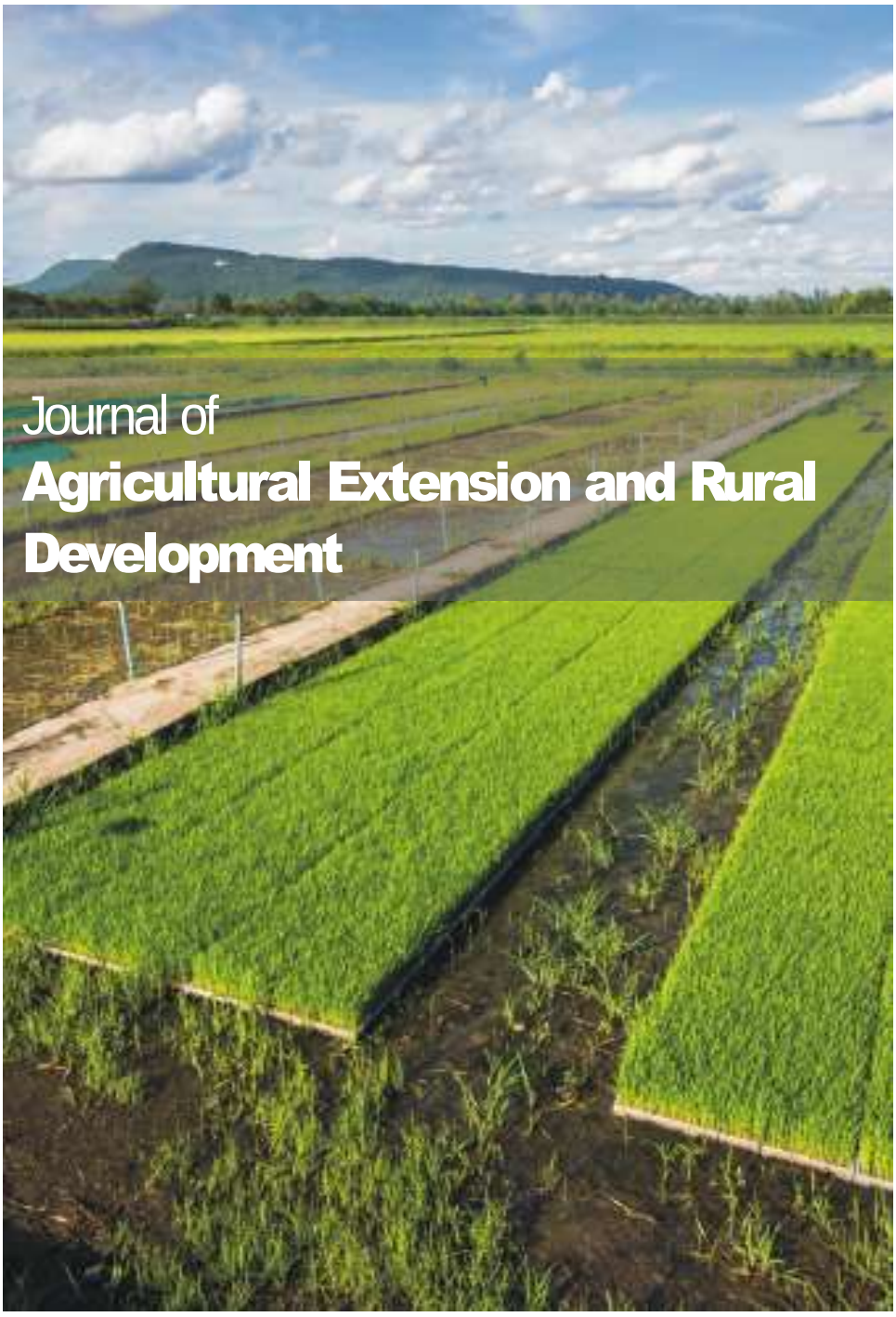
OPEN ACCESS



# Journal of Agricultural Extension and Rural Development

November 2018
ISSN 2141-2170
DOI: 10.5897/JAERD
www.academicjournals.org

ACADEMIC JOURNALS
expand your knowledge

# ABOUT JAERD

The Journal of Agricultural Extension and Rural Development (JAERD) is published monthly (one volume per year) by Academic Journals.

Journal of Agricultural Extension and Rural Development (JAERD) is an open access journal that provides rapid publication (monthly) of articles in all areas of the subject such as Impact monitoring and evaluation system for farmer field schools, Metals in bio solids-amended soils, Nitrogenous fertilizer influence on quantity and quality values of balm, Effect of irrigation on consumptive use, water use efficiency and crop coefficient of sesame etc.

The Journal welcomes the submission of manuscripts that meet the general criteria of significance and scientific excellence. Papers will be published shortly after acceptance. All articles published in JAERD are peer-reviewed.

**Contact Us**


**Editorial Office:** jaerd@academicjournals.org

**Help Desk:** helpdesk@academicjournals.org

**Website:** http://www.academicjournals.org/journal/JAERD

**Submit manuscript online** http://ms.academicjournals.me/

# Editors

**Dr. Kursat Demiryurek**
Ondokuz Mayıs University, Faculty of Agriculture, Department of Agricultural Economics, 55139, Samsun,
Turkey.

**Prof Theera Rukkwamsuk**
Kasetsart University
Thailand.

**Dr. Vincent Bado**
WARDA, Africa Rice Center
Burkina Faso.

**Dr. Tahseen Jafry**
Glasgow Caledonian University
Cowcaddens Road, Glasgow Scotland UK, G4 OBA
UK.

**Dr. Daniel Temesgen Gelan**
Welaita Sodo University ,Ethiopia

**Dr. Ayyanadar Arunachalam**,
Department of Forestry,
North Eastern Regional Institute of Science & Technology,
Nirjuli 791109, Arunachal Pradesh,
India.

**Dr. V. Basil Hans**
St Aloysius Evening College, Mangalore.
# 720 Light House Hill, Mangalore – 575 005,
Karnataka State.
India.

**Dr. Farhad Mirzaei**
Department of Animal Production Management ,
Animal Science Research Institute of Iran

**Dr. Ijaz Ashraf**
Institute of Agri. Extension and Rural Development,
University of Agriculture, Faisalabad-Pakistan

# Editorial Board


**Dr. Vasudeo P. Zamabare**
South Dakota School of Mines and Technology (SDSMT)
USA.

**Dr. Jurislav Babic**,
University of Osijek, Faculty of Food Technology
F. Kuhaca 20, 31000 Osijek
Croatia.

**Dr. Ghousia Begum**
Indian Institute of Chemical Technology (IICT)
India.

**Dr Olufemi Martins Adesope**
University of Port Harcourt, Port Harcourt,
Nigeria.

**Dr. A.H.M.Mahbubur Rahman**
Rajshahi University
Bangladesh.

**Dr. Ben Odoemena**
IFAD
Nigeria.

**Dr. D.Puthira Prathap**
Sugarcane Breeding Institute (Indian Council of Agricultural Research)
India.

**Dr. Mohammad Sadegh Allahyari**
Islamic Azad University, Rasht Branch
Iran.

**Dr. Mohamed A. Eltawil**
Kafrelsheikh University
Egypt.

**Dr Henry de-Graft Acquah**
University of Cape Coast
Applied Statistics
Ghana.

**Prof. Stanley Marshall Makuza**
Umutara Polytechnic
Zimbabwe.

**Dr. Franklin Peter Simtowe**
International Crops Research Institute for the semi-arid Tropics (ICRISAT)
Malawi.

**Dr. Hossein Azadi**
Centre for Development Studies, Faculty of Spatial Sciences, University of Groningen
The Netherlands.

**Dr Neena Singla**
Punjab Agricultural University
Department of Zoology College of Basic Sciences and Humanities
India.

**Dr. Emana Getu Degaga**
Addis Ababa University
Ethiopia.

**Dr. Younes Rezaee Danesh**
Department of Plant Protection, Faculty of Agriculture
Urmia University, Urmia-
Iran.

**Dr. Zahra Arzjani**
Faculty of Geography, Islamic Azad University
Branch of Tehran Central, Tehran
Iran.

**Dr Hossein Aliabadi Farahani**
Islamic Azad University Shahriar (Shahr-e-Qods) Beranch, Agricultural Department
Iran.

**Dr. Shikui DONG**
Environmental School, Beijing Normal University
China.

**Dr. Babar Shahbaz**
University of Agriculture, Faisalabad and Sustainable Development Policy Instiutute Islamabad
Pakistan.

**Dr. H. M. Chandrashekar**
Institute of Development Studies, University of Mysore, Manasagangotri Mysore 570 006, Karnataka State
India.

**Dr. Kassahun Embaye**
Institution: Institute of Biodiversity Conservation (IBC)
Ethiopia.

**Dr. Hasan Kalyoncu**
University of Süleyman Demirel, Faculty of Science and Art, Department of Biology
TURKEY.

Journal of Agricultural Extension and Rural Development

Table of Contents: Volume 10 Number 11 November 2018

ARTICLES

Vol.10(11), pp. 222-233, November 2018
DOI: 10.5897/JAERD2018.1001
Articles Number: D9CB41759363
ISSN: 2141-2170
Copyright ©2018
Author(s) retain the copyright of this article
http://www.academicjournals.org/JAERD

ACADEMIC JOURNALS
expand your knowledge

**Journal of Agricultural Extension and Rural Development**

*Full Length Research Paper*

# Pastoralist's perceptions on the impact of *Vachellia karroo*encroachment in communal rangelands of the Eastern Cape, South Africa

**S. Tokozwayo[1*], U. Gulwa[1], T. Thubela[1], N. Nyangiwe[1] and K. Mopipi[2]**

[1]Department of Livestock and Pasture, University of Fort Hare, P/Bag x 131, Alice, 5700, Eastern Cape, South Africa.
[2]Department of Rural Development and Agrarian Reform, Dohne Agricultural Development Institute, Private Bag x 15, Stutterheim, 4930, Eastern Cape, South Africa.

Received 4 October, 2018; Accepted 21 November, 2018

**The study was conducted in Alice, Eastern Cape Province, South Africa. The objective of this study was to evaluate farmers' perceptions on the impact of *Vachellia karroo* encroachment on livestock production and vegetation. Forty farmers (62% females and 38% males) were interviewed using semi-structured questionnaires. The results showed that goats and cattle were mainly kept for cash sales and sheep for wool production. Shortage of forage and lack of water points were the main constraints to livestock production, especially during dry season. Cattle and sheep owners perceived that *V. karroo* encroachment had a negative impact on grazer production, as it reduces the grazing capacity of the veld. Goat owners viewed *V. karroo* as an acceptable tree to goats and its abundance favors browsers as compared to grazers. Although farmers have different views concerning the impact of *V. karroo* encroachment. The mean of livestock composition showed that goats (11.6±1.3) are more favoured by the veld condition compared to cattle (4.9± 1.1) and sheep (2.6±0.7). This study concludes that *V. karroo* have a negative impact on grazer's production, sheep and cattle owners observed *V. karroo* encroachment as a form of land degradation. Pastoralists recommended that veld burning and bush clearing can be used to mitigate encroachment.**

**Key words:** Encroachment, degradation, livestock composition, *Vachellia karroo.*

## INTRODUCTION

*Vachellia karroo*, commonly known as sweet thorn, native to Southern Africa from Angola east to Mozambique, and south to South Africa. *V. karroo* is classified as a thorn tree plant under the family of *Fabaceae*. *V. karroo* is a small to medium-sized tree and is widely distributed to different veld types of Southern Africa (Mapiye et al., 2011). *V. karroo* has the ability to adapt to different soil types, precipitation, and temperatures (Bernes et al., 1996).

