Can community-based forest management contribute to household income and mitigate land encroachment on Sabah forest reserve? a case study from Mangkuwagu Forest Reserve

Hardawati Yahya

International Tropical Forestry Program, Forestry Complex, Faculty of Science and Natural Resources, Universiti Malaysia Sabah, UMS Road, 88400 Kota Kinabalu, Sabah, Malaysia

E-mail: hardty@ums.edu.my

Abstract. Decades of forest management has shown that Community-Based Forest Management (CBFM) is the key viability. In such management, the local community is involved in the planning, site-preparation, monitoring, decision-making, and benefit-sharing. Although this seems to be a practical and respectful method for forest management, some problematic issues still arise. One of the much debated subjects include the contribution of CBFM to household income and land encroachment. Hence, this study aims to provide an in-depth discussion of this matter where part of the study’s goals is to determine whether CBFM contributes to household income. In addition, the current case study also seeks to evaluate the household perception on land encroachment in Mangkuwagu Forest Reserve. A mixed methodology based on the triangulation method was employed in this research, including household surveys, face-to-face interviews, and observations of the forest and farm land. The respondents were a random selection of 174 households. Overall, the findings demonstrated that households in Mangkuwagu Forest Reserve have benefited from CBFM through labour wage and the sale of non-wood forest products. It was also discovered that perceptions on land encroachment differ according to the household’s interest and need of the land. Based on the thorough analysis of the data, the local community generally has generally gained considerable benefits from CBFM. Nonetheless, other land issues on land should be acknowledged in future studies to optimise CBFM.

1. Introduction

Forest plays an essential role and is considered as a vital source of community livelihood to fulfill human’s daily needs. Hence, Community-Based Forest Management (CBFM) is one of strategies that is aimed at managing forest resources so as to sustain the economic and environmental aspects, as well as to improve the community livelihood. Contributions of the CBFM have been highlighted in various contexts of climate change adaptation [10, 25, 27, 37], community livelihood [2], ecosystem services [8, 35, 39], and forest management [6, 41]. These contributions can benefit both the government and local community [12]. CBFM has gained substantial attention in many of the tropical countries in the context of household income and land encroachment [9, 21, 27]. This is mainly due to its feasible positive contribution to enhance the local community livelihood and mitigate the land encroachment.

In rural areas, most of the people still depend on forest resources for their livelihood, income, and employment [20, 26]. They would use fuelwood, edible plants, wood, and medicinal plants from forests. Empirical studies reveal that the higher the dependency of households on forest resources, the greater
the participation in CBFM activities [16, 27, 31]. Therefore, not only do perceived benefits from the forest sustain the people’s daily needs, but they also increase their involvement in forest management activities. Moreover, the empirical evidence shows that poor households generate higher cash income from the forest to support their expenses compared to their wealthy counterparts [14]. However, the cash income earned from the forest resources or activities are relatively low compared to the agriculture income [15, 42].

In the context of community livelihood, CBFM can be employed as a strategy to improve the household income [31, 41]. This is because it has the capacity to increase the household’s monthly income and employment condition [15, 17]. In Sabah, Malaysia, the poverty rate among households are much higher compared to other states. Most households are landless, living in the remote area, casual employed, and have higher dependency on forest resources [28, 29, 55]. Following the introduction of CBFM, the income of households has shown some improvement [24, 42]. Despite the increment, empirical studies also discovered that the household income decreased after CBFM was adopted [22]. In the case of Sabah, the contribution of CBFM on the household income has yet been thoroughly examined. It is particularly true that CBFM can help to determine the economic impact on household income; however, due to the lack information on benefits and costs, the assessment could be rather complicated [7, 38].

Land encroachment has received much attention and discussion for a long time and it remains a relevant issue in many tropical countries. [44] defined that forest encroachment is an illegal activity that people do to cultivate the crops and build their settlement inside the forest land area. Limited land and unemployment have been identified as the key factors that cause the forest land encroachment [21]. Several studies [5, 43] highlighted the impact of land encroachment to CBFM and the community livelihood. Then, [49] suggested that transferring the land tenure to the community could help to overcome forest encroachment and strengthen the people’s involvement in forest management.

