Global Scientific JOURNALS

GSJ: Volume 9, Issue 12, December 2021, Online: ISSN 2320-9186

www.globalscientificjournal.com

Socio-economic survey and the impacts of forest fire on the lowland Bamboo in North-Western Part of Ethiopia, Asosa Zone

Mulunesh Gebano Terfassa[1]* and Menfese Tadesse[2]

[1]Assosa University, Department of Agricultural Economics, College of Agriculture and Natural Resource, Ethiopia.

[2] Hawassa University, Wondo Genet College of Forestry and Natural Resource, Ethiopia

Corresponding author: mgebano2018@gmail.com

ABSTRACT: The lowland bamboo forest cover of Ethiopia has been diminishing at an alarming rate due to anthropogenic factors. The study was conducted to assess the anthropogenic effect on lowland bamboo and the economic wellbeing of local livelihoods in Bambasi Woreda. A simple random sampling method was used to select 122 sample households for data collection. Conventional methods such as questionnaire survey, Focal Group Discussion (FGD) and Semi-Structured Interviews were used to gather data. Data were analyzed using descriptive and inferential statistics, including the Chi-square test. In the present study, most respondents (60.53%) in the district stated that the frequency of forest fire is increasing in the last ten years**.** Harvesting honey was the main (74.43%) cause for forest fire which was followed by fire caused for hunting purposes (65.13%) and cigarette smoking (64.8%). Expansion of agricultural land contributes to 58.65% of the forest fire in the area. Respondents agreed that a forest fire is the main cause for the decrease in the area cover of the lowland bamboo. Bamboo contributes to fuelwood (95%), house and fence construction (85%), house furniture (88%), food for humans and domestic animals (75%). However, the majority (82%) of the household stated that their income from lowland bamboo was decreasing over the past due to forest fire. The study identified also the low community participation in forest conservation. Thus, the study recommends creating awareness among the local communities on the effect of the forest fire, implement legal enforcement and enhancing participatory forest management practices.

Keywords/phrases: Anbessa, bamboo; forest fires, impacts; lowland; socio-economic.

© GSJ

1. INTRODUCTION

Ethiopia is endowed with rich bamboo resources and stands the first in Africa owning about 1,474,463 ha of the continent's bamboo forest area (Zhao et al., 2016; Trujillo, 2018). There are two species of bamboo in Ethiopia: lowland bamboo (*Oxytenanthera abyssinica*) and highland bamboo (*Yushania alpina*). About 55% (440, 000 ha) of the lowland bamboo of the country is found in Benshangul Gumuz Regional State/BGRS (Desta, S.B., 2016) mainly used for subsistence, including housing, fencing, kitchen utensils, and agricultural implements and shoots for food (INBAR, 2010). Among the total area of lowland bamboo cover in the region, 64,245 ha is found in Bambasi *Woreda* (district) alone (Ensermu et al., 2000). Forest fire is a major ecological problem in Ethiopia and its causes can be categorized into three: carelessness and deliberate activities, social and politically affiliated activities and unknown causes (Tekestay, 2000; Goldammer and Abberger, 2000; Tesfaye et al., 2004).

Farmers in BGRS use fire to clear lands for agriculture ((Kidemu, M. and Anjulo, A., 2016).). People in the region deliberately burn fire on natural vegetation to clear off the grassland for crop cultivation, renew pasture for livestock, remove insect pests and as a wildlife control measure, etc (Desta, S.B., 2016). Forest fire is one of the main factors for diminishing lowland bamboo in the Region (Desta, S.B., 2016). Almost more than 90% of forest fire in Ethiopia is anthropogenic of its origin (Kidemu, M. and Anjulo, A., 2016). The natural resources of Ethiopia and forests, in particular, are under severe pressure from a combination of factors related to ecological, socio-economic and politico-institutional issues (Yemishaw et al., 2009). Although the cycle of events that lead to the destruction of forest resources involves many varying factors, anthropogenic fire to access and remove forest resources is the most severe (Tesfaye et al., 2004). Every year, bamboo forests are exposed to unrestrained bush fire. Burnt forest areas are usually changed into agricultural land. In many cases, bush fires are intentionally ignited to clear land for shifting cultivation. Allocation of land to human settlements to promote crop cultivation also contributes to the destruction of bamboo stands.

BGRS is endowed with forest resources, and also an environment suitable for the cultivation of lowland bamboo. It is one of the most vulnerable regions to forest fire when compared with other places in Ethiopia. Despite wide coverage of bamboo forests and other natural resources, people of the region obtain limited socio-economic benefits due to the absence of a land-use system and unsustainable natural resource management system (Demissew et al., 2011).