This tree becomes invasive when under disturbed,

*Corresponding author. E-mail: furaluke@gmail.com.

Author(s) agree that this article remain permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

over, or underutilized ecosystem, (Smet and ward, 2005).

*V. Karroo* is known as one of the common encroaching woody plant in South Africa (Nyamukanza and Scogings, 2008). Numerous studies have been conducted to test various practices, which can be used to mitigate *V. karroo* encroachment. Some of these practices include the use of chemicals, bush clearing, use of fire and browsers. Use of chemical and bush clearing were reported as not economically viable because chemicals are too expensive for emerging farmers (Nyamukanza and Scogings, 2008). Use of fire in tandem with browsers was cheaper as compared to other practices, but most of the communal grazing areas have always had insufficient fuel load due to continuous grazing.

In South Africa, 80% of the land is used for agricultural purposes of which 11% is arable and 69% of the land is suitable for livestock production both commercial and communal (FAO, 2009). Communal farming in South Africa contributes 75% of agricultural output and communal farming occupies 17% (FAO, 2005; Musemva et al., 2008). The transformation of vegetation from grassland to bush encroachment has resulted in a decline of livestock performance in communal areas of the Eastern Cape (Gxasheka et al., 2013). Bush encroachment has been the main constraint for livestock production in communal areas of the Eastern Cape (Solomon et al., 2014).

Smet and Ward (2006) described bush encroachment as an economic and environmental problem, which threatened livestock production and the livelihoods of farmers. Causes of bush encroachment are still poorly understood globally, but, it is linked to poor veld management practices and climate change (Ward, 2005). Bush encroachment has a negative impact on livestock production by inducing the suppressive effect on forage production and subsequently reducing the grazing capacity (Oba and Kotile, 2001; Lesoli, 2011).

*V. karroo* is most reported encroacher woody plant in the Eastern Cape Province (Lesoli, 2011; Solomon et al., 2014). The encroachment of *V. karroo* is gradual to such an extent that farmers could not even have noticed. Communal rangelands of Eastern Cape has no clear rangeland management practices, as a result, every community member has a free access to rangeland resources (Lesoli, 2011; Solomon et al., 2014). Lack of rangeland regulations might be one of the attributes of *V. karroo* encroachment in communal areas. Lesoli (2011) stated that poor veld management practices by pastoralists have resulted in bush encroachment (Lesoli, 2011). There is still a lack of documented information on the perceptions of pastoralists concerning the impact of *V. karroo* encroachment in communal areas. Roba and Oba (2009) believed that pastoralists have extensive indigenous knowledge on the management aspects of rangelands.

However, researchers (Butt, 2010; Angassa and Beyene, 2003) often ignore farmers. South African government developed numerous approaches for mitigating bush encroachment, which is a form of land degradation in communal rangelands. Some of those developments were unsuccessful because development of concept was based on a top-to-bottom approach (Solomon et al., 2014). Berkes et al. (2000) also reported that the Botswana government established many programmes for addressing bush encroachment, but some of these programs were ineffective because program developers did not consider pastoralist's perceptions. Farmers are known as land users but, their understanding or perceptions on the land vegetation changes has become irrelevant to policy developers and such has created a lack of interaction between farmers and researchers (Roba and Oba, 2009). There are many studies, which have been conducted to assess the scientific causes and possible solutions to bush encroachment in communal areas. However, there is still lack of research information on the understanding of farmers' perception regarding *V. karroo* encroachment and its impact on livestock production and vegetation in communal rangelands of the Eastern Cape. The objective of this study was to evaluate farmers' perception toward the impact of *V. karroo* encroachment in communal rangeland of Eastern Cape.

## MATERIALS AND METHODS

### Description of the study area

The study was conducted at Sheshegu village in Alice under Raymond Mhlaba Local Municipality of the Eastern Cape Province in South Africa. The area lies at 32°53′47″58S, 26°47′8″E, and altitude of 544 m. The annual rainfall of the area ranges between 450-600mm, with February being the warmest month with an average of 25°C and July being the coldest with an average temperature of 6.3°C (Gwelo, 2012). Sheshegu village is under Bhisho thornveld vegetation type and soil parent material is that of mud-sandstone (Mucina and Rutherford, 2006) (Figure 1).

### Sampling procedure and data collection methodology

Sheshegu village had about 100 (hundred) households who are farming with livestock. These households formed one farmers' association with the assistance of Extension officers. Forty households that own livestock were randomly selected for this research. Farmers' association leaders and extension officers recommended the selected households. One livestock owner (female or male) represented each household during an interview. Therefore, 40 pastoralists were interviewed using structured questionnaires (open and closed-ended). No gender restriction, both males and females were included in an interview. Farmers were interviewed based on their knowledge of rangeland vegetation and livestock production. The questionnaires were divided into four sections, namely: demographic information, livestock population, and rangeland management, rangeland condition and bush encroachment (Appendix A). The participants were interviewed separately using their vernacular language (IsiXhosa) and later translated to English at University of Fort Hare. Qualitative data for this study was collected in June 2017.

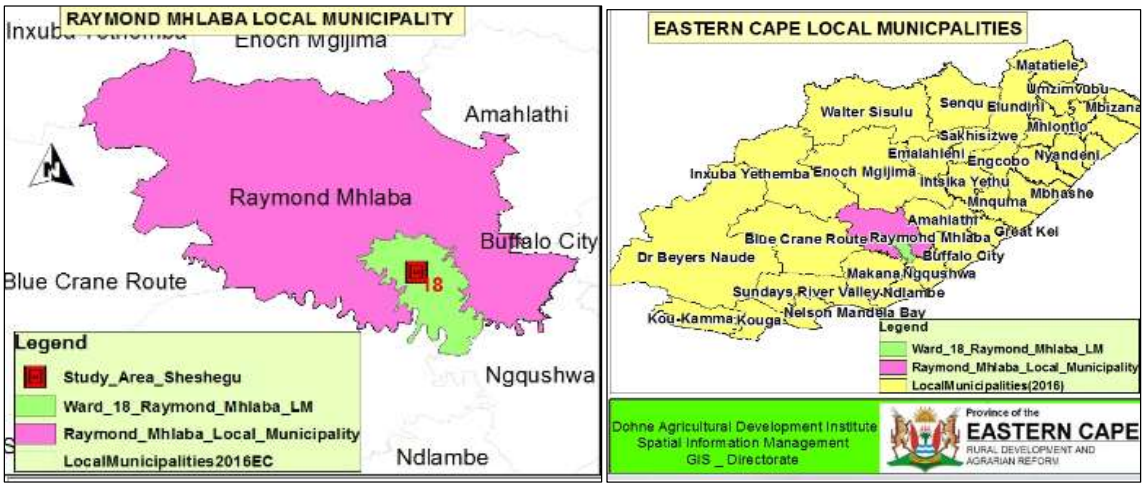



**Figure 1.** Map of the Eastern Cape Local Municipalities and Sheshegu indicating study area.

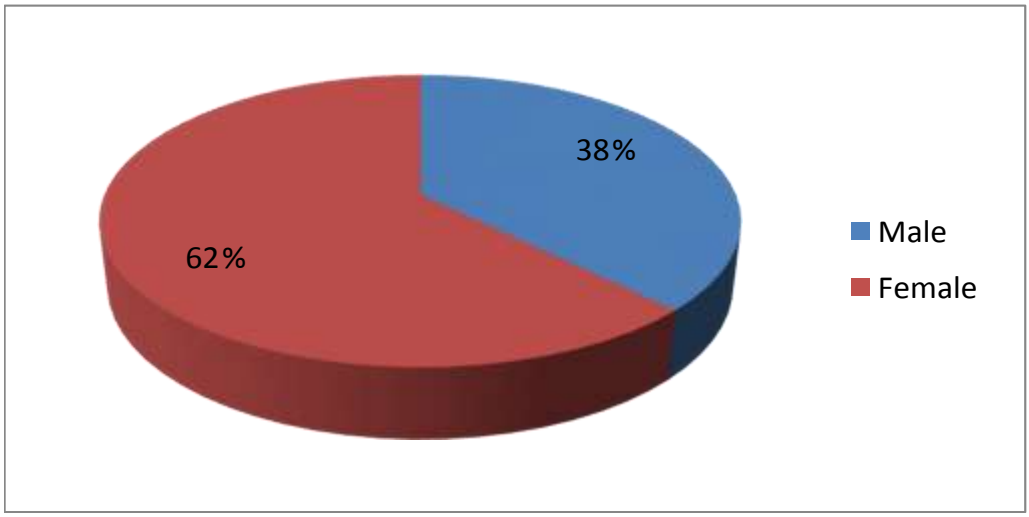



**Figure 2.** Proportion (%) of male and female livestock owners.

**Statistical analysis**

Qualitative data obtained from participants were coded and subjected to analyses using Statistical Package of Social Science (SPSS, 2011). Descriptive statistics (frequencies, means, and percentages) were used. Friedman's Chi-square (Steel and Torrie, 1980) test was used for ranked data. The data which Friedman's test showed significant variation, a set of sign tests for multiple comparisons of means were performed.

## RESULTS AND DISCUSSION

### Demographic information of pastoralists

This study showed that 62% of females participated in this study as compared to 38% of males (Figure 2). This ratio of more females than males was expected because some males were reported to be working during the survey. These results disagree with those published by Admasu et al. (2010) who reported less female participants as compared to males in Southern Ethiopia. About 100% farmers participated in this study were elders with ages ranging from 35-75 years. Lack of participation by the young in this study could result from the fact that the majority of young were at universities and urban areas during data collection. Baars and Aptidon (2002) reported less participation of young people in agricultural activities, but on livestock production. These results revealed that 92% of farmers attended primary and secondary schools, and 8% were illiterate (Table 1). This indicates that these farmers can be easily exposed to sources of information such as trainings and demonstrations. Education as a very

**Table 1.** Age distribution, educational status, primary source of income and household size of respondents (n=40).

| Age | Frequency | Percentage |
|---|---|---|
| 35-45 | 16 | 40 |
| 46-55 | 9 | 22 |
| 56-65 | 8 | 20 |
| 66-75 | 7 | 18 |
| **Educational status** | | |
| Primary school | 17 | 42 |
| Uneducated | 3 | 8 |
| Secondary school | 20 | 50 |
| **Primary source of income** | | |
| Livestock production | 26 | 65 |
| Work & social grant | 14 | 35 |
| **Household size** | | |
| Adults | 97 | 31 |
| Youth | 214 | 69 |

important tool for farming, particularly in the adoption of new technologies (Moyo et al., 2008; Katjiua Ward, 2007). Moreover, 35% of farmers depended on formal or informal jobs and social grants; whereas 65% relied on livestock farming as a primary source of income (Table 1).

## Livestock composition

This study revealed that Sheshegu village had three livestock species such as goats, cattle and sheep. The mean livestock numbers owned by farmers were as follows; 11.6 goats, 4.9 cattle and 2.6 sheep (Table 1). These findings disagreed with the results of Mapiye et al. (2009) who reported 9, cattle and 7, goats; Mngomezulu (2010) also reported 12, cattle and 6, goats in the Eastern Cape. The mean of goats and sheep from this study were similar to those reported by Gwelo (2012), under Bhisho thorn veld vegetation type.

Large stock comprises of cows and heifers (9.6), calves (4.4) and bulls and oxen (0.9) respectively. The moderate proportion of bulls and oxen against high number of cows and heifers observed in this study could improve the production rate of the herd. Mating ratio per household perceived by pastoralists was 2 bulls to 20 cows. These findings were different from those reported by Solomon et al. (2014), who reported a ratio of 1 bull to 20 cows in the same province. Small stock consists of ewes (4.4), lambs (3.0), and rams and wethers (0.6); while goats comprise of doe (18.5), kids (13.7) and bucks and wethers (2.7) according to (Table 2). Farmers perceived that the control of mating ratio during the breeding is not an ease exercise because there are no grazing camps in communal areas. Pastoralists do not care too much about the mating ratio of livestock due to the absence of grazing camps in communal areas of the Eastern Cape (Solomon et al., 2014; Mapekula, 2009).

