area will participate more to the forest and had a more positive attitude towards tourism development. This shows that most of the respondents are the local communities around the forest reserve perimeter. Also, according to Cong *et al. (*2014), Lemelin & Smale (2006), and Tremblay (2008) the role of wildlife and flora in recreation and tourism have focused on wildlife as a major attraction in nature-based tourism destination.

Table 3 shows the types of cultural services related to the average (mean-score) i.e provides tourism area (interesting area, climbing, hiking and waterfall) is the highest scoring 4.42; provide education and learning areas (research, study and school visits) for 4.39, and provide recreational, mental and physical services to improve health (leisure, sports and relaxation) with 4.35. In addition, the type of to improve cultural, artistic and aesthetic value (inspirational sources) range at 3.90.

Meanwhile, the type of increasing spiritual, historical and approaches to the creator (religious and customs) is the lowest compared to others. Quoting from the study by Mojiol et al. (2017), practically undisturbed forest provides high attraction of tourism destination area and visitors are aware to the conservation fees imposed.

Table 3. Cultural Services

Optional answer	Very high	High	Moderate	Low	Very low	(Mean-Score)
• Provides tourism area (interesting area, climbing, hiking and waterfall).	70.59%	12.75%	8.82%	3.92%	3.92%	4.42
• Provide education and learning areas (research, study and school visits).	68.63%	9.80%	14.71%	5.88%	0.98%	4.39
• Provide recreational, mental and physical services to improve health (leisure, sports and relaxation).	65.69%	14.71%	12.75%	2.94%	3.92%	4.35
• Improve cultural, artistic and aesthetic value (inspirational sources).	50.00%	12.75%	24.51%	2.94%	9.80%	3.90
• Increase the spiritual, historical and approaches to the creator (religious and customs).	38.24%	20.59%	19.61%	5.88%	15.69%	3.60

(Mean-score: 5 = Very high; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low)

CONCLUSION

In conclusion, the objectives of this study have been achieved as it involves the local community's views on the importance and contribution of the forest to them. The forest ecosystem functions are divided into three important categories such as provisioning, regulating and cultural services. Most of the respondents understand in identifying their views on the importance and contribution of the forest to them. In general, some of them are still dependent on crop yields as well as the use of forest resources such as clean water supply. The Kawang Forest Reserve, Papar, Sabah and subsequently should be conserved and protected in order to sustain the forest for future generations.

ACKNOWLEDGEMENTS

We would like to thank the Sabah Forestry Department, Kota Kinabalu, the head of villages of Bisuang, Kaiduan, Tanaki, Mook, Bolotikon and Tampasak, and UMS undergraduates for cooperation and assisting in this research. We would also like thank the anonymous reviewers for this manuscript.

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