Bambasi district is one of the 20 *Woredas* in Benishangul Gumuz Regional State with the largest lowland bamboo forest in the past but has decreased due to the forest fire. Lowland bamboo is the main income-generating resource for the *Woreda* rural households. The reduction of lowland bamboo in Anbessa Chaka due to forest fire has initiated this study to examine the socio-economic variables that determining the knowledge of the local communities on causes and effects of forest fire on lowland bamboo and the socio-economic aspects of the Bambasi district.

2. Materials And Methods

2.1. study area

Bambasi is one of the *Woredas* in BGRS, Assosa zone, Northwestern Ethiopia. The region consists of three administrative zones, namely Assosa, Metekel and Kemashi and one special district Mao-Komo. It is 616 km away from the Capital of the country, Addis Ababa and 42 km from the regional and Zonal Administrative City, Assosa.

The *Wereda* is bordered by *Oda Bildigilu* district in the North, *Begi* district in the South, *Mao-Komo* East and Assosa district in the West. The district has 40 rural and 2 urban administrative *kebeles* (the smallest administrative unit in Ethiopia). The total human population of the district is 73, 250 (37, 305 males and 35, 945 females) where the urban dwellers constitute 20% of the total population in the district (Guadie, Y.W., Feyssa, D.H. and Jiru, D.B., 2019). Different ethnic groups including Berta, Amhara, Oromo, Tigre, Gurage and many others live in the district. Muslim and orthodox are major religious institutions in the district (Guadie et al., 2019). The total area of the district covers 221, 016 ha of land. Sandy and clay soils are the dominant types of the district. Annual rainfall ranges from 1350-1450 ml with an average temperature of 28^0C. The district has 80% lowland, 5% midland and 15% highland agro-ecological zones. The livelihood of the people of the study area depends mainly on crop and livestock production. The crops mainly produced are maize, sorghum, finger millet, teff, soybean, Niger seed and sesame. The domestic animals mostly being reared are cattle, sheep, goats, mule, donkey and poultry (Guadie, Y.W., Feyssa, D.H. and Jiru, D.B., 2019).

The vegetation type in BGRS is dominated by broadleaved deciduous trees, much of which is intact. The most common tree species are *Anogeissus leiocarpa* Gill. &Prr; *Balanites aegypticus* Wll., *Boswellia papyrifera Hchst. Combretum collinum Fes, Dalbergia melanoxylon Gill. & Prr, Lannea fruticosa* Egl. L. Welwitschii (Hiern) Egl., *Lonchocarpus laxiflorus* Gill. & Prr.,

Pterocarpus lucens Gill. & Prr , .*Piliostigma thonningii* (Schumach.) Milne-Redh, *Stereospermum kunthianum* Cam, *Terminalia laxiflorus* Egl. *and T. macroptera* Gill. & Prr. *Andropogon L., Cymbopogon Spreng., HyparrheniaAndersson* ex E. Fourn., *Panicum L., Pennisetum Pers. and Rottboellia* (Sebsebe et al., 2003; Sebsebe et al., 2005).

a. Sites selection and sampling techniques

The Bambasi district was purposively selected out of the 20 *Woredas* of BGRS because of the dominance and high percent coverage of lowland bamboo in the area. Anbessa chaka is one of the largest state forest areas in the Benshangul Gumuz Region which is owned by the Government.

A simple random sampling method was employed to select the three *kebeles*. In the first phase, *kebeles* bordering Anbessa chaka were identified and selected based on the frequent occurrence of forest fire. Key informants were selected from elders in each kebele (both governmental and nongovernmental) at different levels according to their long experience (knowledge), age, gender, and socio-political position.

From the three kebeles, a total of 122 households were selected using the formula of Cochran (1977).

$$n_0 = \frac{z^2 pq}{D^2} \qquad n = \frac{n_0}{1 + \frac{n_0 - 1}{N}}$$

Where, no = the desired sample size when the population is greater than 10, 000

n=the desired sample size when the population is less than 10,000

Z=95% of confidence i.e.,1.96

P= 0.1 (Population proportion to be included in the sample i.e., 10%)

q = 1-0.1 i.e., 0.9126

N= total number of populations

D= margin of error or degree of accuracy (i.e.,0.05)

b. Data Source

Valuable secondary data were also collected from various sources including previous scientific studies and reports from *Woreda* level such as Environmental Protection, Land Administration and Use office and other concerned sectors. Two sets of primary data namely biophysical (bamboo and forest fire) data and socio-economic data were collected. The primary data was collected mainly from 122 households, 3 focus groups, each composed of 12 members and 12 key informants. A structured household survey questionnaire was used to identify the main causes and consequences of forest fire on lowland bamboo and the income generation of rural households. The final version of the questionnaire was translated into Amharic as the respondents are expected to understand the language better. The questionnaire was pretested before the actual data collection (attached to the appendix).