In Sabah, the CBFM was first introduced in 1984, with the objectives to mitigate forest land encroachment and increase community livelihood [46]. There are ten CBFM initiated by the Sabah Forestry Department, including Mangkuwagu Forest Reserve, Kelawat Forest Reserve, Gana-Lingkabau Forest Reserve, Bengkoka Forest Reserve, Deramakot Forest Reserve, and Tamparuli Forest Reserve. The classification of these forest reserves varies; some of the CBFM is under forest protection, production, and domestic forests. The public are not allowed to encroach the forest area even to plant cash crops or build houses. These restrictions are embodied under the forest enactment, where people are prohibited from withdrawing or harvesting forest products without the permission from the forestry department, except for their household needs and domestic purpose [53].

This paper aims to assess whether the CBFM can contribute to household income as well as determine the household’s perception on land encroachment in Mangkuwagu Forest Reserve. In the present study, the household income refers to the monthly income is earned by the household, for instance annual forest-based income, salaries or non-farm income. The monthly was later converted into annual income based on the household’s primary and secondary sources of income. Furthermore, the study attempts to assess the community’s perception on forest land encroachment in relation to their awareness background and changes effect based on based on their own perception.

2. Materials and Methods
2.1 Study area
This research was conducted in Mangkuwagu Forest Reserve, Sabah, which is specifically located in Tongod District in the central part of Sabah, Malaysia (figure 1). This area is one of the forest reserves that is managed under Community-Based Forest Management (CBFM) by the Sabah Forestry Department and villagers were involved in managing the forest resources. The forest area covers 8,335 hectare and is classified as Class II (Production Forest) under Forest Management Unit (FMU 17C) [46]. Therefore, forest harvesting is allowed in this forest reserve under a sustainable management. The forest reserve is surrounded by forests, oil palm plantation, and community settlement in which there are four
villages called Mangkuwagu, Saguon, Alitang, and Tampasak that are occupied by people of Sungai and Dusun ethnicity.

Figure 1. Location and view of Mangkuwagu Forest Reserve, Sabah, Malaysia

2.2. Data collection and sampling size
Households from four villages, namely Mangkuwagu, Saguon, Alitang, and Tampasak villages that settle inside the Mangkuwagu Forest Reserve were selected for the purpose of this research. There were approximately 174 households were chosen in this study including those households involved in Community-Based Forest Management (CBFM) and not involved in any forest management activity. This study utilised triangulation method that included household survey, face-to-face interview, and field observation to gather the data. Detailed information on their socio-economic status, involvement in CBFM, and perception towards land encroachment were collected using semi-structured questionnaire, which was modified based on the pilot test pre-testing questionnaire result, informal interview with the few villages, and consultation with the community forestry experts. The face-to-face interviews were conducted with informants, such as the head of the villages, village committee, women leader, and the forest officers in order to gain the relevant information regarding the villages’ background, the CBFM implementation, as well as to validate the information acquired from the survey.

Moreover, two sampling techniques were applied in selecting the households for this the survey. Firstly, households were selected using snow ball sampling, where the head of each villages was consulted to call upon the households to come to the hall to answer the survey. Snow ball sampling was employed during the initial phase of the survey to acknowledge the culture of the community, where the head of the village is responsible to call the households. Subsequently, after few weeks, the households were randomly selected based on the accessibility of the house location. This means houses that were closer to the road and easy to access were selected as respondents.

3. Results and Discussion
3.1. Socio-demographic of study area
The summary of the socio-demographic profile for four villages in Mangkuwagu Forest Reserve are presented in table 1. It is observed that, male respondents were higher than female counterparts. For instance, 78% of respondents were male compared to 22% of female respondents in Mangkuwagu Village. The average age of the households from these four village were between 46 to 50 years old with the family size of five to six people. A similar pattern was also reported in previous studies in which the
households’ average age was between 30 to 50 years old [34, 42]. The average size of the households’ farm ranged from 1.03 to 1.43 hectare, which included the rubber and fruit trees farm. In terms of their literacy status, majority of the households from these four villages were literate. For example, 89% of households from Alitang Village were literate compared to only 11% rate of illiteracy. Other comparable studies of the CBFM recorded that the households with higher literacy had participation in CBFM [33, 40].