## Importance of livestock and constraints faced by farmers

Livestock plays an important role in their livelihoods of pastoralists. Pastoralists kept livestock mainly for cash sales, meat consumption and animal traction (Table 3). An income generated from livestock is used for school payments, purchase medication for livestock and household maintenance. Musemwa et al. (2010) reported that income generated from livestock through cash sales was used for households' maintenance, school fees, and food. Cash sales, meat consumption, and animal traction showed no significant difference ($P>0.05$). Pastoralists showed less interest in animal traction because most farmers were using tractors instead of animal traction. Allsop et al. (2007) reported that animal traction has become less important because farmers rely on the government for mechanization and production inputs. Few farmers keep livestock for prestige because majority of farmers reported that they sell livestock to generate a source of income for their families. Thus, most of the pastoralists have realized that farming is a business or an investment. Mngomezulu (2010) stated that farming for prestige has declined in communal areas because most of the pastoralists are mainly farming to generating income. Most of the pastoralists stated that they sell

**Table 2.** Mean (±SE) composition of livestock species at Sheshegu village.

| Livestock species | Mean (±SE) |
|---|---|
| Cattle | (4.9±1.1)[b] |
| Sheep | (2.6±0.7)[C] |
| Goats | (11.6±1.3)[a] |
| | |
| Bulls and Oxen | (0.9±0.2)[c] |
| Cows and Heifers | (9.6±2.2)[a] |
| Calves | (4.4±0.9)[ab] |
| | |
| Rams and Wethers | (0.6±0.2)[c] |
| Ewes | (4.4±1.2)[a] |
| Lambs | (3.0±0.8)[ab] |
| | |
| Bucks and Wethers | (2.7±0.4)[c] |
| Doe | (18.5±2.0)[a] |
| Kids | (13.7±1.4)[b] |

Different superscripts (column) denote significant differences (P<0.05) among livestock species.

livestock in local markets such as traditional ceremonies and weddings. These results are in agreement with those of Solomon et al. (2014) on the study, which was conducted in communal areas of the Eastern Cape.

Shortage of forage, insufficient water points, and stock theft were the most perceived challenges faced by pastoralists (Table 3). Shortage of forage, lack of water points, stock theft, and predators showed a significant difference (P<0.05). Livestock diseases and the shortage of forage were most ranked (Table 3). Sheep and cattle owners indicated that an increase of *V. karroo* and prolonged drought has resulted in a shortage of feed and water for livestock. The reliance of pastoralists on native foraging methods promotes continuous grazing subsequently resulting in loss of perennial grasses (Solomon et al, 2014; Smit and Ward, 2006). Pastoralists reported scarcity of precipitation especial in winter season is a major challenge faced by pastoralist's community. Pastoralists reported that most of the boreholes, which were constructed by the government, were not maintained and some were vandalized. Dams were properly constructed, but they were reported to be dry due to prolonged drought and such as have resulted in a shortage of forage and poor performance of livestock. Shortage of feed and water due to prolonged drought or changes of weather are the most limiting factor in livestock production in the Eastern Cape (Goqwana et al., 2008; Raats, 1999). Farmers also perceived an abundance of bushes in communal areas creates a very conducive environment for predators. Predators such as jackal were reported to be the serious threat small stock most especially in encroached areas. Kgosikoma et al. (2012) stated that sheep and goats under encroached rangelands are likely to be preys to predators such as jackal.

## Perceived causes and possible solutions to mitigate bush encroachment

Uncontrolled veld fires, overgrazing and climate change were perceived as causes of bush encroachment (Table 4). Uncontrolled veld fires, overgrazing, and climate change showed no significant difference (P>0.05). Drought and absence of browsers were significant (P<0.05) contributors compared to uncontrolled veld fires, overgrazing and climate change (Table 4). Pastoralists perceived that overgrazing, uncontrolled veld fires and climate change are the drivers of bush encroachment (Table 4). Ward (2005) reported that causes of bush encroachment are poorly understood, but bush encroachment is linked to climate change and poor management of veld management practices. Pastoralists stated that livestock were not kraaled during the winter season as result animals graze day and night. Uncontrolled grazing in communal areas promotes loss of soil cover and heavy or selective grazing in communal areas. Under heavy grazed area, grasses tend to use less water due to low photosynthesis rate and such creates a very conducive environment for the woody plant to recruit themselves (Ward, 2005; Smit and Ward, 2006). In addition, some of the pastoralists believed that the summer season has more rainfall with rapid recovery growth rate from grazing whereas winter has less rainfall

**Table 3.** The purpose of livestock keeping and challenges faced by farmers, (1 = most important and 6= least important), (respondents n=40).

| Purpose | Mean Rank (±SE) | Rank |
|---|---|---|
| Milking purposes | 3.0(0.11)$^{d}$ | 3 |
| Cash Sales | 4.8 (0.13)$^{a}$ | 1 |
| Meat consumption | 4.7(0.14)$^{ab}$ | 2 |
| Animal traction | 4.3(0.24)$^{abc}$ | 4 |
| Prestige | 3.0(0.17)$^{d}$ | 5 |
| **Challenges** | | |
| Livestock diseases | 1.4 (0.12)$^{d}$ | 1 |
| Predators | 2.2 (0.15)$^{c}$ | 4 |
| Shortage of forage | 4.7(0.09 )$^{a}$ | 2 |
| Lack of water points | 3.9(0.12 )$^{ab}$ | 4 |
| Stock theft | 2.8(0.14 )$^{cd}$ | 3 |

Different superscripts (column) denotes significant difference among the reasons and challenges at (P<0.05).

**Table 4.** The perceived causes of bush encroachment and possible solutions to control bush encroachment (1= Most important, 5= least important) (n=40).

| Causes | Mean Rank | Rank |
|---|---|---|
| Drought | 1.7 (0.75)$^{d}$ | 5 |
| Absence of browsers | 1.4(0.39)$^{d}$ | 4 |
| Uncontrolled veld fires | 4.6(08.5)$^{a}$ | 2 |
| Climate change | 3.4(0.78)$^{abc}$ | 3 |
| overgrazing | 4.0(0.72)$^{ab}$ | 1 |
| **Possible solution to control bush encroachment** | | |
| Veld burning | 2.8(0.08)$^{b}$ | 3 |
| Destocking | 5.5(0.06)$^{a}$ | 5 |
| Increasing browsers | 2.2(0.16)$^{b}$ | 1 |
| Increasing grazing | 2.3(0.25)$^{b}$ | 2 |
| Bush clearing | 3.3(0.25)$^{b}$ | 4 |

Different superscripts denote significant difference (P<0.05) between the causes and possible solutions.

with slow regrowth rate hence their livestock were not kraaled in winter. These findings are not in agreement with the results of Moyo et al. (2008) who reported communal farmer's kraal livestock at night in all seasons for improving forage for next grazing and preventing stock theft.

Pastoralists are aware of overgrazing of forage material because in this study they perceived that continuous grazing has resulted in the loss of perennial grass species. Loss of perennial grasses through overgrazing has resulted in a shift from grasses to bush dominated ecosystem. Gxasheka et al. (2013) stated that grazing without resting and unplanned grazing might be the possible drivers of bush encroachment in communal areas. Lesoli (2011) argued that overgrazing, selective grazing and uncontrolled veld fires in communal areas are weakening the competitiveness of grasses against woody plants. Pastoralists have a little understanding of climate change, but, these farmers believe that uncontrolled veld fires and prolonged drought due to change in weather patterns have resulted in an occurrence of encroacher species. Tainton (1999) reported that fire can be either a good or a bad tool for controlling undesirable, therefore understanding fire behaviour and its impact on the vegetation is crucial.

Pastoralists have a different understanding concerning

bush encroachment because goat owners perceived that *V. karroo* is highly palatable to goats. Some of the Pastoralists particularly goat owners believed that the abundance of *V. karroo* favours goat production, but goats alone cannot control bush encroachment. Tainton (1999) highlighted that goats cannot completely control bush encroachment, browsers can be used to control the coppicing of woody plant, but goats cannot browse at a height of 1.5 meters. On other hand, sheep owners perceived that *V. karroo* has a negative impact on grazers because *V. karroo* reduces the grazing capacity of the veld. *V. karroo* has long spikes, therefore it causes injuries to livestock animals. Lesoli (2011) reported similar findings on the research that was conducted in the same province.

The results from this study revealed that destocking was regarded as a significant ($P<0.05$) solution to control bush encroachment as compared to an increase of livestock (grazers and browsers), and veld burning. An increase of grazers and browsers were the most ranked solution to address to bush encroachment. Although they have different views regarding bush encroachment, farmers perceive that the spread of *V. karroo* need to be controlled because this tree is encroaching even on abandoned croplands and open grasslands. Some Pastoralists believed that a reduction of livestock numbers (destocking), bush clearing, and veld burning might a possible solution for controlling bush encroachment. Smit (2004) stated that bush clearing, veld burning, and proper application of veld management practices can be used to mitigate the spread of encroacher species in communal areas. From a practical point of view, the application of fire (veld burning) might not work in some communal areas due to the fact fire for killing woody plants requires more fuel load for producing higher fire intensity. Grazing without resting reduces fuel, which is essential for the hot fire (Thomas et al. 2000). Application of bush clearing in an overgrazed area might lead to soil erosion. Therefore, veld resting is important because it improves biomass production and competitiveness ability of grasses against woody plants. Bille and Assefa (1983) argued that bush clearing and veld burning under overgrazed landscape cannot be recommended as control measures of bush encroachment. Smit (2004) highlighted that the phytomass of *V. Karroo* can be reduced where there is an adequate fuel load.

## CONCLUSION AND RECOMMENDATIONS

This study concludes that livestock production plays a crucial role in the livelihood of pastoralists. Livestock production is constrained by bush encroachment, shortage of feed and lack of dams or drinking water points. Pastoralists have a different perception concerning the impact of *V. karroo,* but some farmers believe that *V. karroo* needs to be controlled to a point where grazers and browsers can benefit equally from rangeland resources. The gradual spread of *V. karroo* favours goat production, at the expense of grazers.

Pastoralists have no rules and regulations on the management of rangelands resources. Poor management of veld has resulted in poor veld condition and the transformation of grassland to bush dominated ecosystem. Pastoralists believed that the use of fire (veld burning) and bush clearing could be used to mitigate bush encroachment. Therefore, more studies are still needed to evaluate the understanding of communal and commercial farmers on vegetation transformation adaptability. This study recommends that land care programmes should be implemented to restore rangelands. During the implementation of land care projects, Pastoralists should receive training and demonstrations that can complement their knowledge.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

## ACKNOWLEDGEMENTS

The author appreciates Dr. K. Mopipi, Miss. U. Gulwa, T. Thubela, and Dr N. Nyangiwe for their contribution to this research. He is sincerely indebted to the communal farmers, Department of Rural Development and Agrarian Reform, Dohne Agricultural Development Institute, University of Fort Hare for the opportunity to conduct this research. He is also grateful to the National Research Foundation (NRF) for funding this research.

### REFERENCES

Admasu T, Abule T, Tessema Z (2010). Livestock rangeland management practices and community perceptions towards rangeland degradation in South zone of Southern Ethiopia. http://www.lrrd.org. Livestock Research for Rural Development. Accessed [30-05-2013].