c. Data analysis

Microsoft Excel was used to code data and statistical software SPSS 16.0 was used to run the analysis of the household socio-economic survey to underlying socio-economic variables determining the knowledge of the local communities on causes and effects of forest fire on lowland bamboo and their socio-economy. A combination of qualitative and quantitative analysis was employed to organize and synthesize the collected information. Data from focus group discussions (FGDs) and key informants (KIs) were analyzed to substantiate the questionnaire.

© GSJ

To analyze the socio-economic data, a descriptive method of crosstabulation and frequency and a chi-square (X^2) statistic were used for the study.

$$X^2 = \sum \frac{(\text{observed - expected})^2}{\text{expected}}$$

Where the square of the differences between the observed and expected values in each cell, divided by the expected value, are added across all of the cells in the table. The chi-square distribution is defined for all positive values. The *P-value* for the chi-square test is $P(\chi^2 \geq X^2)$, the probability of observing a value at least as extreme as the test statistic for a chi-square distribution with $(r-1)(c-1)$ degrees of freedom.

The study also used mean, variance and standard deviation to show variability in the collected data. The sample mean is the average and is computed as the sum of all the observed outcomes from the sample divided by the total number of events. Finally, the results of the data were summarized and presented in various forms including frequency tables, percentages, Chi-square test, mean-variance, standard deviation, and graphs.

3. Result

3.1. The occurrence of forest fire in the last 10 years (2005-2015)

Figure 1 shows a response to the frequency of forest fire over the past 10 years. Regardless of localities, most respondents (60.53%) in the district replied that the frequency of forest fire is increasing in the last ten years**.** Whereas 10.41% of the respondent reptorted in decreasing forest fire in the area. Among the respondent groups, 29% responded that there was no change in the occurrence of a forest fire.

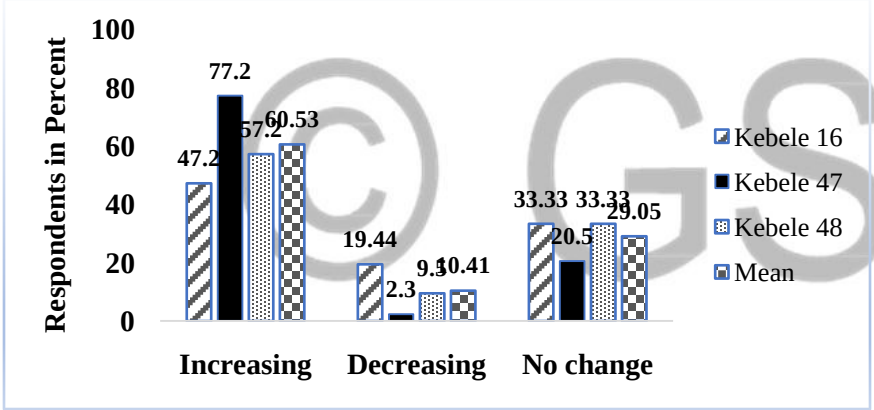


Figure 1 Respondents' view on the incidence of forest fire within the last 10 years (2005-2015).

a. Seasonal occurrence of forest fire

Most respondents (74%) stated that the incidence of forest fire increases during the dry season (December-February). Those respondents who answered that the occurrence of forest fire increases during spring (September-November) and Belg (March-May) were 12% and 11%, respectively (Table 1). Focal group discussions and key informants have also replied that the occurrence of forest fire increases during the dry season (December-February). 74% of the responents reveal that most of the farmers in the study area use fire at least once a year from January to February to prepare the land ready for cultivation. They also use fire for honey collection in April/May and October/November to enforce bees leave out of the hives in the

process of harvesting honey. Fire is also used in the area during the dry season to control insect pests (tsetse fly or ticks) that affect livestock, or to induce sprouting of fresh grazing or browsing vegetation) and grasses.

Table 1. Seasons with increasing forest fire occurrence.

Season	Frequency	Percentage
Kiremt (rainy/wet period from June-August)	1	0.8
Tsedey (September-November)	15	12
Dry season (December-February)	92	73.6
Belg (March-May)	14	11.2
Total	**122**	**100**

b. Causes of the forest fire

Figure 2 shows forest fire and culm cutting are the two main causes for the reduction of lowland bamboo in the district. Though there is a significant difference ($P < 0.05$) among respondents of the three kebeles, of the two causes, a forest fire is the main cause for the reduction in the district.