Table 1. Summary of the households’ socio-demographic information (N=174).

| Villages   | Male     | Female | Age (years) | Family size (people) | Farm land size (hectare) | Literate | Illiterate* |
|------------|----------|--------|-------------|----------------------|-------------------------|----------|-------------|
| Mangkuwagu | 43 (78%) | 12 (22%) | 49          | 6                    | 1.39                    | 46 (84%) | 9 (16%)     |
| Saguon     | 22 (56%) | 17 (44%) | 46          | 6                    | 1.43                    | 28 (72%) | 11 (28%)    |
| Alitang    | 34 (77%) | 10 (23%) | 46          | 5                    | 1.03                    | 39 (89%) | 5 (11%)     |
| Tampasak   | 22 (61%) | 14 (39%) | 50          | 6                    | 1.14                    | 30 (83%) | 6 (17%)     |

Note: Age, family size, and farm land size are mean values. The other descriptive statistics of the variables are in number of households with the percentage in the parentheses.

* Illiterate refers those households who did not receive formal education.

3.2. Income of household

The terms of the households’ income, results showed that the average annual total income was between RM1,777 and RM3,437 per year (figure 2). The villages’ average annual total income was below the poverty line index based on the year 2014 (RM7,236 per year). It is important to highlight that Sabah was reported to have the highest poverty rate to other states in Malaysia due to the imbalance economic structure and infrastructure development [11, 30].

Based on figure 3, household generated 22% higher household income share from agriculture and non-farm self- employment respectively. Meanwhile, sources of income from the CBFM that included forest-based wage employment (12%), agroforestry (9%), and non-wood forest products income (1%) contributed smaller portions to the overall household income share. Even though the contribution of CBFM on household income was relatively low, the CBFM is still the significant and relevant to these households. For instance, forest-based wage employment created by the forestry department can lead to higher income generation and increased employment [17, 19] to the households and simultaneously provide knowledge, skills, and awareness to the community in relation to forest conservation [35, 51].

Figure 2. Average annual total household income based on four villages in Mangkuwagu Forest Reserve.
Figure 3. Source of income of the households in Mangkuwagu Forest Reserve.

3.3. The households’ perception towards income enhancement from community based-forest management

The descriptive statistics of the households’ perception on the changes and response rate of contribution of income from Community-Based Forest Management (CBFM) are summarised in Table 2. Results illustrate that most households from four villages in Mangkuwagu Forest Reserve mentioned that they have received a change in terms of contribution of income from the CBFM. For instance, 61% of Alitang and Tampasak households reported received to have obtained a positive change of their income from the CBFM. Thus, the contribution of the CBFM with regards to the household income should be highlighted as a significant strategy to mitigate the poverty [13, 17]. Even though it was argued that forest-based income contributed less pay to household [50], the CBFM is still vital as it can increase and complement other sources of income.

Additionally, households from these four villages were asked to provide their response rate on the contribution of income from the CBFM. It was recorded that approximately only 14% of households from Saguon and 9% of households from Mangkuwagu, claimed a positive response of income contribution from the CBFM. In addition, households from Tampasak (8%) and Alitang (6%) villages rated a positive response with regards to income contribution from the CBFM. This low positive response rate implies that households are still not totally satisfied with the role of CBFM in increasing their income. Low response rates also supported the villager’s statement with the mean value ranged from 2.02 to 2.39. Most households in Mangkuwagu Forest Reserve have a difficulty to solely depend on forest-based income due to regulation that restricted their consumption of forest products, as well as the relatively low forest-based wage that they received from CBFM activities (e.g site-preparation, replanting, and trees maintenance). Under Sabah forest enactment, households are not allowed to cut and sell forest products, especially timber such that they are only permitted to withdraw non-timber forest products for personal consumption. Therefore, promoting non-wood forest products in the CBFM can help to increase the household income and management of the resources, as well as generating employment [1, 23]. Also, results revealed that there were no significant differences between the villages with regards to the response rate on the perception of income contribution from CBFM with $X^2(3) = 4.846, p = 0.183$.