Allsop N, Laurent C, Debeaudoin LMC, Samuels MI (2007). Environmental perceptions and practices of livestock keepers on the Namaqualand Commons Challenge conventional rangeland management. Journal of Arid Environments 70:740-754.

Angassa A, Beyene F (2003). Current range condition in Southern Ethiopia in relation to traditional management strategies: The perceptions of Borana pastoralists. Tropical Grasslands 37:53-59.

Baars RMT, Aptidon SM (2002). Pastoralists perceptions of rangeland degradation in Eastern Ethiopia. Nomadic Peoples 6:114-157.

Barnes RD, Filer DL, Milton, SJ (1996). *Acacia karroo*: Monograph and Annotated Bibliography. Tropical Forestry Papers 32.Oxford Forestry Institute, Oxford, UK.

Berkes F, Colding J, Folke C (2000). Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications 10:1251-1262.

Bille JC, Assefa E (1983). Rangeland management and range condition: a study in the Medecho and Did Hara areas of the effects of rangeland utilization. Joint Ethiopian Pastoral Systems Study Research Report No.7, International Livestock Centre for Africa.

Addis Ababa, Ethiopia.
Butt B (2010). Pastoral resource access and utilization: quantifying the spatial and temporal relationships between livestock mobility, density and biomass availability in southern Kenya. Land Degradation and Development 21:520-539.
FAO (2005). Grasslands of the world. In: Suttie, JM., Reynolds, SG and Batello C.(Eds.) Rome. P.514.
FAO (2009). Review of evidence on drylands pastoral systems and climate change. In Neely. C, Burning S and Wilkes A. (Eds.), Land Tenure and Management Unit (NRLA). Land and Water Discussion Paper 8, p.50.
Goqwana WM, Machingura C, Mdululwa Z, Mkhari R, Mmolaeng O, Selomane AO (2008). A facilitated process towards finding options for improved livestock production. Journal of Range and Forage Science 25(2):63-69.
Gwelo AF (2012). Farmers' Perceptions of Nguni Cattle Feeding Behaviour and vegetation: Nutrient Dynamics in Two Communal Rangeland, Eastern Cape. MSc. Dissertation, Unpublished. South Africa: University of Fort Hare.
Gxasheka M, Solomon TB, Lesoli M, Mlisa N (2013). *Euryops floribundus* encroachment in Eastern Cape communal rangelands: Indigenous and scientific understanding of effects on Range ecology, and food Security. MSc. Dissertation. University of Fort Hare.
Katjiua M, Ward D (2007). Pastoralist's perceptions and realities of vegetation change and browse consumption in the Northern Kalahari. Namibia. Journal of Arid Environments 69:716-730.
Kgosikoma O, Mojeremane W, Harvie B (2012). Pastoralist's perception and Ecological knowledge on Savanna Ecosystem Dynamics in Semiarid Botswana. Ecology and Society 17:27-38.
Lesoli M (2011). Characterisation of communal rangeland degradation and evaluation of vegetation restoration techniques in the Eastern Cape, South Africa. PhD. Thesis, University of Fort Hare, Alice, South Africa.
Mapekula M (2009). Milk production and calf performance in Nguni and crossbred cattle raised on communal rangelands of the Eastern Cape Province of South Africa. PhD. Thesis, University of Fort Hare, South Africa.
Mapiye C, Chimonyo M, Dzama K, Raats JG, Mapekula M (2009). Opportunities for improving Nguni in the smallholder farming systems in South Africa. Livestock Science. 124:196-204.
Mapiye C, Chimonyo M, Marufu MC, Dzama K (2011). Utility of *Acacia karroo* for beef production in Southern Africa smallholder farming systems: A review. Animal Feed Science and Technology 164:135-146.
Mngomezulu S (2010). Formal Marketing of Cattle by Pastoralists in the Eastern Cape Province of South Africa. MSc. Dissertation. The Netherlands: Wageningen University.
Moyo B, Dube S, Lesoli M, Masika PJ (2008). Communal area grazing strategies: institutions and traditional practices. Journal of Range and Forage Science 25(2):47-54.Mucina L, Rutherford MC, Powrie LW (2006). Vegetation map of South Africa, Lesotho and Swaziland: shapefiles of basic mapping units. SANBI, Cape Town.
Musemwa L, Mushenje A, Chimonyo M, Fraser M, Mapiye C, Muchenje V (2008). Nguni cattle marking constraints and opportunities in the communal areas of South Africa: Review. African Journal of Agricultural Research 3(4):239-245.
Musemwa L, Mushunje A, Chimonyo M, Mapiye C (2010). Low cattle market off-take rates in communal production systems of South Africa: Causes and mitigation strategies. Journal of Sustainable Development in Africa 12(5): 209-226.
Nyamukanza CC, Scogings PF (2008). Sprout selection and performance of goats fed Acacia karroo coppices in the False Thornveld of the Eastern Cape, South Africa. African Journal of Animal Science 38:83-90.
Oba G, Kotile DG (2001). Assessments of landscape level degradation in Southern Ethiopia: Pastoralists versus Ecologists. Land Degradation and Development 12:461-475.
Raats JG (1999). Strategies for feeding Animals during the dry period. FAO Corporate Document Repository. Rome, Italy: FAO.
Roba HG, Oba G (2009). Community participatory landscape classification and biodiversity assessment and monitoring of grazing lands in northern Kenya. Journal of Environmental Management 90:673-682.
Smet M, Ward D (2005). A comparison of the effects of different rangeland management systems on plant species composition, diversity and vegetation structure in a semi-arid savanna. African Journal of Range and Forage Science 22:59-71.
Smet M, Ward D (2006). Soil quality gradients around water points under different management systems in a semi-arid savanna, South Africa. Journal of Arid Environments 65:251-269.
Smit GN (2004). An approach to tree thinning to structure southern African Savannas for long-term restoration from bush encroachment. Journal of Environmental Management 71:179-191.
Solomon TB, Mlisa L, Gxasheka M (2014). Local Perceptions of Livestock and Rangeland Degradation in the Highlands of South Africa: Implication for Development Interventions. Journal of Human Ecology 47(3):257-268.
SPSS.2011.Statistical Package for Social Sciences. Version 20. USA.
Steel RGD, Torrie JH (1980). Principles and Procedures of Statistics: A Biometrical Approach. 2rd Edition. New York: McGraw-Hill.
Thomas DS, Sporton G, Perkins J (2000). The environmental impact of livestock ranches in the Kalahari, Botswana: natural resource use, ecological change and human response in a dynamic dryland system. Land Degradation and Development 11:327-341.
Tainton NM (1999). Veld management in South Africa. University of Natal Press, Pietermaritzburg, South Africa.
Ward, D. 2005. Do we understand the causes of bush encroachment in African savannas? African Journal of Rangeland and Forage Science 22:101-105.

**Appendix A: Questionnaire used to interview farmers at Sheshegu village**

**Title: Pastoralist's perceptions on the impact of *V. karroo* encroachment in communal rangeland of the Ea stern Cape, South Africa**

**The objective**: to evaluate farmers' perception toward the impact of bush encroachment on livestock production and vegetation
Name of interviewer…….Date…….Village…….
Name of respondent……..Questionnaire reference number……

**INSTRUCTIONS: Fill in the relevant information and where possible mark with an X**
**DEMOGRAPHIC INFORMATION**

A.1 Gender

| | | | |
|---|---|---|---|
| Male | | Female | |

A.2 Age

| **Age** | 15-30 | 30-40 | 40-50 | Above 50 |
|---|---|---|---|---|
| **Mark with an X** | | | | |

A.3 Household size

| Number of adults | Number of children (<21 years) |
|---|---|
| | |

A.4 Level of education

| **Levels of education** | Primary school | Secondary school | Tertiary education | Other |
|---|---|---|---|---|
| **Mark with X** | | | | |

A.5. The primary source of income.

| **Sources of income** | **Mark with X** |
|---|---|
| Livestock production | |
| Work and social grant | |
| Other | |

**LIVESTOCK POPULATION**

B.1 Livestock types and numbers

| **Livestock type** | **Numbers** | | | |
|---|---|---|---|---|
| Cattle | Bulls | Cows & heifers | Calves | total |
| | | | | |

| **Livestock type** | **Numbers** | | | |
|---|---|---|---|---|
| Sheep | Ram | ewe | lambs | total |
| | | | | |

| **Livestock type** | **Numbers** | | | |
|---|---|---|---|---|
| Goats | Buck | Boer | kids | total |
| | | | | |

B.2. Why are you keeping livestock? (In order of importance 1= most important, 5=least important)

| **Purposes** | **mark with X** | **Rank** |
|---|---|---|
| Milking purposes | | |
| Cash Sales | | |
| Meat consumption | | |
| Animal traction | | |
| Prestige | | |

B.3 What trend do you observed from livestock population?

| **Trend** | **Increasing** | **Decreasing** | **Remain the same** |
|---|---|---|---|
| **Mark with X** | | | |

B.4 What challenges are you facing on livestock production? (1= most important, 5= Least important).

| **Challenges** | **mark with X** | **Rank** |
|---|---|---|
| Shortage of forage | | |
| Lack of water points/dams | | |
| Predators | | |
| Animal diseases | | |
| Stock theft | | |

B.5. Which type of livestock do you prefer to keep? Grazers [ ] or browsers [ ] and why?
.....
.....

B.6. Which type of livestock is currently increasing? Grazers [ ] or browsers [ ] and what could be the reason such an increase?
……
……..

B.7. Which type of livestock is currently decreasing? Grazers [ ] or browsers [ ] and what could be the reason for such a decrease?
…….....
.....

**RANGELAND MANAGEMENT**

C.1 What type of grazing systems do you practice in your rangeland?

| **Types of grazing systems** | **Continuous grazing** | **Rational grazing** | **Other** |
|---|---|---|---|
| **Mark with X** | | | |

C.2 What time of the year do you experience a shortage of grazing material?

| **Seasons** | **Winter** | **Summer** | **Spring** | **Autumn** |
|---|---|---|---|---|
| **Mark with X** | | | | |

C.3. Do you practice any veld management practices in your rangeland? Yes [ ] or No [ ] If yes fill the table below

| Practices | How often? | In which season(s) |
|---|---|---|
| Veld burning | | |
| Veld resting | | |
| Rotational grazing | | |
| Other (Specify) | | |

**RANGELAND CONDITION AND BUSH ENCROACHMENT**

D.1 Which woody plant (s) species were dominant before *V. karroo* encroachment in your rangeland?

| **Name of woody plant species:** |
|---|

D.2 Which woody plant species currently dominating in your rangeland?

| **Name of woody species:** |
|---|

D.3 Which woody plant species mostly preferred by livestock in your rangeland?

| **Name of woody species:** |
|---|

D.4 Do you notice any shift from grassland to bush dominated ecosystem in your rangeland in your rangeland? Yes [ ] or No [ ] If yes what could be the reason
……
……
….....

D.5 Is there any problem of land degradation in your rangeland? Yes [ ] or No [ ] If yes what could be the reason
.....
.....

D.6 How would you describe the rangeland condition under this encroachment of *Vachellia karroo*? Good [ ], Fair [ ], poor [ ], justify your answer?
……
……

D.7 What do you utilize rangeland for?
……
……
……...

D.8 Does your community have grazing camps? Yes [ ] or No [ ] If yes, for what purposes?
……
…….....

D.9 Do you notice bush encroachment in your rangeland? Yes [ ] or No [ ]

D.10 Do you consider *V. karroo* as an encroaching woody plant in your rangeland? Yes [ ] or No [ ] and justify your answer
……..……
……..