Expansion of agricultural land, cleaning farms, practices used for harvesting honey bees and cigarette smoking are causes for forest fire in the study area (Table 2). The Chi-square analysis indicates that there is a relation between the view of people and the causes of a forest fire. According to the respondent, harvesting honey was the main (74.43%) cause for forest fire which was followed by fire caused for hunting purposes (65.13%) and cigarette smoking (64.8%). Expansion of agricultural land contributes to 58.65% of the forest fire in the area. The respondents were also pointed out that fire was caused only by human activities.

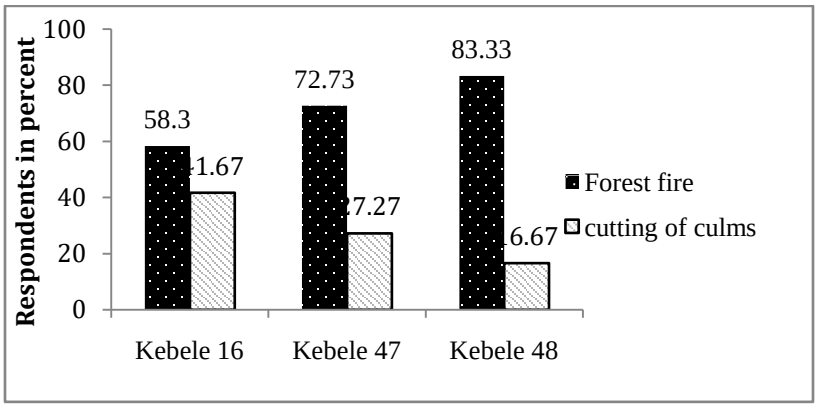


Figure 2. The main causes for decreasing lowland bamboo in Anbessa Chaka

Table 2. Causes of forest fire in the study area.

Forest fire causes	Kebele 16 (%)	Kebele 47 (%)	Kebele 48 (%)	Mean	$\chi 2$	P
Expansion of agricultural land	69.44	63.64	42.86	58.63	6.47	0.039*
Cleaning farm land	88.89	81.82	66.67	58.65	6.11	NS
Hunting purpose	55.56	63.64	76.2	65.13	3.77	NS
For harvesting honey bee	58.3	86.4	78.6	74.43	6.11	0.013*
Cigarette smoking	69.4	75	50	64.8	6.38	0.041*
unknown cause	50	77.3	64.3	63.87	6.46	0.04*

Note: * significant at P< 0.05 and NS for Not-significant

© GSJ

c. The effect of forest fire on lowland bamboo forest

Though, there is a significant difference at $\chi 2 = 6.203$ and $P < 0.05$, the majority (88%) of the respondents in the district described that the lowland bamboo in Anbessa Chaka forest diminishes compared to the situation 10 years ago (Figure 3) mainly due to the forest fire. The fire leads to high destruction on this forest as burning destroys seeds, seedlings and culms perturbating smooth growth and development of this plant, plants clumps produce poor culms that cannot be processed or valorize. Shoots, sometimes use for nutrition are damage, the forest suffers from degradation in the region.

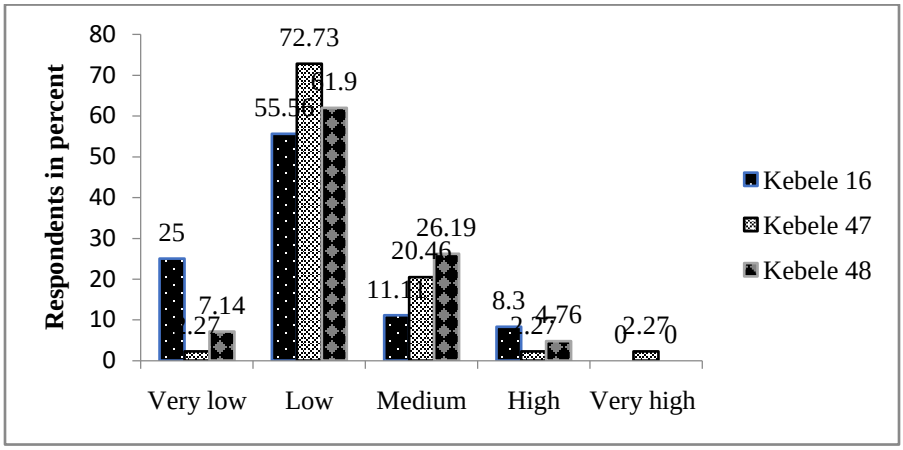
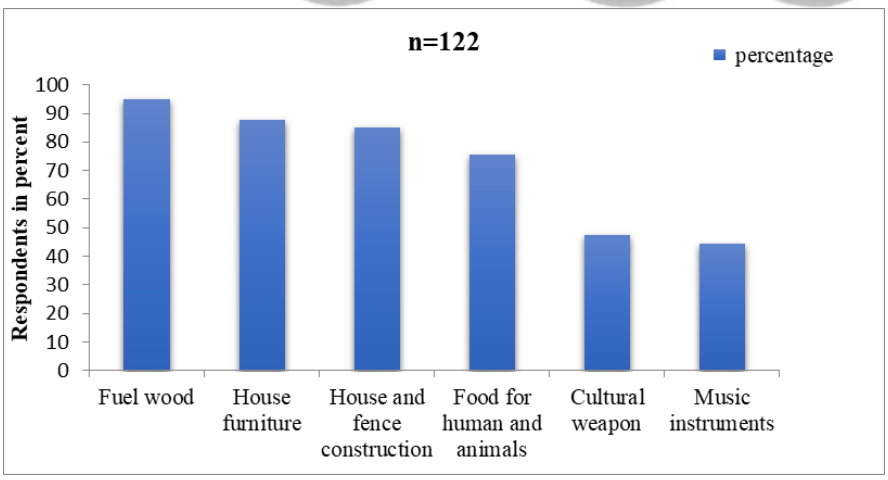