3.4. Perception on level of awareness to mitigate land encroachment after community-based forest management.

It is generally acknowledged that forest land encroachment is one of the major challenges in Community-Based Forest Management (CBFM). Sabah Forestry Department has granted a higher priority to the issue of encroachment into the forest reserve area by strengthen the policy and reduce the
destruction of forest resources. In Sabah, the forestry department took the initiative to involve the community in CBFM, as it has been found that the community involvement can decrease land encroachment and conserve the forest resources [45].

Table 2. Households’ perception on the changes and response rate of contribution of income from CBFM.

| Village   | Changes (%) | Positive response (%) | Mean response rate | $X^2$ | $df$ | $p$ |
|-----------|-------------|-----------------------|--------------------|-------|------|-----|
| Mangkuwagu| 53          | No 47                 | 2.02               |       |      |     |
| Saguon    | 56          | No 44                 | 2.33               | 4.846 | 3    | 0.183 |
| Alitang   | 61          | No 39                 | 2.39               |       |      |     |
| Tampasak  | 61          | No 39                 | 2.17               |       |      |     |

Note: The response rates ranged from 1(low) to 5(high).

There were no significant differences found in Kruskal Wallis test on the response rates between the villages.

The present study revealed that majority of the households possessed positive awareness to stop forest land encroachment. The households rated at somewhat high level on the awareness of land encroachment mitigation from all income categories (Figure 4). Nevertheless, the households from the level income category RM3,001 to RM6,000) rated that they have low level on the awareness to stop land encroachment. However, most households that claimed having awareness of land encroachment, gave somewhat low to high levels on forest land mitigation. This situation might be influenced by their perception that the local community should not be blamed for causing the forest land encroachment. These people believe that the forest land is overlapping with their traditional land, therefore, granting them rights to own the land. However, the status of the traditional land cannot be approved by the government because they do not have legal documents to support the claim. Overlapping land tenure between traditional community and forest land can create more conflicts [48]. Thus, the recognition of the customary or traditional land should be given better perspectives to the community, and the government to support their right could decrease the land encroachment [36, 48, 56].

Furthermore, this study found that there were encroachment activities happening inside the forest land, where households opened the forest land to plant rubber and fruit trees (Figure 5). This implies that even though households that were selected to participate in the CBFM received one-hectare land by the forestry department for rubber trees planting (only in CBFM zone land), forest land encroachment still continued. Based on the results, all household income groups demonstrated tendency to encroach the forest land. Interestingly, none of the households that did not plant rubber and fruit trees had opened the forest land. Most households that not involved in planting plant rubber trees were not participants in the CBFM; thus, they not received the forest-based income. However, those household who are participant in CBFM also illegally open the forest land to plant rubber and fruit trees. Moreover, findings revealed that fruit trees planting was more likely attract the households to open the forest land illegally. Forest land encroachment done by households could be influenced by the fact that the farm that they used for planting the fruit trees has been opened since their ancestors’ time. Therefore, they considered the farm that was located inside the forest reserve (outside the CBFM zone land) as their own traditional land. Based on Sabah customary land law, if the land has more than 50 individual trees and it was opened by their ancestors, they could have the rights to that particular land [18, 53]. Moreover, [28] supported that there is a huge number of indigenous communities in Sabah that still live in highlands areas including the forest land, have no land title and that they only depend on the customary tenure or adat system to manage their traditional land. In addition, rubber and fruit trees are considered as forest trees and highly selected as replanting tree species. Therefore, these tree species are allowed to be planted inside the forest reserve.
Figure 4. Households’ perception on the awareness to stop forest land encroachment based on income categories.

Figure 5. Location of rubber and fruit trees farm in Mangkuwagu Forest Reserve based on household income categories.

Note: Farming inside the forest land is considered as land encroachment.