D.11 From your point of view, what should be done in order to eradicate/control *V. karroo* encroaching species? (1=most important and 5=least important).

| **Possible solution** | **Mark with X** | **Rank** |
|---|---|---|
| Veld burning | | |
| Destocking | | |
| Increasing browsers | | |
| Increasing grazing | | |
| Bush clearing | | |

D.12 What could be the causes of *V. karroo* encroachment in your rangeland? (1= most and 5=least).

| **Causes** | **Mark with X** | **Rank** |
|---|---|---|
| Veld burning | | |
| Drought | | |
| Absence of browsers | | |
| Uncontrolled veld fires | | |
| Climate change | | |
| overgrazing | | |

D.13 Do you think *V. karroo* encroachment has an impact on livestock production? Yes [ ] or No [ ], justify your answer?

……
……
……

D.14. Do you think *V. karroo* encroachment has an impact on herbaceous vegetation? Yes [ ] or No [ ], justify your answer

……
……

Any comment:

……
……
…….

Vol.10(11), pp. 234-244, November 2018
DOI: 10.5897/JAERD2018.0975
Articles Number: 8238F4359453
ISSN: 2141-2170
Copyright ©2018
Author(s) retain the copyright of this article
http://www.academicjournals.org/JAERD

ACADEMIC JOURNALS

**Journal of Agricultural Extension and Rural Development**

*Full Length Research Paper*

# Factors affecting smallholder farmers' participation in degraded forest rehabilitation practices. The case of Gemachis District, West Hararghe Zone, Oromia Region, Ethiopia

**Asfaw Zewdu[1*] and Fekadu Beyene[2]**

[1]Oromia Agricultural Research Institute, Mechara Agricultural Research Center, P. O. Box 19, Mechara, Ethiopia.
[2]Department of Rural Development and Agricultural Extension, Haramaya University, P. O. Box 138, Dire Dawa, Ethiopia.

Received 13 July, 2018; Accepted 4 August, 2018

**The global forest coverage has declined from year to year due to human and natural factors. To address the problems, different rehabilitation strategies have been implemented through government and community in a coordinated manner. This study investigated factors affecting smallholder farmers' participation in degraded forest rehabilitation at participatory forest management in Ethiopia. We used two-stage sampling procedure to select 140 sample households randomly from the district using probability proportional to size. Both quantitative and qualitative data were collected from primary and secondary sources. Tobit model was employed to analyze factors affecting smallholder farmers' participation and the level of participation in forest rehabilitation. The findings demonstrate that livestock holding size, the benefit derived from the forest, forest cooperative membership, perception of households and access to extension services positively affect farmers participation and the level of participation; whereas distance of the forest from the home negatively affects farmers' participation and the level of participation in forest rehabilitation. The study suggested that awareness creation, clear discussion with communities, strengthening existing benefits, creating related ones and providing more extension services, information and supports are required to improve farmers' participation in degraded forest rehabilitation practices.**

**Key words:** Smallholder farmers, participation, forest degradation, rehabilitation, participatory forest management, tobit.

## INTRODUCTION

The total global forest area has declined by 3%, from 4128 million ha in 1990 to 3999 million ha in 2015 (Keenan et al., 2015; FAO, 2015). The annual rate of net forest loss halved from 7.3 million ha per year in the 1990s to 3.3 million ha per year between 2010 and 2015. The natural forest area declined from 3961 million ha to

*Corresponding author. E-mail: asfawzwd2005@gmail.com. Tel: +25155570430.

Author(s) agree that this article remain permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

3721 million ha between 1990 and 2015, while planting forest (including rubber plantations) increased from 168 million ha to 278 million ha (Keenan et al., 2015). The Africa total forest area is declining from 705 million ha in 1990 to 624 million ha in 2015. Due to both natural causes such as drought, fire, storms and disease, and human cause such as clearance for agriculture, over-exploitative timber harvesting, the expansion of settlements, and infrastructure development, natural forest area have been reduced within 25 years. However, planted forest area has increased from year to year because of expansion of reforestation, afforestation and other forest rehabilitation and restoration strategies through community participation (Keenan et al., 2015; FAO, 2015).

Ethiopia has one of the largest forest resources in the horn of Africa. It owns a total of 53.1 million ha covered by woody vegetation which consists of 12.5 million ha of forest land and 40.6 million ha of another woodland (FAO, 2015). The total forest area of the country has declined from 15.1 million ha in 1990 to 12.5 million ha in 2015. The annual rate of forestland decline is 104, 600 ha per year that is 0.8% of forest cover of the country. About 95% of the total forest of the country is located in three regions namely Oromia, SNNP and Gambella regional states (Yitebitu and Eyob, 2014). Both natural and human factors are the main causes of forest degradation in Ethiopia. Human causes are mainly population growth (Badege, 2001; Temesgen et al., 2015), expansion of agricultural land and exploitation of existing forest product (Badege, 2001; Adugnaw, 2014; Temesgen et al., 2015), overgrazing (Badege, 2001), expansion of urban areas and infrastructural development (Adugnaw, 2014). The natural causes of forest degradation are drought, fires and diseases (Gobena, 2010). Ethiopia has been taking measures to rehabilitate degraded forests and forestlands (Mulugeta and Habtemariam, 2014). Establishment of protected and forest priority areas, as well as protecting the sacred forest sites are attempts taken to protect forests in the country. Degraded forest and land are rehabilitated through conservation of the remaining forest, woodlot development, planting of grass tufts, construction of micro-catchments, and enrichment of planting in degraded areas (Eshetu et al., 2014). Similarly, rehabilitation of forests through afforestation, agroforestry, building of soil and water conservation structures, reforestation and area enclosures with participatory forest management practices is another conservation effort that the government is implementing (Adugnaw, 2014; Mulugeta and Habtemariam, 2014; Temesgen et al., 2015). Currently, degraded forest rehabilitation activities are implemented through community participation in Participatory Forest Management (PFM) (Gobeze et al., 2009; Winberg, 2010; Alemayehu et al., 2015) and participatory enclosure management (Eshetu et al., 2014). The government has shifted a policy towards forest management and rehabilitation from state-centered approach to participatory or community-centered approach for sustainable management and utilization of forests (Alemayehu et al., 2015).

Participatory Forest Management (PFM) was started in Ethiopia in 1990 with the help of NGOs to address deforestation thereby managing the forest in a sustainable manner (Said and O'Hara, 2010; Temsgen et al., 2015; UNDP, 2012). It was introduced first to Ethiopia over the last 27 years; the approach is expanding to cover more and more hectares of forest across the country (UNDP, 2012). In Ethiopia, PFM was adopted well in 2010 including regional governments and at every woreda office (Winberg, 2010).

Various studies have been conducted on the degraded forest rehabilitation practice implemented through community participation. They reveal that lack of linkage among actors (Alemyahu et al., 2015), absence of clearly defined property rights and user rights, gender disparity in participation, lack of active community participation (Semeneh, 2016) and absence of rules and regulation to penalize absenteeism (Eshetu et al., 2014) are major constraints that affect rehabilitation practice. Nevertheless, having rules and regulation on penalties in monetary terms and in kind can increase community participation on development activities (Haregeweyn et al., 2012). However, those studies did not elicit the socio-economic factors (education, benefits obtained and others), physical factors and demographic factors towards rehabilitation practice. They also failed to address the determinants of participation towards rehabilitation activities.

In addition, studies conducted on the factors affecting community participation in forest management in Ethiopia address only the levels of participation of forest users association or groups towards forest management (Tadesse and Abay, 2013). Similarly, studies conducted on the determinants of collective action on bamboo forest management do not examine the forest rehabilitation activities performed by the community (Semeneh, 2016). Due to socio-economic (education, income and wealth) factors and forest users' perception (Tefera et al., 2005), institutional (property rights, incentives and extension services) (Semeneh, 2016) and others factors, participation of farmers in forest management activities to rehabilitate degraded land vary contextually and spatially (within communities and even within individuals). This paper aims to assess factors affecting farmers' participation and level of participation in the rehabilitation of degraded forestland through the participatory forest management program.

## METHODOLOGY

### Description of the study area

Gemachis district is one of the districts found in West Hararghe

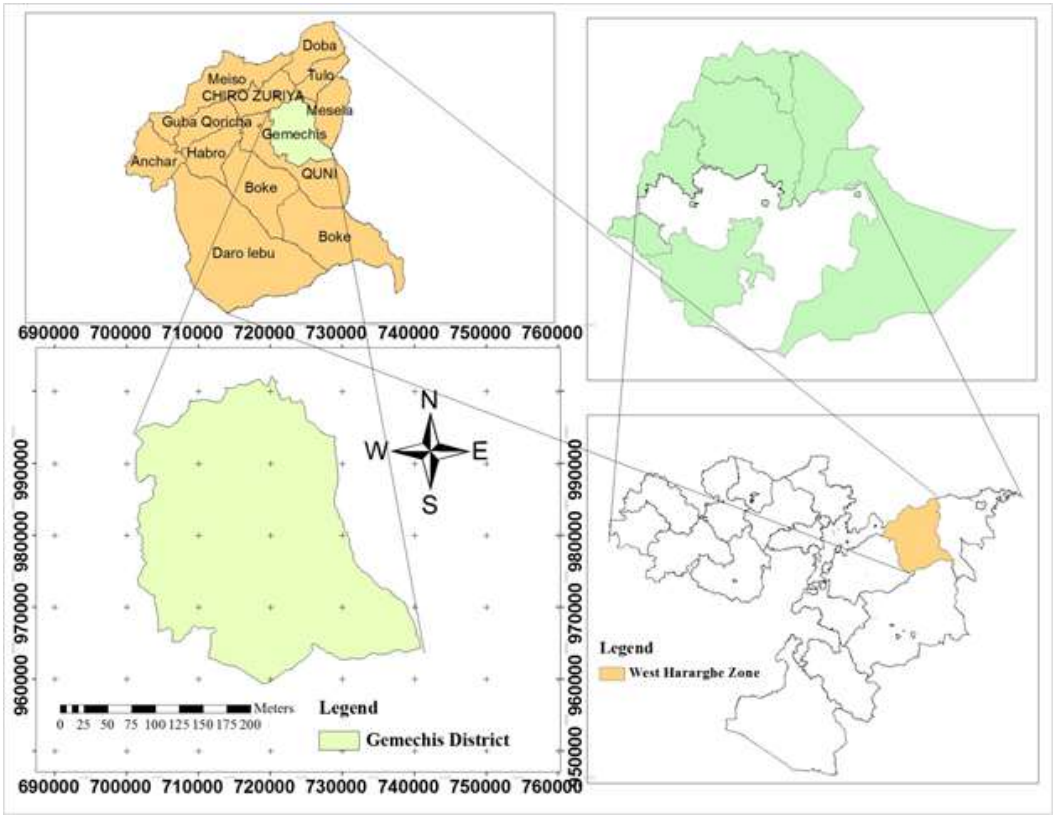



**Figure 1.** Map of the study area.
Source: Own computation from GIS data, 2016.

Zone of Oromia National Regional State, Eastern part of Ethiopia. The district is located about 343 km southeast of Addis Ababa and 17 km from Chiro town, the capital town of West Hararghe Zone. Kuni town is the administrative set of the district. It shares a border with Chiro district in the West and North, Oda Bultum district in the South and Mesala district in the East directions (GDoANRO, 2016). It is located at 9° 0′ 44.992″ latitude in the North and 6° 39′ 50.42″ longitude in the East. The district covers an area of 77,785 ha and it has 35 rural *Kebeles* and 3 urban administrative towns. The district s found within 1300 to 3400 m above sea level (m.a.s.l). The minimum and maximum annual rainfall is 800 and 1200 mm with an average of 850 mm. The district has bi-modal distribution in nature with small rains starting from March/April to May and the main rainy season extending from June to September/October. The minimum and maximum temperature is 15 and 30°C while the average temperature is 22°C. The total population of the district is 243,497 of which 124,140 are males and 119,357 are females. The number of agricultural households in the district is 42,869 with 38,057 males headed and 4,812 females headed. The average family size is estimated to be 6 and 4 per household in rural and urban areas, respectively. The district is the first most densely populated district in the zone. Participatory forest management was started in the district in 2011 with the help of Hararghe Branch of Oromia Forest and Wildlife Enterprise and other district government offices. PFM covers a total of 921 ha of land and organized farmers living in and nearer the forests into seven user groups to address forest degradation and deforestation in the area. Of the land use pattern of the district, 32,994.5 ha is cultivable, 6185 ha is grazing land; forest, bushes, and shrubs cover 1385 ha; 6603.62ha is not arable and 17,949.34 ha is used for other purposes such as encampments and infrastructure facilities (Figure 1).