Figure 3. Community participation in forest conservation in the study area.

3.2 Socio-economic importance of lowland bamboo for rural households

Figure 4 shows the use of bamboo in the study area. Bamboo contributes to fuelwood (95%), house and fence construction (85%), house furniture (88%), food for a human and domestic animal (75%), cultural weapons (47%) and musical instruments (44%). Table 3 shows the contribution of bamboo as a source of income for the household. The majority (82%) of households use bamboo as a source of income. They use the tree as their main source of income generation by selling bamboo as firewood, bamboo culms for house and fence construction (scaffolding) to ensure their subsistence needs.



© GSJ

Figure 4 Importance of bamboo in the study area

Table 3. Respondents' response on whether the households use bamboo as a source of income in the study area

Households use of lowland bamboo	No	Yes	$\chi 2$	P
kebele 16	11(30.60%)	25(69.90%)		
Kebele 47	7(15.90%)	37(84.10%)		
Kebele 48	4(9.50%)	38(90.50%)		
Total	**22(18.00%)**	**100(82.00%)**	**6.011**	**---**

© GSJ

Figure 5 shows the average annual income of households in the study area. From households that use bamboo as a source of income, the majority (36%) earns an average annual income of less than 1000 USD. Whereas, 35% and 18% of the households earn 1000-3000 and greater than 3000 USD, respectively.

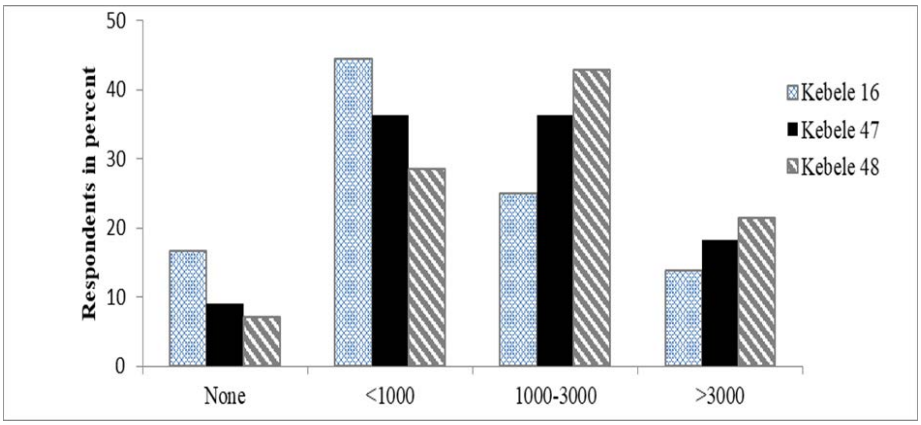


Figure 5. Average annual incomes of households gain from bamboo in USD in the study area'

3.3.The effect of forest fire on household income

Table 4 shows households whose income from lowland bamboo was decreased due to forest fire for the kebele. There was significant difference at $\chi 2 = 7.051$ and $P < 0.05$ among respondents. However, the majority (82%) of the household agreed/stated that their income from lowland bamboo was decreasing over the past due to forest fire.