There were several variables that could influence households’ tendency to encroach the forest land area (table 3). Findings indicated that two variables including the size of fruit trees ($r_s = -0.805$) and its distance from the house ($r_s = -0.818$) had a high significant correlation coefficient with households that participated in the forest land encroachment activities. Besides, other variables including secondary occupation ($r_s = -0.168$) and age group ($r_s = -0.271$) showed low significant correlation with the land encroachment. Furthermore, the community prefer to choose the area for settlement where the can have more access to the land and other facilities [28]. Accordingly, the forest land is the perfect choice for people to access more land. The finding also supported the statement where the size of agriculture and farm lands were also the reasons for households to open the forest land [3,4]. People need more land to plant the crops in order to support their daily needs and subsistence. Other reason that influence people to do forest encroachment include the fact they have income, big family size, occupation issue, and less land holding [21].
Table 3. Correlation coefficient between encroachment and socio-demographic variables.

| Variables            | Encroachment | Secondary Occupation | Age Group | Rubber trees farm size | Fruit trees farm size | Rubber trees farm distance | Fruit trees farm distance |
|----------------------|--------------|----------------------|-----------|------------------------|-----------------------|---------------------------|--------------------------|
| Encroachment          | 1.000        |                      |           |                        |                       |                           |                          |
| Secondary Occupation | -0.168*      | 1.000                |           |                        |                       |                           |                          |
| Age group            | -0.271**     | -0.079               | 1.000     |                        |                       |                           |                          |
| Rubber trees farm size | -0.09       | -0.003               | 0.300**   | 1.000                  |                       |                           |                          |
| Fruit trees farm size | -0.805**    | 0.198**              | 0.308**   | 0.129                  | 1.000                 |                           |                          |
| Rubber trees farm distance | -0.084     | -0.017               | 0.260**   | 0.936**                | 0.118                 | 1.000                     |                          |
| Fruit trees farm distance | -0.818**    | 0.148                | 0.202**   | 0.088                  | 0.870**               | 0.104                     | 1.000                    |

4. Conclusion

Community-Based Forest Management (CBFM) is becoming an alternative strategy for many tropical countries to overcome serious issues of forest land encroachment and poverty. This study has reflected on the CBFM’s contributions in increasing the household income and mitigating the forest land encroachment at Mangkuwagu Forest Reserve, Sabah. Empirical findings have recorded that CBFM had a significant contribution in increasing the household income, even though the sharing proportion to the income was low (12% income share from forest-based wage). Furthermore, the households that were selected for the purpose of the study now have the awareness to stop forest land encroachment, which they think is relevant for themselves and younger generations. However, forest land encroachment in Mangkuwagu Forest Reserve still persists due to the traditional land issue and the need to have plant more fruit trees. An important contribution of this paper has been highlighted where the question either the CBFM can contribute to the household income and mitigate the forest land encroachment has been taken into consideration. First, the CBFM can help to increase the household income through the forest-based income, agroforestry, and forest products. Secondly, the awareness to mitigate forest encroachment does exist among the households, despite still doing encroachment. In this regard, it is crucial to note that rubber and fruit trees planting activities inside the forest reserve occur illegally due to the limitation of the farm land size and the location of the farm land which is close to their house. Overlapping of the households’ traditional land, which was inherited from ancestors (referring only to those who do not have legal documents) with the forest land could also influence the forest land encroachment practice. An effective land conflict management mechanism should be employed to ensure the land conflict between the community and the forestry department can be solved so that it can bring about positive impacts for both parties. The community involvement in CBFM activity should be continued in order to strengthen the relationship and cooperation to conserve the forest reserve.

5. References

[1] Abdelrahim M 2015 Inter. J. Agri. For. Fisheries Contribution of non-wood forest products in support of livelihoods of rural people living in the area south of Blue Nile State, Sudan 3 pp 189-194

[2] Adhikari B Williams F and Lovett J C 2007 For. Policy. Econ. Local benefits from community forests in the middle hills of Nepal 9 (5) pp 464-478
[3] Agbeja B O Otesile A A 2011 *For. For. Products. J*. Conflicts and forest land-use: a case study of forest reserves in Ogun State, Nigeria 4 pp 61-74

[4] Angelsen A 2009 *PNAS* Policies for reduced deforestation and their impact on agricultural production 46 pp 19639-19644

[5] Anup K C 2017 *Global Exposition Wildlife Manag.* Community forestry management and its role in biodiversity conservation in Nepal 4 pp 51-72