**Sampling technique and sample size determination**

Two-stage sampling technique wasemployed to select *Kebeles* and sample respondents. In the first stage, out of 35 rural *Kebeles* in Gemachis district, three *Kebeles* were selected purposively because the only *Kebeles* were adjacent to the forestland. In the second stage, 140 sample respondents were randomly drawn from the sampling frame using simple random sampling based on probability proportional to size. A total number of household head were obtained from district and sampling frame of all listed *Kebeles* was organized to select sample respondents.

**Type of data and data collection methods**

Both primary and secondary data sources were used to collect qualitative and quantitative data for this study. Primary data (demographic (age, family size, and gender), socioeconomic (education status, benefit derived or expected from forest, forest cooperative membership, etc), institutional factors (rules and regulations, property rights, and extension services) and perception of household) were collected. The data were collected from sample households in the district by preparing and distributing a semi-structured questionnaire through interview schedule as well as from three focus group discussions. The questionnaire was pre-tested on five randomly selected farmers prior to execution of a formal survey to modify the interview schedule prepared for the study. Five

enumerators who are familiar with the study area, understand the native language and have prior experience in data collection were recruited. Those enumerators trained on the content of the questionnaire and data collection procedure. Secondary data (demographic characteristics, physical characteristics, topography, maps, forestland area coverage, etc.) were collected from district agricultural office, other governmental offices, internet, and reports. Checklist was developed for the collection of data from secondary sources and focus group discussion. Quantitative data such as demographic, socio-economic, institutional factors and others as well as qualitative data such as perceptions and participation status were collected.

**Method of data analysis**

Descriptive statistics (percentage, mean and standard deviation), inferential statistics (independent sample t-test and chi-square test) and econometric model (Tobit model) are used based on their importance for analyzing the quantitative data that have been collected from primary and secondary sources through SPSS version 20 software and STATA 13.1 software. Qualitative data were analyzed through description, explanation, and narration of collected data. Tobit regression model was used to analyze factors affecting farmers' participation and level of participation in degraded forest rehabilitation practices. It is possible to analyze participation and its intensity through the censored regression model; if there is no bias and too many zeros (Zbinden and Lee, 2005). Cragg (1971) modifies the Tobit model to overcome the restrictive assumption inherent in it; he suggests the "double-hurdle" model tackle the problem of too many zeros in the survey data. Similarly, Heckman selection model is another model which helps us to analyze participation and the extents of participation; develops correct selection bias (for not having a randomly selected sample which means our sample is not representative of the group we want to study) (Dageye and Mengistu, 2016). This model was chosen because it has an advantage over other participation models (Logistic and Probit) and it reveals both the probability of participation and level of participation in rehabilitation practice. Following Tobin (1958), the Tobit model can be defined as:

$$PI_i^* = \beta_i X_i + U_{i=1,2,.....n}$$
$$PI_i = PI_i^* \text{ if } PI_i^* > 0$$
$$= 0 \text{ if } PI_i^* \leq 0 \quad (1)$$

Where:
$PI_i$= is participation index for the $i^{th}$ farmer
$PI_i^*$= is the latent variable and the solution to utility maximization problem of the level of participation subjected to a set of constraints per household and conditional on being above a certain limit,
$X_i$= Vector of factors affecting participation and level of participation,
$\beta_i$= Vector of unknown parameters, and
$U_i$= is the error term which is normally distributed with mean 0 and variance $\sigma^2$.

Individual major degraded forest rehabilitation activities were considered to assess the level of participation in the PFM approach. Participation index of each farmer was calculated using the following formula:

$$PI_i = \left( \frac{\sum_{J=1}^{N} Y_{ij}}{N} \right) 100 \quad (2)$$

Where,
$PI_i$ = Participation index for the $i^{th}$ farmer
Yij = Participation of $i^{th}$ farmer in $j^{th}$ activity.
N = Total number of activities taken up in the degraded forest rehabilitation practices.

**Definition of variables and working hypotheses**

***Dependent variables***

Participation index was the dependent variable of the Tobit regression model used for the study. The individual activities (tree hole preparation, tree planting, construction of soil and water conservation, forest management and protection, sharing benefits and meeting for planning and decision making) within the forest were used for measuring participation and the level of participation in forest rehabilitation practice. Similarly, others authors have used the approach to measure participation and extents of participation of the community in natural resource management (Badal et al., 2006; Meshesha and Birhanu, 2015). The participation index was constructed by dividing the summation of individual activities within the forest to overall activities and multiplying by 100 percent. The minimum and maximum numbers of forest rehabilitation activities performed by sample respondents were 1 and 7 per year, respectively.

***Independent variables***

Farmers' decision to participate and the level of participation in degraded forest rehabilitation in a given period of time is hypothesized to be influenced by a combined effect of various factors such as the demographic, socio-economic, institutional, psychological and biophysical environment in which farmers operate. Based on the brief literature reviewed in this study, a total of 12 explanatory variables were hypothesized to explain participation and level of participation of the sample households towards degraded forest rehabilitation activities. The summary of the explanatory variables is presented in Table 1.

## RESULTS AND DISCUSSION

This section presents the findings obtained from the study. Descriptive and inferential statistical analyses are employed to describe demographic and physical, socio-economic and institutional characteristics. Econometric analysis is employed to identify factors affecting farmers' participation and level of participation in degraded forest rehabilitation practices in Gemachis District.

### Summary of descriptive and inferential analysis results

This section presents the summary results of demographic and physical, socio-economic and institutional factors of sample respondents in the study area (Tables 2 and 3). The Chi-square result in Table 2 indicated that there was a significant difference between participant and non-participants of households in terms of forest cooperative membership, benefit obtained from the forest, secure property rights, access to extension

**Table 1.**Summary of hypothesized explanatory variables.

| Code | Variables | Type of variables | Expected sign |
|---|---|---|---|
| | **Dependent variables** | | |
| PARTINDE | Participation index score | Continuous | |
| | **Independent variables** | | |
| AGEHH | Age of household head(Years) | Continuous | ± |
| SEXHH | Sex of household head (1=Men and 0=Women) | Dummy | ± |
| HHSIZE | Household size (Number) | Continuous | + |
| EDUSHH | Education status of household head (1= literate and 0=illiterate) | Dummy | + |
| LANHSIZ | Landholding size (Hectare) | Continuous | - |
| BENDEFST | The benefit derived or expected from the forest (1= Yes and 0= No) | Dummy | + |
| LIVHSIZE | Livestock holding size (TLU) | Continuous | + |
| FCOOPME | Forest cooperative membership (1= Yes and 0=No) | Dummy | + |
| PRORIGH | Perceived security of property rights (1=Yes and 0=No) | Dummy | + |
| AEXTSER | Access to extension service (1=Yes and 0=No) | Dummy | + |
| DISFHOM | The distance of forest from home (Kilometer) | Continuous | - |
| PERCHH | Perception of household head (1= Agreed and 0=Disagreed) | Dummy | + |

services and perception of household towards participation at 1% significant level. Household's home far from the forest, lack of interest to join the group, absence during community registration and lack of awareness were the major reasons for households not to join forest cooperatives. Rules and regulations, external support delivered from organizations and incentives given enable the households in the forest cooperatives to participate in degraded forest rehabilitation practices. Both direct (grasses, beekeeping, dead fuelwood and money from hunting) and indirect benefits (reduction of soil erosion and floods coming from upper stream, access to irrigation and training on forest management and protection) were obtained from the forest area. The household home far from the forest, non-membership of forest cooperatives, weak protection in some of the forest area and lack of money for purchasing and transportation of grasses were major factors for the household not to obtain or expect benefit from the forest.

The forest user certification delivered to the group, an agreement signed among users of the group, proximity of the home to the forest resources and written rules and regulations within the forest cooperatives enable the households to participate more in degraded forest rehabilitation practices in the study area. Similarly, in the country for participatory forest management user groups, use rights such as access to forest, right to own a defined physical property, withdrawal rights (right to obtain the products and benefits of a resource), management right (right to regulate resource use patterns and transform the resource by making improvements) and exclusion rights (right to determine who may have access) and legally securing these rights have been provided for the community groups to be involved and maintain participation in the decision making process (MOA, 2012).

Access to extension services in forest management, rehabilitation, protection, and conservation is the other variable used for this study. Advisory services on tree planting and soil and water conservation structure construction, training on forest management, inputs (tree and forage seedlings and beehives) and the field day were major extension services given to sample respondents by government (District Agricultural Offices, Research Center and Oromia Wildlife and Forest Enterprises of Hararghe Branch) and non-government organizations. Perception of the household towards participation in degraded forest management can be viewed from the angles of perceived benefits, effect of forest degradation and approach of PFM in the area. Clear discussion among communities, government inducement, awareness created for the communities through devolution and decentralization of resources and power, empowerment of farmers in planning, implementation and decision making process in PFM approach and vulnerability of livelihoods of farmers to the effects of forest degradation enabled the households to positively perceive participation in degraded forest rehabilitation practices and in turn increased their participation in the area.

But, sex and education status of sample respondents is not the same based on the hypotheses/expectation in this study. The Chi-square result in Table 2 indicated that there was no significant difference between participant and non-participants of households in terms of sex and education status of sample respondents. Equal opportunity given to male and female household heads to organize themselves in forest cooperatives and right to

**Table 2.** Summary of descriptive and inferential statistics for dummy explanatory variables.

| Variables | | Non-participant (54) | | Participant (86) | | Total (140) | | $\chi 2$ |
|---|---|---|---|---|---|---|---|---|
| | | N | % | N | % | N | % | |
| Sex | Female | 7 | 13 | 14 | 16.3 | 21 | 15 | 0.29 |
| | Male | 47 | 87 | 72 | 83.7 | 119 | 85 | |
| Education | Illiterate | 24 | 44.4 | 37 | 43 | 61 | 43.6 | 0.03 |
| | Literate | 30 | 55.6 | 49 | 57 | 79 | 56.4 | |
| Forest cooperative | Non-member | 54 | 100 | 15 | 17.4 | 69 | 49.3 | 90.46*** |
| | Member | 0 | 0 | 71 | 82.6 | 71 | 50.7 | |
| Benefit | Non-users | 39 | 72.2 | 1 | 1.2 | 40 | 28.6 | 82.07*** |
| | Users | 15 | 27.8 | 85 | 98.8 | 100 | 71.4 | |
| Property rights | Non-holders | 45 | 83.3 | 4 | 4.7 | 49 | 35 | 90.27*** |
| | Holders | 9 | 16.7 | 82 | 95.3 | 91 | 65 | |
| Extension services | Non-accessed | 49 | 90.7 | 13 | 15.1 | 62 | 44.3 | 76.89*** |
| | Accessed | 5 | 9.3 | 73 | 84.9 | 78 | 55.7 | |
| Perception | Disagreed | 22 | 40.7 | 8 | 9.3 | 30 | 21.4 | 19.47*** |
| | Agreed | 32 | 59.3 | 78 | 90.7 | 110 | 78.6 | |

***: indicate significant at 1% level.
Source: Own survey result, 2016

use forest resources, government inducing participation, presence of great indigenous knowledge on natural resources conservation by the community, perceived effects of forest degradation on their livelihoods and perceived benefits of rehabilitation practices enabled the households to participate more in forest management, conservation and rehabilitation practices in the study area.