Table 1. Respondents' response regarding whether forest fire causes a reduction in income of households in the study area

Income of households	No	Yes	$\chi 2$	P
kebele 16	12(33.33%)	24(66.67%)		
Kebele 47	8(18.18%)	36(81.82%)		
Kebele 48	4(9.52%)	38(90.48%)		
Total	**24(19.67%)**	**98(80.33%)**	**7.051**	**0.029***

© GSJ

3.4.Consequences of post-fire on the socio-economic environment

Figure 6 shows the response of the community regarding the impact of forest fire on the socio-economic environment. They stated that forest fire leads to loss of indigenous plants and animal species as well as leads lack of wood that uses for firewood, construction, shade. It also increases soil erosion and flooding, climate change and drought.

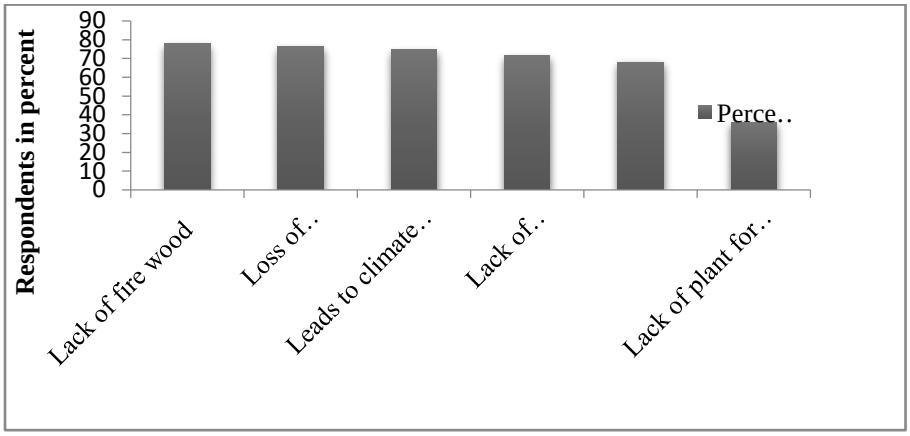


Figure 6. Major consequences of forest fire on the socio-economic environment in the study area.

4. Discussion

In Ethiopia, bamboo is one of the non-timber forest products contributing to Ethiopian Birr (ETB) 56,250,000 and where an estimated 750,000 people of the country depend upon bamboo forest for their livelihood (Dash, T. and Dubey, S., 2017).). Over 600 million people around the world generate income from bamboo, and millions live in bamboo houses ((Liese, W. and Tang, T.K.H., 2015)). About 2.5 billion people depend on bamboo with an estimated value of US $ 7 billion per year (FAO, 2005). BGRS is endowed with forest resources, and also an environment suitable for the cultivation of lowland bamboo. However, it is one of the most vulnerable regions to forest fire and people of the region obtain limited socio-economic benefits from it.

The present study indicated that fire is a significant problem in the lowland bamboo forest environment of the region. The occurrence of forest fire continues to rise in its occurrence and intensity in the last 10 years. Expansion of agricultural land as population size increases, careless use of fire for different activities, insufficient advocacy on its negative effect, weak attention on communities, justice bodies and other stakeholders to implement the fire management strategy are some of the things that aggravate the problem. The respondents were pointed out that fire was caused only by human activities. Similarly, ((Kidemu, M. and Anjulo, A., 2016) reported that, forest fire incidence increases due to different factors such as an increase in the number of agricultural investors, expansion of farmlands due to a rise in population size in the area. People in rural areas and illegal migrants, in particular, consider forests to be free, unoccupied areas and settle there to grow crops. Furthermore, there is no management plan for the forest resources and the absence of systematic fire management structure at different levels

except in operative forest fire control committees. There is no proper economic incentive for efficient forest management and conservation ((Kidemu, M. and Anjulo, A., 2016)).

The study indicated, though there is an incidence of forest fire throughout the year, the intensity/occurrence increase during the dry season (December-February). Dechassa and Matthew (2001) reported that, in Ethiopia, at the end of the dry seasons, farmers usually use fires for different agricultural activities. They use fire for honey collection in April/May and October/November to enforce bees leave out of the hives in the process of harvesting honey. They use also fire use to control insect pests (tsetse fly or ticks) that affect livestock, or to induce sprouting of fresh grazing or browsing vegetation) and grasses. According to (Kidemu, M. and Anjulo, A., (2016), surface fire is the commonest type of forest fire in the region in which dead grasses, pruned branches, dead trees, or felled trees and dried litter accumulation are considered as fire hazards. Thus it is recommended that forest stakeholders and local communities should work together to mitigate the effects of fire.