[6] Basnyat B Treue T Pokharel R K Lamsal L N and Rayamajhi S 2018 *For. Policy. Econ.* Legal-sounding bureaucratic re-centralisation of community forestry in Nepal 91 5-18

[7] Bhattarai R C 2011 *Econ. J. Dev. Issues* Economic impact of community forestry in Nepal: a case from Mid-Hill Districts of Nepal 13 (1) 75-96

[8] Birch J C, Thapa I, Balmford A, Bradbury R B, Brown C, Butchart S H M, Gurung H, Hughes F M R, Mulligan, M, Pandeya B, Peh K S -H, Stattersfield, A J, Walpole M, and Thomas D H *Ecol. Serv.* What benefits do community forests provide, and to whom? A rapid assessment of ecosystem services from a Himalayan forest, Nepal 8 pp118-127

[9] Blackman A Corral L Lima E S and Asner G P 2017 *PNAS* Titling indigenous communities protects forests in the Peruvian Amazon 114 pp 4124-4128

[10] Bluffstone R A Somanathan E Jha P Luintel H Bista R Thomas A and Asner G P 2017 *World Dev.* Does collective action sequester carbon? Evidence from the Nepal community forestry program 101 pp 133-141

[11] Borneo Post 2017 Sabah shows decline in Poverty – Rahman October 11, 2017.

[12] Chankrajang T 2019 *J. Dev. Econ.* State-community property-rights sharing in forests and its contributions to environmental outcomes: evidence from Thailand’s community forestry pp 261-273

[13] Chapagain N Banjade M R 2009 *J. For. Livelihood* Community forestry and local development: experiences from the Koshi Hills of Nepal 8 pp 78-92

[14] Chhetri B K B Asante P and Yoshimoto A 2016 *FORMAT* Forest dependence and inequality: an empirical study from community forests in Kaski, Nepal 15 pp 33-43

[15] Chhetri B K B 2017 *FORMAT* Importance of non-farm income to community forest user households in rural Nepal 16 pp 1-11

[16] Coulibaly-Lingani P Savadogo P Tigabu M Oden P C 2011 *For. Policy. Econ.* Factors influencing people’s participation in the forest management program in Burkina Faso, West Africa 4 pp 292-302

[17] Dhakal B Bigsby H R and Cullen R 2007 *Mt. Res. Dev.* The link between community forestry policies and poverty and unemployment in rural Nepal 27 pp 32-39

[18] Doolittle A A 2007 *J. Peasant Studies* Native land tenure, conservation, and development in a pseudo-democracy: Sabah, Malaysia 34 474-497

[19] Foundjem-Tota D Duguma L A Speelman S and Piabuo S M 2018 *Ecol. Soc.* Viability of community forests as social enterprises: a Cameroon case study 23 p 50

[20] Hutauruk T R, Lahjie A M, Siarangkir B D A S, Aipassa M I, and Ruslim Y 2018 *IOP Conf. Ser.: Earth Environ. Sci* Setulang forest conservation strategy in safeguarding the conservation of non-timber forest products in Malinau District 144

[21] Iftekhar M S and Hoque A K F 2005 *Geo. J.* Causes of forest encroachment: an analysis of Bangladesh 62 pp 95-106

[22] Jagger P Luckert M M Duchelle A E Lund J F and Sunderlin W D 2014 *World Dev.* Tenure and forest income: observations from a global study on forests and poverty 64 pp 43-55

[23] Kanel K R and Kandel B R 2004 *J. For. Livelihood* Community forestry in Nepal: achievements and challenges 4 pp 55-63