The two sample t-test result in Table 3 revealed that there was a significant difference between participant and non-participant in forest rehabilitation practices in terms of distance of the forest away from home and livestock holding size in the study area. Shortage of infrastructures (road and transport), information asymmetry, being a non-member of forest group and fewer beneficiaries of direct benefits from forest resources enabled the households far from the forest not to participate in degraded forest rehabilitation activities. The major feed resources of the livestock such as grasses, trees, and shrubs are obtained from an enclosed forest area. Moreover, in turn, it serves as incentives for the households to participate more in rehabilitation practices. But, the two sample t-test result in Table 3 revealed that there was no significant difference between participant and non-participant in forest rehabilitation practices in terms of average age, household size and landholding size in the area. Sharing their experience and indigenous knowledge on forest management, susceptible to erosion due to living in the mountains area, livelihoods dependence in the forest, less income-generating activities other than agriculture and inducement of government in participation enable the household to participate in forest management, rehabilitation, and other activities.

## Participation status of sample respondents

The survey results showed that about 38.6% of sampled households were non-participants in degraded forest rehabilitation practices; while 61.4% of the sample households were participants in rehabilitation practices. Household home far from the forest, less direct benefit obtained from the forest, information asymmetry and non-members of forest cooperatives were major factors that made them not to participate in degraded forest rehabilitation practices. Similarly, 7.1, 26.4 and 27.9% of sample respondents from participants were passive, medium and active participants in degraded forest rehabilitation practices, respectively (Table 4).

The result of the survey revealed that seedling hole preparation, tree planting, construction of different soil

**Table 3.** Summary of descriptive and inferential statistics for continuous explanatory variables.

| Variables | Non-participants (N=54) | | Participants (N=86) | | Overall (N=140) | | Min | Max | t-value |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | Std.Dev. | Mean | Std.Dev. | Mean | Std.Dev. | | | |
| Age | 37.81 | 9.98 | 40.85 | 12.64 | 39.68 | 11.74 | 18 | 80 | -1.58 |
| Household size | 6.22 | 2.34 | 5.62 | 2.56 | 5.85 | 2.49 | 1 | 15 | 1.42 |
| Distance | 3.99 | 1.21 | 0.80 | 0.70 | 2.03 | 1.82 | 0.1 | 6.5 | 17.55*** |
| Land size | 0.38 | 0.28 | 0.40 | 0.37 | 0.39 | 0.34 | 0.06 | 2.5 | -0.13 |
| Livestock size | 2.21 | 1.51 | 2.78 | 1.78 | 2.56 | 1.70 | 0.03 | 10.03 | -1.95* |

***, *: indicate significant at 1 and 10% level.
Source: Own survey result, 2016.

**Table 4.** Status of participation made by sample households in degraded forest rehabilitation activities.

| Participation categories | N | % | Index value | Mean of Index | Std. Dev of Index |
|---|---|---|---|---|---|
| Non-participants | 54 | 38.6 | 0 | 0 | 0 |
| Passive | 10 | 7.1 | 14-29 | 0.23 | 0.08 |
| Medium | 37 | 26.4 | 43-71 | 0.49 | 0.07 |
| Active | 39 | 27.9 | 86-100 | 0.98 | 0.03 |
| Total | 140 | 100 | 0-100 | 0.42 | 0.40 |

Source: Own survey result, 2016.

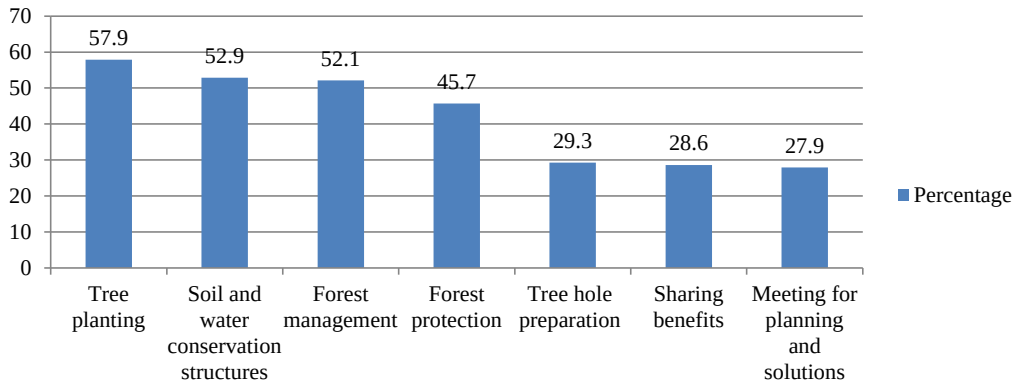



**Figure 2.** Major degraded forest rehabilitation activities practiced by sample respondents.
Source: Own computation from the survey, 2016.

and water conservation structures, forest protection through daily monitoring and evaluation, forest management, sharing benefits and meeting for planning, problem identification and decision making were major degraded forest rehabilitation activities practiced by sample respondents. The results of Figure 2 indicated that 57.9, 52.9, 52.1 and 45.7% of the sample respondents participated in tree planting, soil and water conservation structures, forest management and forest protection activities, respectively.

The focus groups discussion indicated that member of forest cooperatives highly participated in degraded forest rehabilitation activities than non-member of forest cooperative sample respondents. Each member of the forest cooperative protected the forests from illegal practice through rotational guarding methods. The forest management activities practiced by sample respondents were pruning canopy of juniper trees, cultivating planted seedlings of trees and removal of weeds from forestlands. Member of the respondents shared benefits such as grasses, old trees and other monetary benefits as cooperatives. Especially, grass sharing system practiced by the respondents were equally giving to each member of forest cooperatives in the form of lottery method and the grasses left over members sold with less cost to a non-member of the communities living in the *Kebeles*. Most of the non-members of forest cooperative households involved in tree seedling plantation, soil and

**Table 5.** Factors affecting participation and level of participation in forest rehabilitation practices.

| Variables | Coef. | Std.Err. | t | Marginal effects | | |
|---|---|---|---|---|---|---|
| | | | | CHILP | CHIPP | TOCH |
| AGEHH[a] | - 4.752 | 6.486 | - 0.73 | -4.037 | -0.053 | -3.043 |
| SEXHH | 9.194 | 8.689 | 1.06 | 7.638 | 0.111 | 5.673 |
| HHSIZE[a] | 4.594 | 5.036 | 0.91 | 3.816 | 0.055 | 2.834 |
| DISFHOM | -16.417*** | 3.483 | - 4.71 | -13.638*** | -0.197*** | -10.129*** |
| EDUSHH | 0.441 | 5.339 | 0.08 | 0.367 | 0.005 | 0.272 |
| LANHSIZ[a] | - 4.473 | 3.006 | - 1.49 | -3.716 | -0.054 | -2.759 |
| LIVHSIZE[a] | 8.861*** | 2.995 | 2.96 | 7.361 | 0.107** | 5.467*** |
| BENDEFST | 17.419* | 10.071 | 1.73 | 8.336* | 0.137* | 6.105* |
| FCOOPME | 24.329*** | 7.006 | 3.47 | 19.843*** | 0.293*** | 14.964*** |
| PERCHH | 24.330*** | 7.898 | 3.08 | 17.598*** | 0.367** | 12.767*** |
| PRORIGH | 16.212 | 10.274 | 1.58 | 12.874* | 0.215 | 9.463 |
| AEXTSER | 24.103*** | 6.691 | 3.60 | 19.306*** | 0.304*** | 14.434*** |
| Constant | -43.028 | 36.154 | -1.19 | | | |
| Sigma | 20.993 | 1.611 | | | | |
| N | 140 | | | | | |
| LR $\chi 2$ (12) | 262.80 | | | | | |
| Prob > $\chi 2$ | 0.000 | | | | | |
| Log likelihood | -390.712 | Pseudo $R^2$ | 0.252 | | | |

***, ** and*: indicates statistical significant at 1, 5 and 10% level, respectively.
Note: CHILP=Change in the level of participation, CHIPP=Change in the probability of participation and TOCH=Total change
a= variables converted to natural logarithm.
Source: Own computation of model result, 2016.

water conservation and forest protection activities.

According to focus groups discussion, a non-member of forest cooperatives participated mainly through government inducement in campaign program and by non-government organization support such as monetary and food aid program. Communities living in and nearer forestlands participated mainly through voluntary and government inducements by organizing different groups in associations to obtain different benefits from the forests. Each of the forest cooperative members met once weekly to plan, identify problems and solve them and set rules and regulations on benefit sharing mechanisms of grasses and other issues.

## Econometric analysis results

Here, censored Tobit regression model was performed to identify factors that determine the participation decision of smallholder farmers to participate (or not) and the level of participation in degraded forest rehabilitation practices. The result of Tobit estimation shows that the decision made by respondents to participate or not and the extent of participation in degraded forest rehabilitation practices in the study area are significantly influenced by households distance from the forest, livestock owned, benefit derived or expected from the forest, forest cooperative membership, perception on participation and access to extension services (Table 5).

### *Distance of forest from home (DISFHOM)*

Distance of the forest from the home had a negative impact on participation and level of participation of degraded forest rehabilitation activities at 1% level of statistical significance; that satisfies prior expectation. The marginal effect indicated that as households are far away from the forest by one kilometer, their level of participation, their likelihood of participation and both participation and level of participation in forest rehabilitation decreased by 13.64 units, 19.7%, and 10.13 units, respectively, keeping other factors constant. The household far from the forest did not benefit from the forest because it requires additional cost for transportation of grasses/other forest resources and information asymmetry on the different forest rehabilitation programs. The result is consistent with others studies conducted by Tadesse and Abay (2013) in Ethiopia and Musyoki et al. (2013) in Kenya. They found a negative relationship between distances of a household's home from the forest and participation in forest management and rehabilitation practices due to information asymmetry and rare benefits obtained from the forest.

***Livestock holding size (LIVHSIZE)***

The variable had a positive sign and statistically significant at 1% level which satisfies the prior expectation. The marginal effect implies that an additional of livestock in TLU would increase the intensity of participation, the probability of participation and both participation and intensity of participation in degraded forest rehabilitation by 7.36 unit, 10.7%, and 5.47 unit, respectively, keeping other factors constant. The highest number of livestock owned by the households requires a high amount of feed resources and in turn, participates in forest management and rehabilitation activities. The major livestock feeding system in the study was the cut and carry system due to the absence of grazing land. The major feed resources utilized by the household were grasses, crop residue, agro-industrial product and trees, and shrubs. The major source of grasses and trees and shrubs are obtained from an enclosed forest area of PFM. The sample respondents had a high number of cows as compared to non-participants and produced milk and sell to the market in the group. This result is in line with the findings of Musyoki et al. (2013) in Kenya and Oli and Treue (2015) in Nepal. They found that households that own comparatively large amounts of livestock seem to rely more than others on community forests for the fodder and bedding material, in turn, they were more participants than a small number of livestock owners.