The respondents agree that lowland bamboo in the Anbessa Chaka forest diminishes compared to the situation 10 years ago. Arsema (2003) reported, the area of lowland bamboo forest cover in Ethiopia diminishes at an alarming rate due to a combination of anthropogenic and natural factors. Similarly, INBAR (2010) stated that enormous hectares of lowland bamboo in the region are cleared for crop production.

The present study identified the low status of community participation in forest conservation in the district which indicates that there is a weak linkage between the government and the communities in participatory forest management. During FGD and KI interviews, respondents reveal that there are prepared national and regional legal frameworks on natural resource conservation, and particularly, forest conservation, but there is weak enforcement of the existing policy and legal frameworks by the concerned stakeholders. So, the government of the Region should work on creating awareness on legal frameworks forming structure and adopting regulation on participatory forest management to engage the community in forest conservation and on making feeling the sense of ownership of the forests, on the other hand, the local people will engage in conservation. Respondents revealed that forest fire is important for bamboo regeneration and the survival of the bush. But this is important only during the flowering of bamboo and dead/drying.

The lowland bamboo has tremendous importance on the socio-economic importance of the rural households in the district. It contributes to fuelwood, house and fence construction, house

furniture, food for a human and domestic animal, cultural weapons and musical instruments. Desta, S.B. (2016) reported that Bamboo is the most widely used plant in Ethiopia, especially by the economically disadvantaged, local poor groups/communities. In the bamboo production villages, bamboo is of economic, social and cultural importance, ranking second only after agriculture in village production systems. INBAR (2011), crop cultivation and productivity in BSG are very limited due to the use of rudimentary labour-intensive farm tools, the prevalence of crop diseases, pests and weeds, declining soil fertility, inadequate use of improved inputs and low working experiences. As a result, the majority of the people in the region base on forest resources to ensure their subsistence needs. Bamboo products may also form valuable traded commodities at local, national, regional and international levels, providing employment and income opportunities at each level.

In this study, the majority (82%) of households use bamboo as a source of income. They use the tree as their main source of income generation by selling bamboo as firewood, bamboo culms for house and fence construction (scaffolding) to ensure their subsistence needs. The role of forests and woodlands in poverty reduction and rural development is one of the most debated issues in the environment and development discourse, both at the national and international levels (Angelsen and Wunder, 2003). Despite all the importance of lowland bamboo in the area, the household income from it is decreasing over the past due to forest fires. Angelsen et al. (2001) reported that the majority of the population, especially the poor households use bamboo as a source of income generation. But at present time, the bamboo forest is decreasing mainly due to forest fire and the population in the study area benefits less from the resource and the income they make. These partly result in contemporary development challenges (e.g., climate change) that impedes economic growth and development, and huge resource depletion and biodiversity losses in developing countries (Desta, S.B., 2016).

5. CONCLUSION AND RECOMMANDATIONS

From the current study, it is concluded that forest fire is the main cause of a decline in lowland bamboo in the BGRS generally and specifically in the study area. The result of this study serves as a guide to policymakers to promote awareness creation through sensitization and capacity building of stakeholders on sustainable fire ecology and management and to ensure local people users' right to forest resources. Law enforcement and sustainable uses of forest and forest resources by community members should be strengthened.

REFERENCES

Angelsen, A. and Kaimowitz, D. 2001. Agricultural Technologies and TropicalDeforestation. CABI Publishing in association with Center for International Forestry Research (CIFOR).

Angelsen, A. and Wunder, S., 2003. Exploring the forest-poverty link. CIFOR occasional paper, 40, pp.1-20.

Arsema, A. 2003. Value chain Analysis for Bamboo Originating from Shedem Kebele, Bale Zone: A project Report submitted to the School of Graduate Studies A. A. university

Bessie, S., Beyene, F., Hundie, B., Goshu, D. and Mulatu, Y., 2016. Land use/land cover change and its effects on bamboo forest in Benishangul-Gumuz region, Ethiopia. International Journal of Sustainable Development & World Policy, 5(1), pp.1-11. BGRSFFS .2011.

Bayrak, M.M. and Marafa, L.M., 2016. Ten years of REDD+: A critical review of the impact of REDD+ on forest-dependent communities. *Sustainability*, *8*(7), p.620.

Bwalya, Samuel M., 2013. Household Dependence on Forest Income in Rural Zambia, Zambia Social Science Journal: Vol. 2: No. 1, Article 6.

Cochran, W.G. 1977. Sampling techniques. 3rd ed. New York: John Wiley & Sons.

Dechassa, L., 2001. Khat and its botany, distribution, cultivation, usage and economics in Ethiopia. US (2001).

Dash, T. and Dubey, S., 2017. Political economy of community forest rights. *Economic and Political Weekly*, *52*(25-26), pp.44-47.

Ensermu K., Tamrat,B., Alemayehu,G., Gebremedhine H. 2000..Socio-Economic Case study of t. Bamboo sector in Ethiopia; an Analysis of the Production to Consumption System.

FAO, 2005. Situación de los bosques del mundo, 2005. Food & Agriculture Organization..

Goldammer, J.G. and Hoffmann, A.A., 3.2. 6 Fire Situation in Indonesia. FRA 2000, p.132.

Goldammer, J.G. and Abberger, H. 2000. The Integrated Forest Fire Management (IFFM) concept: Lesson learned from Indonesia and opportunities to transfer the IFFM concept to Ethiopia. *In: Ethiopia Round Table Workshop on Forest FireManagement* (19-20 September

2000) (Ministry of Agriculture, Ethiopia, with GTZ and GFMC, ed.), Proceedings, 96-106. Ministry of Agriculture, Addis Ababa, 166 p.Kidemu, M. and Anjulo, A., 2016. Determinants of women adaptation to the potential impacts of climate change: a case study in Assosa Woreda, Benshangul Gumez Region, Western Ethiopia. *Journal of Scientific Research & Reports 11 (4),* pp.1-11.

Guadie, Y.W., Feyssa, D.H. and Jiru, D.B., 2019. Socio-economic importance of highland bamboo (Yushania alpina K. Schum) and challenges for its expansion in Bibugn District, East Gojjam, Ethiopia. *Journal of Horticulture and Forestry, 11*(2), pp.32-41.

INBAR. 2010. Study on utilization of lowland bamboo in Benishangul-Gumuz Region, Ethiopia.

INBAR .2011. The Value Chain Development and Sustainability of Bamboo Housing in Ethiopia, :No. 8, East Avenue, Fu Tong, Wang Jing Area ,Chao Yang District, Beij100102, P. R. China http: //www.inbar.int

Kefale, A. and Mohammed, Z., 2018. Migration, Remittances and Household Socio-economic Wellbeing: The Case of Ethiopian Labour Migrants to the Republic of South Africa and the Middle East. Forum for Social Studies.

Kidemu, M. and Anjulo, A., 2016. Determinants of women adaptation to the potential impacts of climate change: a case study in Assosa Woreda, Benshangul Gumez Region, Western Ethiopia. *Journal of Scientific Research & Reports 11 (4),* pp.1-11.

Liese, W. and Tang, T.K.H., 2015. Properties of the bamboo culm. In *Bamboo* (pp. 227-256). Springer, Cham.

Sebsebe Demissew, Nordal, I., Herrmann, C., Friis, I., Tesfaye Awas&Stabbetorp, O. 2005. Diversity and endemism of the western Ethiopian escarpment — a preliminary comparison with other areas of the Horn of Africa.Biol. Skr. 55: 315– 330.

Desta, S.B., 2016. Collective action, property rights and bamboo deforestation in Benishangul-Gumuz Region, Ethiopia. J. Resour. Dev. Manag, 16, pp.94-102.

Teketay, D., 2000. Vegetation types and forest fire management in Ethiopia. In: proceedings of the Round Table Conferenceon Integrated Forest Fire Management in Ethiopia.Ministry of Agriculture with GTZ and GFMC, Addis Ababa, Ethiopia.

Tesfaye, G., Teketay, D., Assefa, Y., and Fetene, M. 2004. The effect of fire on composition and density of soil seed bank and regeneration in a humid Afromontane forest, southeast Ethiopia. Mountain Research. Mountain Research and Development 24: 354–361.

Trujillo, D., 2018. Developments in structural design standards with bamboo. In *World Bamboo Congress Keynote Presentation. Xalapa, Mexico*.

Yemishaw, Y., Teketay, D., Worku, A. and Yoahnnes, Y., 2009. Gathering storm: The fate of Forestry Research and Development in Ethiopia: In: Nigusu Aklilu. *Proceeding of forestry at cross road in Ethiopia, the way forward, Hilton Hotel*, pp.21-23.

Zelalem, S., Gemechu, A. and Tesso, A., 2019. Farm Households' Willingness to Contribute Labor for Conservation of Bamboo Forest Ecosystem: The Case of Mao Komo Special Woreda Benishangul Gumuz Regional State, Ethiopia. *Finance & Economics Review*, *1*(1), pp.41-63.

Zhao, P., Lu, D., Wang, G., Liu, L., Li, D., Zhu, J. and Yu, S., 2016. Forest aboveground biomass estimation in Zhejiang Province using the integration of Landsat TM and ALOS PALSAR data. *International Journal of Applied Earth Observation and Geoinformation*, *53*, pp.1-15.