[24] Khanal B 2011 *Int. J. Soc. For.* Is community forestry decreasing the inequality among its users? Study on impact of community forestry on income distribution among different user groups in Nepal 4 pp 139-152
[25] Khatri D B, Marquardt K, Pain A, Ojha H 2018 For. Policy. Econ. Shifting regimes of management and uses of forests: what might REDD+ implementation mean for community forestry? Evidence from Nepal 92 1-10
[26] Langat D K Maranga E K Aboud A A and Cheboiwo J K 2016 Int. J. For. Res. Role of forest resources to local livelihoods: the case of East Mau Forest ecosystem, Kenya 2016 pp 1-10
[27] Lawlor S Madeira E M Blockhus J and Ganz D J 2013 Forests Community participation and benefits in REDD+: a review of initial outcomes and lessons 4 pp 297-318
[28] Lunakapis G J 2015 Springerplus Secure land tenure as prerequisite towards sustainable living: a case study of native communities in Mantob village, Sabah, Malaysia 4 p 549
[29] Maid M Tay J Yahya H Adnan F I Kodoh J Chang L K 2017 Int. J. Agric. For. Plantation The reliance of forest community on forest for livelihood: a case of Kampung Wawasan Sook, Sabah, Malaysia 5 pp 110-118
[30] Mohamed M Z and Xavier J A 2015 Inter. Academic Res. J. Econ. Finance Poverty alleviation strategies and new economic model in Malaysia 3 pp 17-31
[31] Mohammed J Osei-Fosu A K and Yusif H 2017 Indep. J. Manag. Prod. Factors influencing households’ participation in forest management in the northern region of Ghana 8 pp 1324-1340
[32] Moktan M R Norbu L and Choden K 2016 For. Policy. Econ. Can community forestry contribute to household income and sustainable forestry practices in rural area? A case study from Tshapey and Zariphensum in Bhutan 26 pp 149-157
[33] Mukadasi B and Nabalega M 2016 J. Agr. Environ. Sci. Human Ecology and household socio-economic determinants of community forestry projects in Uganda 5 pp 177-186
[34] Musyoki J K Mugwe J Mutundu K and Muchiri M 2013 ISRN Forestry Determinants of household decision to join community forest associations: a case study of Kenya 2013 pp 10
[35] Musyoki J K Mugwe J Mutundu K and Muchiri M 2016 J. Sus. For. Factors influencing level of participation of community forest associations in management forests in Kenya 35 pp 205-216
[36] Pacheco P and Benatti J H 2015 Forests Tenure security and land appropriation under changing environmental government in Lowland Bolivia and Pará 6 pp 464-491
[37] Pandey S S, Cockfield G and Maraseni T N 2016 For. Ecol. Manag Assessing the roles of community forestry in climate change mitigation and adaptation: a case study from Nepal 360 pp 400-407
[38] Pasgaard M and Chea L 2013 ASEAS Double inequity? The social dimensions of deforestation and forest protection in local communities in northern Cambodia 6 pp 330-355
[39] Paudyal K Baral H Lowell K Keenan R J 2017 Land Use Policy Ecosystem services from community-based forestry in Nepal: realising local and global benefits 63 pp 342-355
[40] Paulos T and Tessfaye Y 2017 J. Culture. Soc. Dev. Role of gender in community forest management: the case of Humbo District community based forest management project Wolaita zone, Snnp, Ethiopia 35 pp 1-8
[41] Pokharel R K Neupane P R Tiwari K R and Köhl M 2015 For. Policy. Econ Assessing the sustainability in community based forestry: a case from Nepal 58 pp 75-84
[42] Rai R K Neupane P Dhakal A 2016 Inter. J. Commons Is the contribution of community forest users financially efficient? A household level benefit-cost analysis of community forest management in Nepal 10 pp 142-157
[43] Rajpoudel N Fuwa N and Otsuka K 2014 GRIPS Discussion Paper The impacts of a community forestry program on forest conditions, management intensity and revenue generation in the Dang districts of Nepal pp 13-24
[44] Rimal R K Maharjan R Khanal K Koirala S Karki B Nepal S M and Shrestha H L Banko Janakari 27 pp 65-71
[45] Toh S M and Grace K T 2006 For. Policy. Institute Working Paper Case study: Sabah forest ownership in Understanding forest tenure in South and Southeast Asia by FAO pp 253-280
Acknowledgements
The author is thankful to Universiti Malaysia Sabah and acknowledges the Sabah Forestry Department as well as to the villagers who involved in this study and during data collection. This research was carried out as part of a doctoral dissertation research. The author also thanks the proofreader and referees for their comments and revision.