***Benefit derived or expected from the forest (BENDEFST)***

The variable had a positive effect and statistically significant at 10% level that satisfies the prior expectation. The marginal effect implied that being users of forest products compared to non-users would increase the level of participation, the likelihood of participation and both participation and the level of participation in forest rehabilitation practices by 8.34 units, 13.7%, and 6.11 units, respectively, keeping other factors constant. The highest number of livestock owner and households closer to the forest utilized feeds for their livestock either by sharing system or through payment. Most of the users of timber and non-timber forest products engaged in different livelihood activities such as beekeeping, cattle fattening, milk production and other livelihoods activities in individual and forest cooperative manner. The prevailing shortage of land was initiating farmers to diversify forest-based incomes through managing the forest in a sustainable manner. The result is consistent with findings of Tadesse and Abay (2013), Eshetu et al. (2014), Alemayehu et al. (2015) in Ethiopia and Blay et al. (2008) in Ghana and Musyoki et al. (2013) in Kenya. They found that benefits obtained or expected from the forest such as timber and non-timber forest products serve as incentives for the households to engage more in forest management and rehabilitation practices.

***Forest cooperative membership (FCOOPME)***

The variable had a positive effect and statistically significant at 1% level which conforms to our expectation. The marginal effect indicated that being a member of forest cooperatives compared to non-member would increase the level of participation, the probability of participation and both participation and the level of participation by 19.84 units, 29.3%, and 14.96 units, respectively, keeping other factors constant. PFM approach practicing through community participation organized farmers in groups for sustainable management and rehabilitation of the degraded forestland. The households closer to the forest, previously living in forestland, having interest in group action and unemployed ones were organized in a cooperative manner in the study area. Organization of household in a cooperation create a set of rules and regulation, incentive mechanism (the right to use, manage and control of forest resources) and external support obtained from different organization encouraged respondents to participate actively in degraded forest rehabilitation activities. The result is similar with studies conducted by Gobeze et al. (2009), MOA (2012), Tadesse and Abay (2013), Alemayehu et al. (2015), Semeneh (2016) in Ethiopia and Musyoki et al. (2013) in Kenya. They found that households who were living in the forest previously and nearer the forest organized in the group/association/ cooperative to manage forests and their result indicates a strong relationship of forest cooperatives and participation in forest management and rehabilitation practices.

***Perception of household head (PERCHH)***

The variable had a positive relationship and was statistically significant at 1% level in line with prior expectation. The marginal effect implies that agreed respondents to participate compared to disagreed respondents would increase the extent of participation, the likelihood of participation and both participation and the extent of participation in forest rehabilitation practice by 17.59 units, 36.7% and 12.77 units in the study area, respectively, keeping other factors constant. The perception of farmers towards participation in rehabilitation viewed from the angles of perceived benefits obtained from the forest, perceived extent of forest degradation and their effects, perceived current PFM approach, perceived rules and regulation and perceived responsibility of community in the area as a whole for sustainable management of forest in the area. In other ways, the farmers highly benefited in indirect ways from rehabilitation practices in conserving natural resources such as water and soil thereby protecting soil erosion. The improvement of groundwater resources entails farmer's access to irrigation and changes the attitude of farmers towards actively participating in forest

management and other related rehabilitation activities. The result coincides with the study conducted by Tadesse and Abay (2013) who indicate positive perception of households has a positive influence on the level of participation in forest management at Alamata forest in Tigray region of Ethiopia. Similarly, the study conducted by Arowosoge (2015) indicates that the attitudes of the community have a positive relationship with the participation of communities in forest conservation in Nigeria.

### *Access to extension services (AEXTSER)*

The variable had a positive relationship and statistically significant at 1% level on both participation and level of participation of forest rehabilitation activities in line with prior expectation. The marginal effect revealed that households who have access to extension services compared to their counterparts would increase the level of participation, the probability of participation and both participation and extent of participation by 19.32 units, 30.4%, and 14.43 units, respectively, keeping other factors constant. Households with access to extension services were a member of forest cooperatives, had strong linkage with group/extension agent and access to information on different extension programs. In addition, sample respondents obtained more knowledge and information about forest utilization and management through training, advisory services and field day, access to different forage seed/seedlings and other agricultural inputs. The result is consistent with a study conducted by Zbinden and Lee (2005) who indicate that households who have extension service are more likely to participate in forest rehabilitation program in Costa Rica. Similarly, the study conducted by Musyoki et al. (2013) indicates that household training on forest management, utilization, and rehabilitation have a positive influence on the participation of forest management, and rehabilitation practices in Kenya.

## CONCLUSION AND RECOMMENDATIONS

The decline of forest capacity at the global and national level is a great problem that currently affects the livelihoods of people in different ways. To address the alarming rate of forest degradation, different forest rehabilitation and restoration strategies were practiced through community participation. Similarly, Ethiopia has been implementing different rehabilitation strategies through establishing participatory forest management, participatory watershed management, and participatory area enclosures through community participation in different areas. But, absence of uniform participation, unfair benefit sharing, absence of strong punishment and others are major constraints observed in different rehabilitation strategies across different places. Therefore, improving community participation and the level of participation are necessary through strengthening the bottom-up approach for sustainable management of the forest.

Distance of the forest from the home, livestock holding size, benefit derived or expected from the forest, forest cooperative membership, perception of households and access to extension services have impacts on participation and the level of participation in degraded forest rehabilitation practices. Information asymmetry, time delay, fewer direct benefits obtained from the forest, low incentives, rules and regulation of participatory forest management approach and lack of extension services on the forest create a gap on households participation in forest management, protection and rehabilitation practices in the area. Therefore, improvement of rural infrastructures such as road and transportation, timely dissemination of information, improvement of production and productivity of livestock, strengthening of existing benefit schemes and creating related ones give farmers the opportunities to join the group; and awareness creation is an option to improve households' participation and the level of participation in degraded forest rehabilitation activities in the study area.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

## ACKNOWLEDGMENTS

Authors would like to thank Oromia Agricultural Research Institute and Mechara Agricultural Research Center for financial support and facilitating logistics. The authors would also like to thank enumerators, District Agricultural Office, Oromia Wildlife and Forest Enterprise Office of Hararghe Branch, *Kebele* administration, development agents and sample households for great contribution on the study.

## REFERENCES

Adugnaw B (2014). Environmental Degradation and Management in Ethiopian Highlands: Review of Lessons Learned. International Journal of Environmental Protection and Policy 2(1):24-34.

Alemayehu NA, Vandenabeele N, Arts B (2015). Performance of participatory forest management in Ethiopia : institutional arrangement versus local practices. Critical Policy Studies, http://doi.org/10.1080/19460171.2015.1024703

Arowosoge OG (2015). Local People's Perception of Forest Resources Conservation in Ekiti State, Nigeria. Journal of Environmental Science and Engineering B, 4:132-140.doi:10.17265/2162-5263/2015.03.004.

Badal PS, Kumar P, Bisaria G (2006). Dimensions and Determinants of Peoples' Participation in Watershed Development Programmes in Rajasthan. Agricultural Economics Research Review 19:57-69.

Badege B. (2001). Deforestation and Land Degradation on the Ethiopian Highlands: A Strategy for Physical Recovery. Paper presented at International Conference on Contemporary

Development Issues in Ethiopia, Kalamazoo, Michigan, U.S.A.
Blay D, Appiah M, Damnyag L, Dwomoh FK, Luukkanen O (2008). Involving local farmers in the rehabilitation of degraded tropical forests : some lessons from Ghana, Environment Development and Sustainability (10):503-518.
Cragg J (1971). Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods. Econometrica, 39(5):829-844.
Dageye G, Mengistu K (2016). Analysis of Cross-Sectional, Time Series and Panel Data Using Stata and Eviews. Unpublished Training Module I, Haramaya University, Haramaya, Ethiopia.
Eshetu Y, Mulualem T, Mulugeta L, Mesele N, Demel T (2014). Rehabilitation of degraded forest and woodland ecosystems in Ethiopia for the sustenance of livelihoods and ecosystem services pp. 299-313. In: Pia Katila, Glenn Galloway, Will de Jong, Pablo Pacheco, Gerardo Mery (eds.) Forest under pressure – local responses to global issues. IUFRO World Series Volume 32. Vienna.
Food and Agricultural Organizations of United Nations (FAO) (2015). Global Forest Resources Assessment 2015. Desk Reference. Food and Agriculture Organization of the United Nations, Rome, Italy.
Gemachis District of Agriculture and Natural Resource Office (GDANRO) (2016). Unpublished Report of Office, Kuni, West Hararaghe Zone, Oromia Region, Ethiopia.
Gobena M (2010). Effects of large-scale land acquisition in rural Ethiopia: The case of Bako-Tibe Woreda. M.Sc. thesis. Swedish University of Agricultural Sciences, Uppsala, Sweden. 52 p.
Gobeze T, Bekele M, Lemenih M, Kassa H (2009). Participatory forest management and its impacts on livelihoods and forest status: the case of Bonga forest in Ethiopia. International Forestry Review 11(3):347-356.
Haregeweyn N, Berhe A, Tsunekawa A, Tsubo M, Tsegay D (2012). Integrated Watershed Management as an Effective Approach to Curb Land Degradation: A Case Study of the Enabered Watershed in Northern Ethiopia. Environmental Management 50:1219-1233.
Keenan RJ, Reams GA, Achard F, de Freitas JV, Grainger A, Lindquist E (2015). Dynamics of global forest area: Results from the FAO Global Forest Resources Assessment 2015. Forest Ecology and Management 352:9-20.
Meshesha YB, Birhanu BS (2015). Assessment of the Effectiveness of Watershed Management Intervention in Chena Woreda, Kaffa Zone, Southwestern Ethiopia. Journal of Water Resource and Protection 7:1257-1269. http://dx.doi.org/10.4236/jwarp.2015.715102
Ministry of Agriculture (MOA) (2012). Guideline for Participatory Forest Management in Ethiopia. Scaling-up Participatory Forest Management Project, Natural Resource Sector, Ministry of Agriculture, Addis Ababa, Ethiopia.
Mulugeta L, Habtemariam K (2014). Re-Greening Ethiopia: History, Challenges and Lessons. Forests 5:1896-1909.
Musyoki JK, Mugwe J, Mutundu K, Muchiri M (2013). Determinants of Household Decision to Join Community Forest Associations. Hindawi Publishing Corporation, ISRN Forestry, http://dx.doi.org/10.1155/2013/902325.
Oli ABN, Treue T (2015). Determinants of Participation in Community Forestry in Nepal. International Forestry Review 17(3):311-325.
Said A, Hara P (2010). Participatory Forest Management Guidelines. Non-Timber Forest Project – Participatory Forest Management - Research and Development Project, South West Ethiopia, Mizan Teferi and Addis Ababa, Ethiopia.
Semeneh BD (2016). Collective Action, Property Rights and Bamboo Deforestation in Benishangul-Gumuz Region, Ethiopia. Journal of Resource Development and Management, 16:94-102.
Tadesse GE, Abay TM (2013). Explaining the Determinants of Community Based Forest Management: Evidence from Alamata, Ethiopia. International Journal of Community Development 1(2):63-70. DOI: 10.11634/233028791301431.
Temesgen G, Fikirte A, Damena E (2015). Forest Degradation in Ethiopia: Extent and Conservation Efforts. PJ Palgo Journal of Agriculture 2(2):49-56.
Tobin J (1958). Estimation of relationships for limited dependent variables. Econometrica 26:24-36.
United Nations Development Programme (UNDP) (2012). Ethiopia, United Nations Conference on Sustainable Development (Rio+20) National Report of Ethiopia Federal Democratic Republic of Ethiopia Environmental Protection Authority.
Winberg E (2010). Participatory Forest Management in Ethiopia, Practices and Experiences. Addis Ababa: Food and Agriculture Organization, Subregional Office for Eastern Africa (SFE).
Yitebitu M, Eyob T (2014). Overview of REDD+ Process in Ethiopia. Ministry of Environment and Forest, Addis Ababa, Ethiopia.
Zbinden S, Lee DR (2005). Paying For Environmental Services: An Analysis of Participation in Costa Rica's PSA Program. World Development 33(2):255-272.

## Related Journals: