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Journal of Science and Sustainable Development (JSSD)

An International Journal of Ambo University

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Journal of Science and Sustainable Development (JSSD)

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- To promote the effective teaching of science, technology and management; identifying problems and developing solutions through dissemination of new information from researches align in the direction of solving the basic need of the country.

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Following the abstract, about 3 to 5 **key words** that will provide indexing references should be listed.

A list of non-standard **Abbreviations** should be added. In general, non-standard abbreviations should be used only when the full term is very long and used often. Each abbreviation should be spelt out and introduced in parentheses the first time it is used in the text. Only recommended SI units should be used. Standard abbreviations (such as ATP and DNA) need not be defined.

The **Introduction** should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

Materials and Methods should be complete enough to allow experiments to be reproduced. However, only truly new procedures should be described in detail; previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer's name and address. Subheadings should be used.

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Tables should be kept to a minimum and be designed to be as simple as possible. Tables are to be typed double-spaced throughout, the captions. Each table should be numbered consecutively in Arabic numerals. Tables should be self-explanatory without reference to the text. The same data should not be presented in both table and graph forms or repeated in the text.

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Abayomi (2000), Agindotan et al. (2003), (Kelebeni, 1983), (Usman and Smith, 1992), (Chege, 1998; Chukwura, 1987a,b; Tijani, 1993,1995), (Kumasi et al., 2001)

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Examples:

Moran GJ, Amii RN, Abrahamian FM, Talan DA (2005). Methicillinresistant *Staphylococcus aureus* in community-acquired skin infections. Emerg. Infect. Dis. 11: 928-930.

Chikere CB, Omoni VT and Chikere BO (2008). Distribution of potential nosocomial pathogens in a hospital environment. Afr. J. Biotechnol. 7: 3535-3539.

Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing *Escherichia coli* in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51: 1281-1286.

Pelczar JR, Harley JP, Klein DA (1993). Microbiology: Concepts and Applications. McGraw-Hill Inc., New York, pp. 591-603.

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RESEARCH PAPER

Prevalence and pattern of severe malaria among adults in Jimma University Specialized Hospital, Jimma, Southwest Ethiopia: A three years retrospective study

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Abstract

Severe malaria is a protozoan disease of human caused mainly by plasmodium falciparum (P.falciparum) but sometimes by Plasmodium vivax and mixed infections. The objective was to assess the prevalence, pattern and trends of severe and complicated malaria among adults admitted to the Medical wards of Jimma University Specialized Hospital (JUSH), South West Ethiopia, from May 1, 2013 to April 30, 2016. A retrospective medical record review study was conducted from May 1, 2013 to April 30, 2016 to assesses the files and registries of patients' with severe malaria admitted to Medical wards of JUSH. The prevalence of confirmed sever and complicated malaria in JUSH from May 1, 2013 to April 30, 2016 was 2.6 % (144) out of the total admission of 5590 patients cards in the three years to JUSH medical ward. Out of the confirmed severe and complicated malaria case mortality was 0.6 %(32) with case fatality rate was 22.2 %(32/144). Adult severe malaria cases showed slightly declining pattern during the study period: 90 %(58) in 2013/14, 3.82% (33) in 2014/15 and 1.64% (53) in 2015/16. Distribution of cases over months showed bimodal pattern for all of the years with the two peaks during the months of May to July and during November to January. P. falciparum accounted for 91.6% of severe malaria causative agent. Patients with co-morbid infections account 33% of cases of severe and complicated malaria. The commonest co-morbid infection was meningitis. More than 80% of the cases were presented to the hospital after 24 hours of malaria episode, which may contributed to increased case fatality rate. Delayed hospital visit was significantly associated with average annual case fatality rate of 5.32 %(15.97% for all the study years) (X2=33.75, P=0.001).This study has shown that trend of malaria admission over three years showed marked decline from 2013/14 to 2015/16. Delay in presentation to the health facility is associated with poorer prognosis, hence early recognition and treatment would decrease mortality. Though declining pattern of malaria s being observed adult severe malaria transmission was active over the studied years even at the end of the first phase of Roll Back Malaria Initiative. Therefore, the efficiency of malaria control and treatment programs should be investigated to fill gaps.

Keywords: adult severe malaria, P.falciparum, P. vivax, retrospective record review

Introduction

Human malaria is one of the medical emergency disease (Andrej, 2003) that affects the biochemical and physiological processes of the body. It is caused by one of five obligate intra cellular protozoan parasitic protozoa of genus plasmodium, single celled organism. Malaria causing plasmodia are *P. falciparum*, *Plasmodium vivax* , Plasmodium ovale and *Plasmodium malaria*and *Plasmodium knowlesi* (Nour, 2009).

The sign and symptoms of malaria caused by different species of plasmodium vary. The common features of malaria include fever, chills, and flu-like illness (CDC, 2019). The

parasite and the disease are transmitted from infected patient to healthy person. This transmission involves two steps: initially during blood meal female anopheles bite an already infected person and pick up the parasite at its gametocyte stage in second step the same mosquito will bite the other (healthy). In the later step it will inject the parasite through saliva to the blood of the person but now at its sporozite stage that will grow first in the liver cells and later in red blood cells into merozoite stage. This will grow into gametocyte stage, completing the life cycle of the parasite When an individual is inoculated with a plasmodium parasite, a variety of clinical effects may follow, within the sequence from infection, asymptomatic parasitemia, uncomplicated illness through severe malaria to death (WHO, 2014).

Observing the stages of progression of malaria it is possible to categorize the disease into two forms: uncomplicated (non-sever) and complicated (sever) type. Detailed comparison of the two forms can be seen in references (Andrej, 2003; Nour, 2019; WHO, 2014; Grobusch and Kremsner, 2005). If promote and appropriate treatment is given before the disease transform into severe type recovery from the disease is very rapid otherwise it may cause severe complications and death (CDC, 2019). Patients with uncomplicated malaria can be treated as an outpatient while patients with severe malaria require an intensive care and treated as an inpatient (Nour, 2019) levying heavy burden on the family and health system.

Severe malaria is caused mainly by infection from *P.falciparum* but sometimes by *P.vivax* and mixed infections can contribute to the development of severe and complicated malaria. The approximate global incidence and mortality from severe malaria in one year are estimated to be two million cases and 627,000 respectively (Thwing and Steketee, 2011), which is mainly due to progression of infection to severe malaria. Severe malaria shall be treated as rapidly as possible. The case fatality rate of severe malaria in hospitals is 20% and at home is 90% (Thwing and Steketee, 2011). The distribution of severe malaria with in age and social group differs based mainly on the transmission feature of *P. falciparum.* In areas where malaria transmission is stable as in sub-Saharan Africa, severe and fatal malaria affect children < 5 years (WHO, 2012) than adults. In areas where *P. falciparum* transmission is unstable, severe malaria occurs in all age groups (young children (<5 years), older children, and adults) due to lack of protective immunity (Black et al., 2010). This disparity is basically dependent on immunological adaptation to disease. In areas where transmissions stable, a person could have malaria in the blood but s/he may be asymptomatic. The body will develop immunity against repeated infection by plasmodium by mosquito bite (WHO, 2014).

Ethiopia is one of the Sub-Saharan African countries whose large population is vulnerable to malaria. An estimated 68% of the population in Ethiopia lives in malarious areas and 75% of the total land mass is malarious. Malaria is one of the leading causes of mortality and morbidity in Ethiopia (FMoH, 2006).Though malaria is common in Ethiopia, the major malaria transmission is highly unstable in character and season (Ruth et al., 2011). *P. falciparium* is the dominant pathogen of malaria though it is also possible to find *P. vivax* (PMI, 2015).

The main malaria control strategies in Ethiopia include selective vector control, epidemic management and control, environmental management and personal protection through the use of insecticide-treated bed nets (Grobusch and Kremsner 2005; Black et al., 2010). Despite recent efforts to control the disease, malaria remains the leading cause of mortality and morbidity in the country (FMoH, 2006; FMoH, 2004; WHO, 1993). The assessment of the prevalence, pattern and trends of severe malaria will help to recognize gaps in the performance of malaria control program like gaps in: the provision of preventive measures such as insecticide- treated bed nets or indoor residual spray, the use of preventive measures, delays in seeking treatment or poor access to diagnostic testing and treatment (WHO, 2012). Furthermore, the use of data on each inpatient case of confirmed malaria (a proxy of severe malaria) or death is

important for investigation of possible program weaknesses in the prevention or treatment of malaria is recommended (WHO, 2012). However, to the knowledge of our understanding there is no data which specifically reports, about adult severe malaria from southwest Ethiopia specifically JUSH as this hospital serving people from different districts of Jimma zone and other nearby zones Southern Nation and nationalities and Gambella region in which these districts in the zone and other zones of southern nation and nationalities and Gambella region are suspected malarious area.

Therefore, the aim of this study was to assess retrospective medical recorded review on prevalence, pattern and trends of severe malaria among adult inpatients attending and admitted to JUSH Medical wards from 2013 to 2016.

Materials and methods

Study area

This study was conducted at JUSH, Jimma, Ethiopia. JUSH is located to the Northeast of Jimma city, which has a geographic coordinate of $07^0 40'$ N, $36^0 50'$E. Jimma city is located about 352 km from Addis Ababa, the capital city of Ethiopia to the south west. It is one of the oldest hospital in the country and established in 1930 by the Italians invaders. JUSH is the only teaching and referral hospital in the southwestern part of the country, providing services for about 15 million people with catchments area of about 250km radius(Elias and Mirkuzie, 2010). It has training center for about 700 health science students each year. The hospital has four major departments such as Medical, Surgery, Gyneclology /Obstetrics and pediatrics and five other departments. The hospital provides postgraduate training in Internal Medicine, Surgery, Gynecology/obstetrics, pediatrics and Ophthalmology. It has about 600 beds and total of more than 550 employees. The hospital provide service for inpatients and outpatients with diagnostic modalities are routine laboratory investigations, Radiology and histo-phatologic techniques.

Study design

Retrospective study design was used on medical record review from May 1, 2013 to April 30, 2016.

Data collection

The data was collected from medical records of medical wards focused on patients admitted for sever malaria cases. Questionnaire was used for the collection of data for the purpose of this study. The data was collected by nurses working in the medical wards during data collection time.

Selection of medical records

All medical records of patient's visited JUSH during May 1, 2013 to April 30, 2016 were screened for severe malaria. All medical records of adult patients with presumptive and confirmed severe malaria were collected and rescreened for adult medical records with confirmed severe malaria were only selected. In then medical records of patients with presumptive severe malaria were screed out. Based on this procedure a total 5590 medical records were found in medical wards for the intended study periods of these records only 201 presumptive and confirmed records were selected. Of the 201 presumptive records only 144 medical records were retained for data abstraction (Fig.1).

Data abstraction was conducted by comparing medical records with discharge register of inpatients. This comparison was done to make sure that all the information required for this study can be located. Discharge register, which contains the final diagnosis, is the most important register for malaria surveillance systems. Data was abstracted in JUSH medical ward by trained nurses with close supervision by medical intern by using data abstraction tool. The tool was pretested before use.

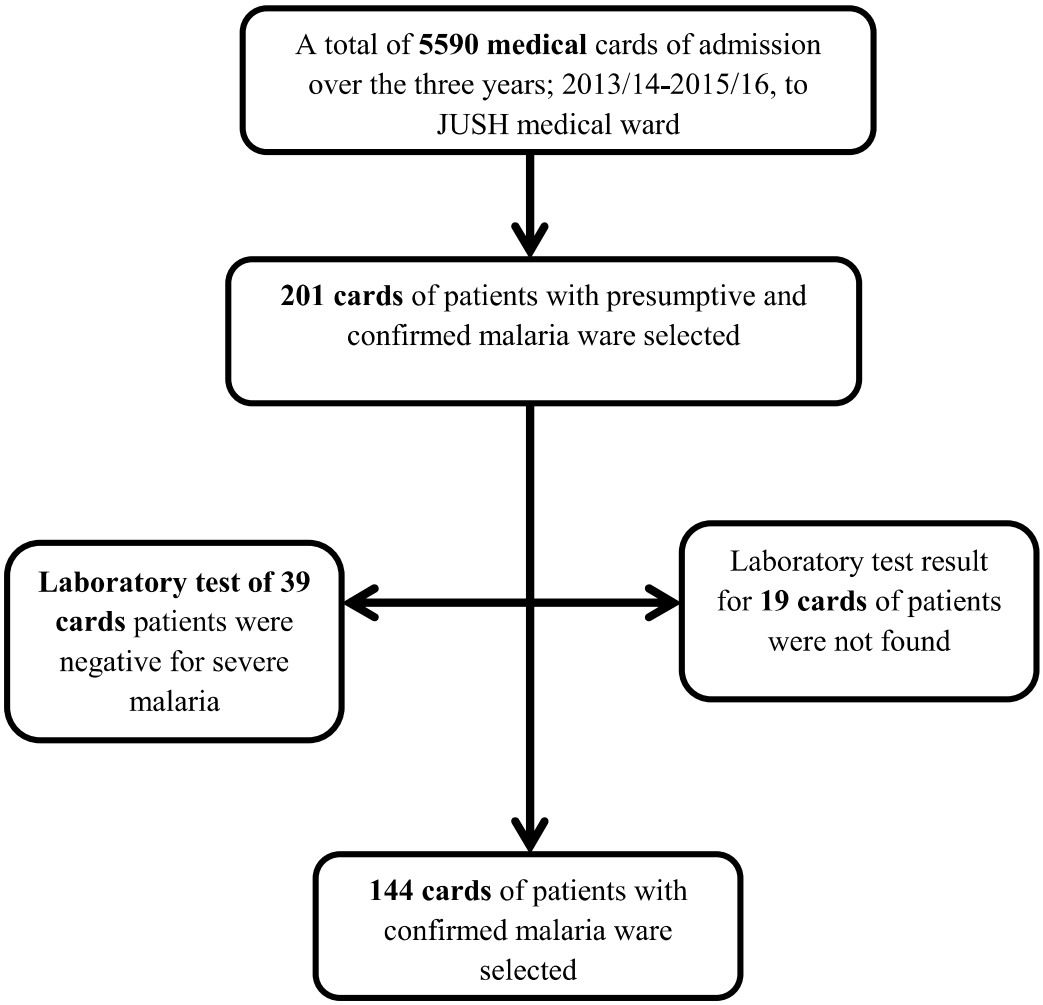

Figure 1.Flow chart for selection of cards of severe malaria patients

The data abstraction format used here was modified discharge reister and features of severe malaria. This format has six parts. The first part contains socio-demographic information the patient's. The second part contains information about diagnosis of pathogen of severe malaria pathogen and co-morbid infections. The third part contains the defining features of severe malaria in symptomatic patient. The fourth, fifth and sixth parts contain information about duration of delayed arrival in the hospital after the onset of the episode, length of stay in hospital and reason for leaving hospital (discharged, died, transferred, absconded), respectively

Severe malaria case definition

For case definition of sever malaria we used (WHO, 2014) guideline as described in Table 1 below.

Table 1. Epidemiological and research definition of severe *falciparum malaria* criteria for this study/

For epidemiological and research purposes, severe malaria is defined as one or more of the following, occurring in the absence of an identified alternative cause, and in the presence of *P. falciparum* asexual parasitaemia:	
Impaired consciousness:	A Glasgow Coma Score <11 in adults or a Blantyre coma score <3 in children
Acidosis:	A base deficit of >8 meq/l or, if unavailable, a plasma bicarbonate of <15 mM or venous plasma lactate >5 mM. Severe acidosis manifests clinically as respiratory distress – rapid, deep and laboured breathing
Hypoglycaemia:	Blood or plasma glucose <2.2 mM (<40 mg/dl)
Severe malarial anaemia:	A haemoglobin concentration <5 g/dl or a haematocrit of <15% in children <12 years of age (<7 g/dl and <20%, respectively, in adults) together with a parasite count >10 000/μl
Renal impairment (acute kidney injury):	Plasma or serum creatinine >265 μM (3 mg/dl) or blood urea >20 mM
Jaundice:	Plasma or serum bilirubin >50 μM (3 mg/dl) together with a parasite count >100 000/μl
Pulmonary oedema:	Radiologically confirmed, or oxygen saturation <92% on room air with a respiratory rate >30/min, often with chest indrawing and crepitations on auscultation
Significant bleeding:	Including recurrent or prolonged bleeding from nose gums or venepuncture sites; haematemesis or melaena
Shock:	Compensated shock is defined as capillary refill ≥3 s or temperature gradient on leg (mid to proximal limb), but no hypotension. Decompensated shock is defined as systolic blood pressure <70 mm Hg in children or <80 mm Hg in adults with evidence of impaired perfusion (cool peripheries or prolonged capillary refill)
Hyperparasitaemia:	*P. falciparum* parasitaemia>10%

Data Analysis

The collected data were transferred from data abstraction form to spread sheet and cross checked for completeness and proper recording. Data were presented and analyzed using charts, graphs, chi square and frequency tables.

Ethical consideration

This study was approved by college of health science graduating class Student's Research Program organizing committee. This study was conducted after obtaining an official letter from the same committee. Furthermore, the objective of the initiative was presented to JUSH hospital managers and key stake holders to get permission.

Results

Prevalence and socio-demographic features of severe malaria in JUSH

A total of 5590 patients were admitted to the medical wards of JUSH during the study period: May 1, 2013 to April 30, 2016. Out of this 201 (3.6%) medical cards of patients assumed to be severe malaria possetive. But only 2.6%(144) of the total admission cards were found to havelabortory test confirmed severe malaria.

The majority of severe malaria infection was found in patients who are in the productive ages range. More than eighty five percent (85.50%) of the patients were in age range of 15-45, active working age, with the mean age of 31.9 years. The proportion of patients aged older than 45 years was 14.50 %.

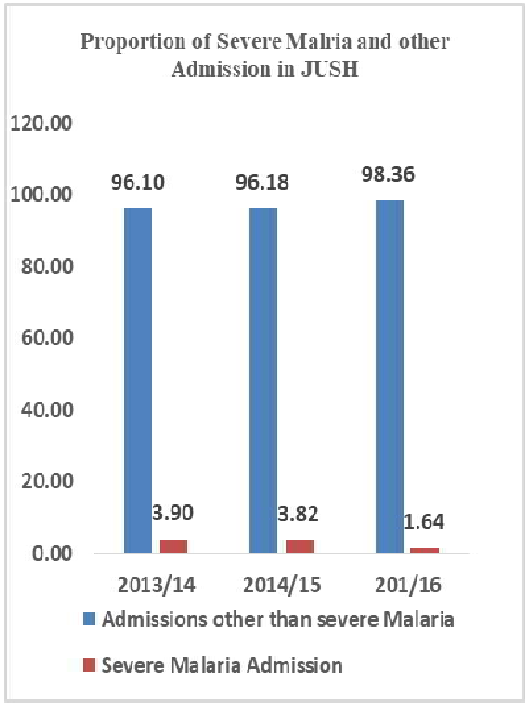

Figure 2: comparison of proportion of severe malaria admission and admission other than sever malaria over three years to the medical wards, JUSH, from May 1, 2013 to April 30, 2016

The annual admissions in the JUSH medical ward for each year from 2013/14 to 2015/2016 were 1489, 865 and 3236 while the identified severe malaria for each year was 3.90% (58), 3.82% (33) and 1.64% (53) respectively. The highest admission due to severe malaria was observed during 2013/14 with a marked decline in the proportion of cases admitted thereafter (Fig.2).

Prevalence of malaria by parasites among severe malaria patients in JUSH

In this study microscopic test had confirmed Plasmodium in only 143 study subjects. The malaria causing parasites detected with in the blood of severe malaria patients were *P. falciparum* and *P. vivax*. The former accounted for 91.66 %(132) of the cases and was the dominant pathogen. The same test showed that *P. vivax* was observed only in 4.16 %(6) of the cases. The remaining 4.16% blood films showed mixed infection from both *P. falciparum* and *P. vivax* was detected (fig.3).

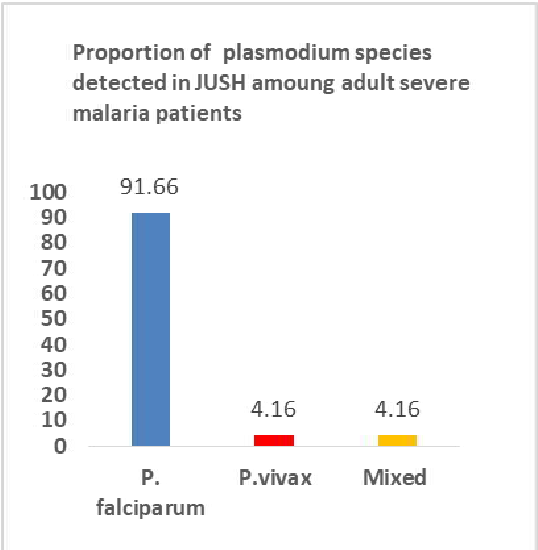

Figure 3: Malaria Pathogen species identified in patients with severe malaria admitted to medical wards, JUSH, from May 1, 2013 to April 30, 2016

Distribution of severe malaria by months in JUSH

The distribution of severe malaria occurrence over months (Fig.4) showed bimodal pattern for all of the three years. The two peaks were during the months of April and May and during September to December. The higher peaks were recorded in the September to December throughout the study period. The moderate peaks were recorded during April and May. Both the higher and moderate peaks showed declining tendency from the years 2013-2016.

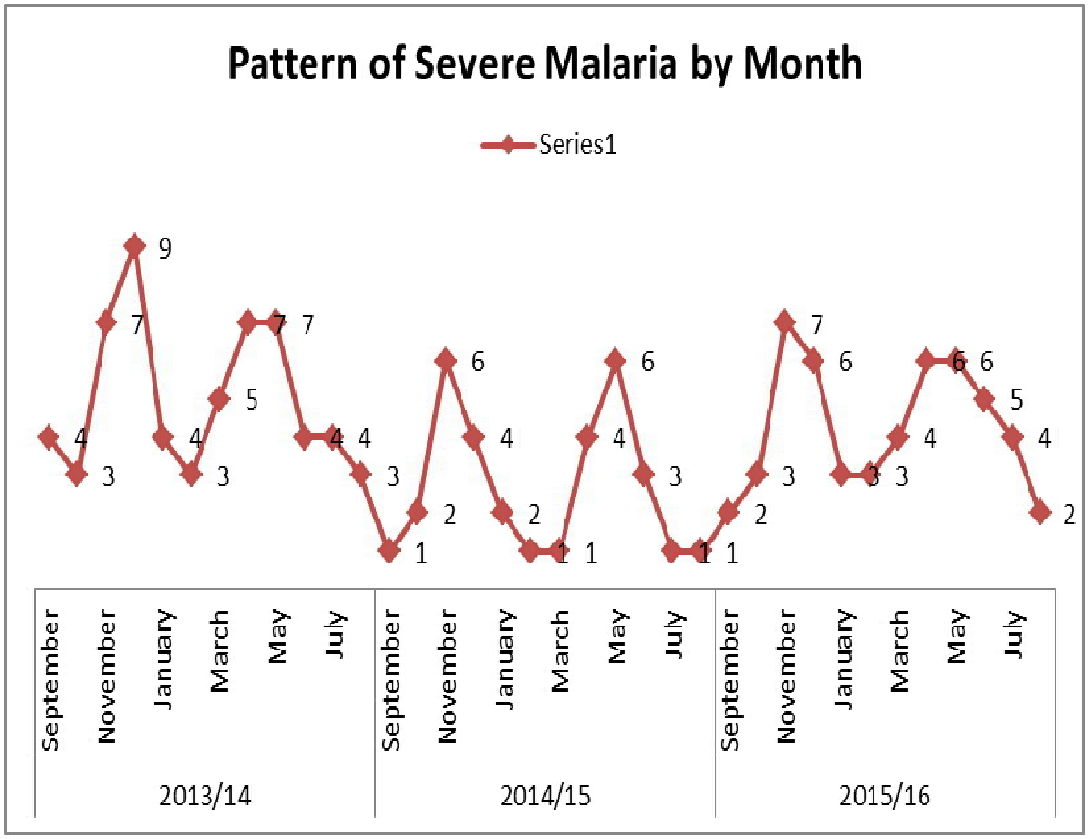

Figure 4: Patterns of malaria admission by month over three years from May 1, 2013 to April 30, 2016

Duration of Hospital arrival after the first episode of Malaria sign-and association of hospital out comes in JUSH

The result of assessment of the charts of patients in this study showed (Table.1) that only 19 % (27) (arrived in or contacted health systems within 24hrs; 54 % (78) within 24-72hrs and the rest 27% (39) after 72 hrs of the onset of symptoms of illness. Delay in hospital visit (Table 2.) for more than 72hrs is related to more frequent deaths (16 deaths out of 144 cases). Delay in hospital visit for 24-72hrs resulted in moderate deaths (six deaths out of 144) while immediate hospital visit (< 24hr) after the initial episode caused the death of one person only. In general more than 15.97% (23) of the patients admitted with severe and have died. This showed that the development of severe malaria and its hospital outcome is significantly associated with delay in hospital visit with(X^2 =33.75, P=P=0.001< α=0.05).

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Table 2: Duration of illness before arrival versus outcome cross tabulation of patients admitted with severe malaria to the medical wards, JUSH, from May 1, 2013 to April 30, 2016.

	Hospital Out come					
Duration	**Improved**	**Dead**	**Total**	**%**	**X^2**	**P-value**
<24hrs	26	1	27	19	33.75	0.001*
24-72hrs	70	6	76	54		
>72hrs	24	16	40	27		
Total	120	23	143	100		

*There is significant association between delay in hospital visit and severe malaria deaths in hospital (n=143), P=0.001< α=0.05.

Duration of Hospital Stay for Severe malaria Cases in JUSH

Equal proportion of severe malaria patients stayed in JUSH medical ward before discharge for 3-7(three to seven days) and more than 7 (seven days) days (Table 2.). The former accounted for 43.60% and the later for 43.10% of patients. Small proportion, about 13.10% percent of patients was discharged within less than three days of admission

Discussion

This study showed that severe malaria admissions were active atJUSH consistently over the three years of study period. This deadly disease was found affecting active, working age group. The prevalence showed slightly decreasing pattern from the years 2013-2016. The average annual server adult malaria admissions recorded in JUSH over the study period was 2.6%(48/1863) and is far less than the annual general malaria caused hospital admissions, which is 16% and reported from Oromia regional state (PMI, 2015).This discrepancy would be due to the difference in the mode of the report. We restrict our report to confirmed adult severe malaria admissions while the report from Oromia regional state includes all age groups. The result of our study was slightly less than what is reported from Gondar University Hospital, where hospital malaria admission accounted for 4.4% (Mangistu et al., 1978). Severe malaria cases showed progressively declining pattern over the three years study period. This reduction would be attributable to the implementation of malaria contention intervention program in the past few years by Federal Ministry of Health (FMoH) and Oromia Health Bureau in the study area. In 2007 the FMoH distributed 20 million Long Lasting Insecticide Nets and conducted mass drug administration with the Artemesinin Combined Treatment drug artemeter-Lumefantrine (PMI, 2015) as first line treatment. The other reason could be the fact that JUSH is a tertiary hospital; most cases may get managed in nearby health centers. However, this problem was observed in a referral hospital, JUSH even during the last phase of the Millennium Development Goal 6 (Roll Back Malaria; UN, 2015). The mean age of severe malaria affected patients in our study was 31.9 years with minimum. Similar results were reported by Van and Kim (1990) in Vietnam, Endeshaw and Assefa, (1990) in Ethiopia and, Alcantra, 1982) in Philippines.

The major annual transmission modes of adult sever malaria in this study area showed seasonal bimodal scenario. Malaria transmission in Ethiopia is mainly seasonal and has unstable character and areas with bimodal seasonal rain fall will have two major malaria transmissions seasons (National Malaria Control Team, Ethiopian Public Health Institute, World Health Organization, Addis Ababa University and the INFORM Project ., 2014).

In this study, the dominant single plasmodial species detected in the blood of severe malaria

affected patients was *P. falciparum*. Mixed infection (*P. falciparium* and *P. vivax*) contributed smaller cases. Infection rate from *P.vivax* alone was equal to mixed infection rate and it is low. The result of this study is concordant with a study done in San Lasaro Hospital (Rowena and Arturo, 1992). Tajebe et al. (2014) also reported high infection rate from *P. falciparum*, moderate infection rate from *p. vivax* and very low mixed infection in microscopic diagnoses. Another study reported higher prevalence (53.01%) and severity of adult severe malaria caused by mixed infection (Kochar et al., 2014). The difference observed in prevalence of specific plasmodium and its malaria may be due to the difference in the malaria endemicity and immunity status of study subjects in those study areas.

This study showed that delay in treatment seeking as demonstrated by late arrival in the hospital seems to contribute more to the development of severe malaria and associated morbidity and mortality. More than 80 %(81.25%) of the cases arrived in hospital after 24hours of the onset of illness, which account for 95.65% of all dead patients (X^2=33.75, P=0.001). Other studies also showed that risk factors for severe malaria and associated mortality include delay in treatment, old age (> 65), severity of illness and the level of innate or acquired immunity and missed or delayed diagnosis (Bruneel, 2003; Blumberg et al., 1996; Schwartz etla., 2001).

The average annual severe malaria case fatality rate in this study was 5.32%. This result was almost similar to (7.8%) adult severe malaria case fatality rate reported from Yemen (Sawsan, 2013). The case fatality rate of severe malaria reported in this study was less than that of both Gondar university Hospital (11%) Mangistu et al,(1978) and the one reported by Kain, (1998) on imported severe malaria that is estimated to exceed 20%; 19% in adults in hospital from western Cambodia hospital (Chanthap Lon, 2013) and 15.20% in Vietnam (Van et al., 1982). The discrepancy among the results of these studies may be due to the different diagnostic criteria used in each study, to the hospital set up & facilities used in the treatment of each case and to included study participants.

Conclusion

This study showed malaria transmission was still occurring in south western Ethiopia during two major seasons: September to December and May to April. At least some of these cases transform into severe malaria. Delay in the health facility visit was associated with poorer prognosis; hence early recognition and treatment would decrease mortality. As the occurrence of severe malaria is an indication for malaria contention intervention inefficiency, the components of the intervention program in the south west Ethiopia should be re investigated so that possible behavioral risk factors, possible occurrence of insecticide and drug resistance will be sorted out while thinking for the WHO set technical strategy for malaria during 2016-2030.

Limitation of the study

This study addressed adult severe malaria only. Therefore, for peoples in less than 15 years was not addressed. The study was conducted over only three year period, which relatively short. Thus the result of the study will not clearly catch the tendency of the adult severe malaria case in the study setting

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Author's conflict of interest

All the authors participated in this study would like to declare that we agree on the publication of this manuscript and would like to disclose that this work is not related to any person or institution that can bias our report.

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RESEARCH PAPER

Determinants of Households' Decision to Save at Household Level: Evidence from Small holder Farmers' of Ambo District, Oromia National Regional State, Ethiopia

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Abstract

Saving is an important economic growth to be studied under the purview of the economic arena on an individual as well as household basis. In a country like Ethiopia, the income standard is almost uncertain and leads to more consumption rather than saving which has now been a central problem. The objective of this study was to identify the determinants of farmers' decision to save at household level. Both primary and secondary data source were used for this study during 2018/19. Accordingly, the study was based on the survey of a total of 130 farmers covering three kebeles of Ambo district. Besides, binary logit model was used to analyze the factors affecting households' decision to save. The results of this study indicated that education level of the household head, income of the household and land holding size had positively and significantly affected households' decision to save. But distance from microfinance Institution had negatively and significantly affected households' decision to save in the study area. This study recommends that in order to make micro-economic successful these factors and problems need to be taken into consideration by policy makers to encourage farmers to participate in saving.

Keywords: Ambo District, Decision to save, Logit Model, Smallholder

Introduction

Ethiopia is one of the developing countries where there has been a reliable increase in the national saving rate after the independence period from different saving institution, though with considerable fluctuations from year to year. Saving is an important variable for every country to be studied for the economic growth and development of any country. Saving is an important macroeconomic variable to be studied under the purview of the economic arena on an individual as well as household basis. Saving is among important variables for economic growth of any country. It is about income that is not consumed by immediately buying goods and services (Girma, 2012). Saving constitutes the basis for capital formation, investment and growth of a country.

Serious problem confronting poor countries including Ethiopia is the savings and investment gap. Because of this gap, these countries find it difficult to finance investments needed for growth from domestic saving (Soneye, 2014).

The saving level in Ethiopia particularly in rural areas is very low and little is known empirically about its patterns and determinants. Savings in rural Ethiopia is mainly made out of the income from agricultural activities (Soneye, 2014). However; rural households do indeed save in the form of tangible assets and/or in financial forms which can be potentially utilized by savings institutions and for investments which is very essential for both households and nation.

Although there is controversy regarding the relation between savings and economic growth, it is generally agreed that once savings start to rise-perhaps due to increases in income-they enhance the potential to finance investment, and lead to the creation of more opportunities in the economy (Mulat, 2001). Household saving could be accumulating in real assets or financial assets. Large part of saving accumulation in developing countries is in the form of real assets such as livestock, precious metals, or food stocks. They could save in banks or non-bank financial institutions in cash form. In this respect, access to financial institution that meets liquidity needs is crucial (Girma, 2012).

The present study can be a relevant one to know; the reasons for lower saving patterns of households and what the determinants which are responsible for saving are. Aggregate saving in any economy is dependent on a number of variables (Girma, 2012). For effective economic planning, the planners should have an idea regarding the volume of saving of different groups of people and the method by which saving can be improved more over in a better way. In Ethiopia, especially at West Shewa zone in Ambo district there is a poor access to the saving and credit institution and lack of motivation of households to develop their habits of saving (Girma, 2012). This study tried to fill the gap by providing insight in to the households in the improvement of the habits of saving of households in the study area. There are different studies which is evident on habits of saving in rural areas of Ethiopia. Household saving expand their patterns of households and what are the determinants which are responsible for saving (Tesfaye, 2014; Tezera, 2010; Woinishet, 2010 and 2016). Therefore, rural households saving derive their income from agricultural activities (Soneye, 2014).

However, there are studies indicating the different constraints which affect the determinants of rural household saving accumulation in developing countries are in the form of real assets. These include livestock, precious metals, or food stocks (Girma, 2012). Therefore, the objective of the study was to identify factors affecting households' decision to save in the study areas.

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Research Methodology

Description of the Study Area

Ambo town is located in the western Oromia national regional state and it is the zonal town of the west shoa zone. It is located at a distance of 112km from Addis Ababa on the main road that leads to western region of Ethiopia. Ambo town was established in 1889 and covers an area of 8587 hectares of land. It is one of the oldest towns in Ethiopia.

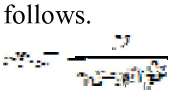
Geographical location of Ambo town is 08 59' E longitudes. The average elevation of the town is 2090 meters above sea level and it varies from 2060 meters to 2140 meters above sea level. The town and its surrounding have mean annual precipitation of 912 millimeters and the mean annual temperature of the town is about 17.6 centigrade. The town is an administrative capital for west shoa zone. The master plan covers different aspects such as development plans road network plans, drainage and land use plan etc.(Ambo town city administration, 2019).

Data Sources and Type

The study used both primary and secondary types of data. The primary data was collected from households using structured questionnaires prepared and distributed to those respondents who are selected as a sample of study area. The secondary data on the other hand was gathered from Ambo town Trade and Market Development Office, investment office and different publications.

Sampling Techniques

In this study, Two-stage samplings were employed. At first stage, three kebeles were selected from all kebeles of the district by simple random sampling of lottery method. At the second stages, households were selected using systematic random sampling. The summary of sampling design is displayed as follows.

 (Yamane,1967)

$n = \frac{N}{1+N(e)^2} = 130$..... (1)

N = Population size (total number of household in the *woreda)*

Where: n = Sample size for the research use

e = Level of precision 5 (=0.05)

Table 1. Sample size determination

No.	Name of kebeles	THH	Percent (%)	Sample size
1	Awaro	651	0.36	47
2	Sankale	710	0.39	51
3	GosaKora	438	0.25	32
Total		17,99	1.0	130

Source: Ambo district Agricultural Office, 2019

Data Collection Method

Both quantitative and qualitative data types were collected for the study. In order to generate these data types, both secondary and primary data sources were used. Primary data sources were smallholder farmer's from three purposely-selected kebeles. The data collection methods used includes survey using structured questionnaire. The structured questionnaires was pre-tested with similar households operating within the study area, but not included in the final survey. Using the questionnaire data were collected on household characteristics, socioeconomic and demographic characteristics, farm information, input utilization, and access to services such as extension, credit and market information. Experienced enumerators were recruited and well trained for actual field data collection. The data were collected in January 2018/19.

Methods of Data Analysis

Descriptive Statistics

Descriptive statistics such as mean, standard deviation and percentage, were used to describe characteristics that can influence participation in saving which was presented by tabular form. In addition, mean comparison tools were applied between the characteristics of credit participants and non-participants using t-test for continuous variables and chi-square test for dummy variables respectively.

Econometrics Model

To identifying factor affecting household decision to save at the individual household level, Binarylogit model was used. This method was chosen because it is a standard method of analysis when the outcome variable is dichotomous (Hosmerand Lemeshow, 2000), measured as having a value of 1 or 0, where 1 = participant and 0 = non participant. Generally, the Binary logitmodel can be written as:

$$P_i=F(z_i)=F(\alpha+\beta_i x_i)=\frac{z_i}{1+e^{-z_i}}$$

Where, P_i is the probability that an individual will participate in formal saving or does not participate given X_i;

X_i represents the i^{th} explanatory variables; and α and β_i are parameters to be estimated.

Logit model could be written in terms of the odds and log of odds, which enables one to understand the interpretation of the coefficients. The coefficient of the logit model therefore represents the change in the log of the odds associated with a change in the explanatory variables. The odds ratio implies

the ratio of the probability (P_i) that an individual would choose an alternative to the probability ($1-P_i$) that he/she would not choose it.

$$1-p_i=\frac{1}{1+e^{zi}}\text{……..……......2}$$

$$\frac{p_i}{1-p_i}\left(\frac{1+e^{zi}}{1+e^{-zi}}\right)=e^{zi}\text{…….……3}$$

Or

Therefore, to get linearity, we take the natural logarithms of odds ratio equation (4), which results in the log odds ratio of the logit (equation 6).

$$\frac{p_i}{1-p_i}=\frac{1+e^{zi}}{1+e^{-zi}}=e^{(\alpha+\sum\beta_i x_i)}\text{……..……..…4}$$

$$z_i=\ln\left(\frac{p_i}{1-p_i}\right)=\alpha+\beta_1x_1+\beta_2x_2+\beta_3x_3+...+\beta_mX_m\text{…5}$$

If the disturbance term (u_i) is taken in to account, the logit model becomes

$$Z_i=\alpha+\sum_{i=1}^{m}\beta_i x_i+u_i\text{……..……... .6}$$

The data covered information necessary to make household level indices of social, economic, demographic and institutional indicators comparable across different categories of identifying factor affecting access to saving service eat the individual household level. In order to identify factors affecting access to credit service at the household level, both continuous and discrete variables were identified based on economic theories and empirical studies as follows.

Decision to save: This is dependent variable for household participation in saving that takes value '1' if households participate in saving; otherwise '0'. It indicated as dependent variable that households' participation in saving for agricultural activities can be affected by socio-economic factors, demographic factors, institutional and other factors.

Age of household head: is continuous variable used for the age of household head. The life-cycle model suggests that there exists a relationship between ages and saving rate. Therefore, we expect that there is a direct relationship between age of household head and households' saving habit

Sex of household head: A Dummy variable that represent the sex of household head. It takes values 1, if the household is male and 0, if female. Sex of household is also considered as an important variable to determine the saving the behaviour of households.

Level of Education of household head: This variable is measured using formal schooling of the household head and hypothesized to affect decision to use saving positively. It has taken dummy values 1 if the household attended any formal education of any level and 0 otherwise. This variable was necessary to improve the understanding of formal financial institution by individual and hence their choice of services in the formal financial institutions.

Marital status: A Dummy variable that represent the marital status of household head. It takes values 1, if the household is married and 0, if unmarried. Is the condition when the two opposite partners are joining together with agreement. It is one of the determinant variables that influence the saving habits of households head.

Income of the household: a continuous variable used for total income household in birr. Total income is computed as aggregation of the monetary income derived from agricultural and non-agricultural activities, including the monetary values of agricultural items produced and consumed by the household. The ability to save of household depends on the income of the household and household is considered as the most important explanatory variable of the saving of the household.

Family size: When the number of family size of the household increases their saving performance is declined. They consume more rather than to save. The most probable explanation could be more family size could mean they consume more and decrease their Income and they do not motivate to save.

Land size: A continuous variable measured in hectare. The variable used for land holding of the household. The land holding signifies the economic system as it acts as an economic unit

for any physical asset to be considered. Land is considered as the biggest asset for rural household as it can be accumulated in terms of money and productive asset at the time of financial emergency. Therefore, we expect a direct relationship between land owned by households and households' saving habit.

Distance: A continuous variable used for distance to nearest formal financial institution measured in kilometer from residence of households and is as for saving access and different financial institutions. Household nearby the financial institution have a location advantage and can save more from their income which obtained from different sources than those live in more distant locations. Therefore, we expect a negative relationship between distance to the nearest financial institution from households' residence and households' saving habit.

Occupation: This variable is a dummy variable having 1 for government 0 for private and affect positively for both status and participation of saving (Nayak, 2013). It is one of the determinant factors in the saving habits of the community.

Results and Discussion

Descriptive statistics results

The survey has collected a wide range of information which is essential to the interpretation of the findings and the understanding of the results of the study on factor affecting rural household saving participation. The background characteristics of respondents interviewed in the study area such as age, sex, income, education, and marital status, size of land holding, family size, occupation, and distance from saving institutions are presented in this section using tables.

As table 2 shows, from the total respondents the non-participant age of rural household with mean and standard deviation of 37.53 and 11.68 years respectively whereas the average and standard deviation of participant 40.20 and 1.48 respectively. The result of two -tailed test (T=0.906) shows that age was statically insignificant at 1% between mean of participant and that of non-participant of household. This finding is inconsistent with the preceding research findings (Abdalla et al., 2009). The reasons for these contradictory conclusions might be due to the current similar awareness of saving and better access to financial institutions between participant and non-participant in the study areas.

Table 2 indicated that, from the total respondents, the mean and standard deviation of participant 1.80 and 1.003 hectares respectively, whereas the average and standard deviation of non-participant 0.715 and 0.69544 respectively. Land is considered as the biggest asset for the rural households as it can be accumulated in terms of money and productive asset at the time of financial emergency. Most of the rural households do not possess any land which can be used as a liquid asset at the time of emergency and earning the livelihood. The result of two -tailed test (T= 5.51***) shows that size of land holding was statically significant between mean of participants and that of non-participants inhabits of saving. These results agree with the findings of Girma (2012) land reflects the accumulated saving, capital transfer and revaluation of assets. The respondents who have higher income save more than respondents that has less income.

The respondents who have higher income save more than respondents that has less income. Table 2 indicated that from 130 of total respondents, the average and standard deviation of non-participant household 15903.3 and 16084.9birr respectively whereas the average and standard deviation of participant households 25570 and 10729.2 respectively. The result of two -tailed test (= 3.8216) shows that income was statically significant between mean of participant and that of non-participant in habit of household saving. This result is in line with the finding of Teka (2008), which found out household with high annual income saves more than household has less annual income.

Table 2, Summary of descriptive statistical results for continuous variables and t-value

Variable	Participants		Non-participants		Total		t- value
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	
Age	40.20	1.48	37.53	11.68	39.58	14.13	0.906
Income	25570	10729.2	15903.3	16084.9	23339.2	12775.9	3.8216***
Distance	4.955	2.10	10.03	2.60	6.13	3.08	10.98***
Land	1.80	1.003	0.715	0.695447	1.55	1.044	5.51***

Source: Computed from the field survey data, 2019

Table 3, Summary of descriptive statistical results for dummy variables and chi-squares

Variable	Category	Participant		Non Participant		Chi-squares
		N	**%**	**N**	**%**	
Sex	Male	51	78.46	14	21.54	0.82NS
	Female	49	75.38	16	24.62	
Occupation	Government	20	83.33	4	16.67	0.409NS
	Private	80	75.47	26	24.53	
Marital Status	Married	82	77.36	24	22.64	0.804NS
	Unmarried	18	75.00	6	25.00	
Education	Literate	66	70.25	18	19.52	17.2470
	Illiterate	34	35.4	12	13.23	

Source: Computed from the field survey data, 2019

In this study, more than 70% of males and females small holders farmers were participate in saving. The sex of the head of the household emphasizes the impact of saving as it is shown that the male population are more and suppose to involve themselves in the different occupational status are inclined to save. As shown in the table 3. (X2=0.82) shows as sex is statically insignificant indicates that participate to saving is the same as who do not participate to saving. That means there is not a significance difference between participant and non-participant or homogeneity between them. This finding is consistent with previous studies (Faridi et al., 2010).

The result also indicated that more than 75 % sample household were participate any types of saving institution. This shows as married rural households participate in habits of saving than unmarried rural households due to the married rural households use the money in systematic way rather than spend the many for consumption purpose. The marital status of the respondents and the head of the households also determine the saving participation of the rural households. As shown in table 3, (X2=0.804) shows that there is no a significance difference between participant and non-participant groups participation of rural household of formal saving related to marital status of the households statically insignificance. These results in line with the finding of Gina et al. (2012) rural households participate in rural households was the same as the rural households not participate in formal saving.

The study showed that the maximum of the households heads have occupation. More than 75% of the households are privates and 25 %

having the main occupation of the family as many of the occupation category lies by the ancestral occupation like mostly the agriculture. As shown in the table 3, (X2=0.409) the Chi-square results shows that who participate in habits of saving were the same as who do not participate in habits saving due to occupation was statically insignificant.

As indicated in table 3, more than 70% of small holder farmer were literate and about 34% of them participated any saving institutions. The level of education is one of the deciding factors of the employment in which one is engaged in. In general, those who are engaged in lower employment have low educational qualifications whereas those with higher education are engaged in higher income occupations. AS shown in the table 2, (X2=17.2470) indicates that there is a significance difference between Participant and non-participant regarding to education was statically significant. This result supported by Gina (2012) literate people who participate in the habit of saving were more than those who did not participate in habit saving.

Econometric Results

The factor affecting households' decision to save were examined using logistic regression model since the dependent variable is dichotomous. Binary logistic regression model is the multivariate statistical tool used to analyze the relationship between the dependent variable (decision to save) and the independent variables; namely age, sex ,marital status, education, occupation , family size, size of land holding and income. The logistic regression model predicts the log odds (participation of saving or not) of the dependent variable.

The regression coefficient together with their sign indicates the direction of the independent variable on the effect of the dependent variable, being the category of interest of response variable for a unit of increase in the independent or uncontrolled variable and also used the marginal effect for the interpretation due to it is more popular than odd ratio or expected value in order to determine by what magnitude of the explanatory variable changes the dependent variable. There is no the problem of multicollinearity and hetroscedasticity for this study.

Education of household head

The result of logistic regression presented that education level of household head was positively affect the probability of households' decision to save at 5% significance level. If other variables being constant, the rural households shift from illiterate to literate will have the probability of participation of rural households in decision to save increases by 0.06199(6.199%) factors (Table 4. This may be because decision to save requires some skill and training. Education tends to improve rationality and have good attitude about decision to save by considering the benefits which gained from saving diversified use of resources. Similarly, studies conducted by Mulat, (2001) and Gordon (2001) were reported that skilled and educated people are believed to be more participate in habits of saving because of their access to information and opportunities. In addition to this, the high literacy level of the respondents increases the probability of rural households' heads having improved standard of living by making informed decisions on consumption and savings as Mulat (2001) resulted study

Income of household head

This explanatory variable affects the status of saving positively at 5% significance level. Because income is the total amount of household earning that captured by different means of sources may be privately or governmentally. As shown from the table 4, if the income of the rural households increases by 1%, the rural household decision to save or performance increases by (3.15E-06**)3.15 to 0.6 units. There are different source of income in the households like; farm source and nonfarm sources. Due to the increase in source of income households are raise their awareness about saving and they increase amount of saving. In the same manner, the rural households have very less income and high consumption as their marginal propensity to consume is high and they are subjected to save less which significantly puts an impact on their

investment pattern and the status of saving as studied Nayak (2013).

Tab le 4. Logistic regression model of factors affecting households' decision to save

Variable	Coef.	Std. Err.	Z	P>z	dy/dx
Age	-0.0188122	0.0020491	-0.26	0.796	-0.0005298
Sex	-1.558116	0.043725	-1	0.316	-0.0438783
Martatus	-0.9520679	0.0449996	-0.6	0.551	-0.0268113
Famsize	-0.3224775	0.0094589	-0.96	0.337	-0.0090813
Occu	-0.9887585	0.0774141	-0.36	0.719	-0.0278446
Educ	2.201266	0.0252397	2.46	0.014	0.0619901**
Income	1.12E-04	1.31E-06	2.41	0.016	3.15E-06**
Distance	-1.438379	0.0105505	-3.84	0.000	-0.0405064***
Land	2.717353	0.0275437	2.78	0.005	0.0765237***

Note: Dependent variable is aDecision to save, N=130, prob [illegible], Prop > chi2 = 0.9357, Log likelihood = -29.65, *** and ** means, statistically significant at 1% and 5% respectively. Std.Err is robust.

Size of land holding

As shown from the table above Size of land holding is the main factors which affect the status of saving at 1% significance level and positively. This means, other being constant, if the Size of land holding of the rural households increases by 1 hectare, the probability of household decision to save increases by 0.0765.The main reason was land is considered as the biggest asset for the rural households as it can be accumulated in terms of money and productive asset at the time of financial institution which gained from the land by change in a cash form for the sake of got good security from formal saving institution rather than other informal way. In short manner the size of the land is high, the income is high, and this leads to increase the intensity of saving. The same to that Oluwakam (2013) studied that land could serve as additional households income through rent and this would have increased their source of income and the intensity of saving and also he proposed that size of land holding was affect significantly the amount of saving negatively.

Distance of household head

Distance of rural households from formal financial institution is one of the factors that influence households' decision to save. This variable affects the dependent variable negatively at 1% significance level. The marginal effect of this variable indicated that, other things being constant, as walking hour of households to financial institutions increases by one hour the probability of participation of households in decision to save reduced by the factor 0.0499(4.499%). This is because of distance from saving institution increase transaction costs and lack of infrastructure. Increase in distance from the household to saving institution reduced households' decision to save due to increased transaction costs that is farmers who reside in rural areas far from the locations of formal saving institutions have a lower opportunity of getting the probability to saving. This result is in lined with a study by

Abdallah and Ebiaidalla (2015) in kassala, East Sudan.

Conclusion and Recommendations

This study was aimed at identifying factor affecting household decision to save in Ambo District of Oromia National regional State. The data were generated from both primary and secondary sources. The logit model was run to identify factors affecting decision to save. The model result indicated that education of the household head, Income and land size of small holder farmers were positively and significantly affected household decision to save while distance the household head from financial institutions were negatively and significantly affect household's decision to save in the study area. Therefore, this study recommends that in order to make micro-economic successful these factors and problems are taken into consideration by policy makers to participate in saving. Our results have important implications for the management and future of farmers, as well as for the assessment of their development impacts.

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RESEARCH PAPER

Analysis of Gender Roles in Beef Cattle Value Chain: In West Shewa Zone, Oromia National Regional State, Ethiopia

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Abstract

Gender is an important aspect of beef cattle value chain analysis since gender relations both affect and are affected by the ways in which the value chains function. Gender issues fundamentally shape the totality of production, distribution and consumption within an economy but have often been overlooked in value chain development. Thus, understanding gender relationships and adjusting methods and messages is crucial for the full participation and benefits of all the community. The study was aimed at analyzing Gender Roles in beef cattle value chain in Toke Kutaye and Bako Tibe Districts, West Shewa Zone, Oromia National Regional State, Ethiopia. Both qualitative and quantitative data were collected for the study. The data were collected from both primary and secondary sources. The primary data for this study were collected from 376 producers, 30 fatteners, 20 traders, 10 butchers, 12 hotels, 2 local abattoirs and 10 consumers; totally 460 respondents by using interview schedule, site visit and personal observation. Data analysis was made using descriptive and inferential statistics and gender analysis frameworks. The results of Harvard Analytical Framework showed that at the lower stage of beef cattle value chain there were contributions of all gender categories and the marketing activities of beef cattle value chain were dominated by men's role. Men have more access to and control of resources than women along the beef cattle value chain activities. But there is a probability that both men and women have almost equal benefit from resources along the beef cattle value chain. It was concluded that men, women, boys and girls participation in marketing, access to and control of resources are not equal in beef cattle value chain. Therefore, the recommendation was empowering women by improving their access to resources and services, control over the resources and gender mainstreaming in the value chain.

Keywords: Value chain, beef cattle, gender roles

Introduction

Gender is an important aspect of value chain analysis since gender relations both affect and are affected by the ways in which value chains function. Such gender analysis and integration of gender issues is usually however the weakest point in beef cattle value chain analyses and largely ignored in most value chains (IFAD 2010; Njuki et al., 2012). Gender issues fundamentally shape the totality of production, distribution and consumption within an economy but have often been overlooked in value chain development (Rubin, 2010). Most current value chain development has failed to integrate gender analysis. Value chain development policies are often based on gender-blind or gender-discriminatory assumptions (Mayoux et al., 2008). Gender analysis is the process of analyzing information in order to ensure development benefits and resources are effectively and equitably targeted to all members of the society, and to successfully anticipate and avoid any negative impacts development interventions may have on gender relations (Overholt et al., 1985). Gender analysis in beef cattle value chain is essential to understand the relationships; participation of different actors, men and women; and the constraints that limit growth of

beef sector and the compositeness of smallholder farmers (IFAD, 2010).

According to Coles and Mitchell (2011), call attention to the crucial role of value chain analysis as a tool for addressing gender inequities in markets. Results from gender and value chain analyses have been used in the development sector to design market oriented interventions, gender inequalities and value chain upgrading strategies that are beneficial to smallholder farmers and the marginalized groups particularly women, in the developing countries (van den Berg et al., 2009; IFAD 2010). However, to the extent that the constraints and opportunities faced by the marginalized groups differ, the interventions are likely to be different for the different categories of smallholder farmers. Coles and Mitchell (2011) provide a comprehensive review of value chain studies that have addressed gender issues and suggested or implemented upgrading strategies to reduce inequalities.

Although value chain approaches is widely adopted as strategy for enhancing economic growth and reduction of poverty, few have considered how gender issues affect value chain (USAID, 2010). The knowledge among practitioners and policy makers on the gender aspects of value chain intervention are still limited (Riisgaard et al., 2010). Also it has been reported by Coles and Mitchell (2011) that little is known about gender in value chain and that there is insufficient evidence to make general statements about gender roles in different kinds of value chains. Previously, women who participated in livestock value chain were confined to lower levels of the chain and suffered more inequalities in the upper levels of the value chain where benefits are shared and distributed (Njarui et al., 2012). They also lacked the ability to make decisions regarding the use of proceeds from the chain activity venture. Therefore this study intends to disclose information concerning gender roles that exists in beef cattle value chain.

In beef cattle farming systems, there is a division of labor. This determines the different tasks for which men and women are responsible. An existence of differences in the beef cattle farming activities by male and female signifies the importance of gender consideration in beef value chain. At present, in many societies, women's access to information and training in modern farming activities continues to be limited (FAO, 2005). Because of these, it is important to recognize that gender considerations in beef cattle value chain always need to take into account both men's and women's roles, access to and control of resources and benefits from the activities. Failure to consider these differences, between men and women, leads to unsuccessful project activities. Thus, understanding gender relationships and adjusting methods and messages is crucial for the full participation and benefits of all the community.

Therefore, also the study areas have a potential of beef cattle production and marketing due to its suitable climatic condition for the cattle and presence of main road connecting the markets in the area with the capital city of the country; gender roles access to and control of resources in the key stages of the beef cattle value chains has not yet been systematically studied and documented in the areas. Due to all these reasons, the analysis of gender in beef cattle value chain has been initiated to understand gender roles, access to and control over and benefits from resources in the value chain and recommend viable options to improve the gender equity and equality. At the end, the study makes an attempt to solve the information gap in the study areas.

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Materials and methods

Description of the study areas

This study was conducted in two major livestock producing districts, namely Toke Kutaye and Bako Tibe Districts of West Shewa Zone, Oromia National Regional State, in central Ethiopia. Description of each district was given below.

Bako Tibe is one of the districts of West Showa zone, Oromia national regional state, Ethiopia. It is located at 250 km west of Addis Ababa,

125 km of Ambo, the capital city of west Showa zone and 81 km east of west Wollega. The district is bordered with the south, west and north by East Wollega zone and on the East by Ilu Galan district. The administrative center of the district is Bakko town. The district has three Agro-ecological zones, in which 12 % is high land (Dega), 37% is mid-land (Woina-dega) and 51% is low land (Kolla) and the average rain fall is varies between 1000-1200 mm, with the average temperature of 13.2°C – 27°C. This district has 3 urban and 28 rural PAs. The total area of the district is 637.19 square kilometer. Total population of the district is 133,799, out of which 68,401 are male and 65,398 are female with population density of 210 people per Square Kilometer which is greater than the Zone average of 152.8.(CSA, 2010).

Toke Kutaye is one of the districts in the west shewa zone, Oromia Region of Ethiopia. Toke Kutaye is bordered on the east by the Ambo district, on the north by Mida kegn, on the west by Chalia. The administrative town of the district is Guder. The district located 12 kilometers west of Ambo town, at a distance of about 137 kilometers away from Addis Ababa on the Addis Ababa Nekemte main road. The 2007 national census reported a total population for this district of 119,999, of whom 59,798 were men and 60,201 were women; 15,952 or 13.29% of its population were urban dwellers. The majority of the inhabitants said they practiced Ethiopian Orthodox Christianity, with 49.48% of the population reporting they observed this belief, while 32.8% of the populations were Protestant, and 16.25% practiced traditional beliefs. The economic source of the district depends on agriculture and its produces. Agriculture accounted for more than 90% of the economy of the district.

Sources of Data and Methods of Data Collection

Both primary and secondary sources of data were used for the study. Various publications and reviews (from internet), material studies, data from the National Statistics Agency, Ministry of Agriculture, district offices and other relevant sources were used as secondary sources. Interview schedules, site visits, focus group discussion and structured observation methods of data collection and information obtained from different government and non-governmental organizations were used as primary sources. Both qualitative and quantitative data were collected for the study. The qualitative data was collected using Participatory research approach / key informant interview, site visits and structured observations and quantitative data was collected using interview schedules.

Sampling Techniques and Sample Size Determination

Toke Kutaye and Bako Tibe districts were selected purposively based on the existing potential of cattle production, fattening practices and marketing of beef cattle in the districts. Toke Kutaye and Bako Tibe districts have 27 and 32 kebeles, respectively. With the consultation of districts' livestock experts, out of the potential kebeles from the districts, three kebeles from each district namely Naga File, Birbirsaf dogoma and Lenca from Toke Kutaye and Dembi Dima, Seden Kite and Bacara Oda Gibe from Bako Tibe district were selected randomly. A simple random sampling technique was used to select the required sample household producers from the kebeles.

The sample size for collecting data for the study was determined by using (Yamane, 1967) formula and the following formula was used to calculate total sample size (n) for households. The sample size for each kebeles was calculated proportionally.

$$n = \frac{N}{1+N(e)^2} = 376$$

Where,

n = designates the sample size the research uses (376);
N = designates total number of households (12634);
e = designates maximum variability or margin of error 5%;
1 = designates the probability of the event occurring.

Table 1. Sample size of the study areas

Name of selected districts	Name of selected kebeles	Number of household producers in the kebeles	Sample of household producers in the kebeles
Toke Kutaye	Naga File	1420	42
	Birbirsaf dogoma	3430	104
	lencha	2160	64
Bako Tibe	Dembi Dima	1054	30
	Seden Kite	1820	54
	Bacara Oda Gibe	2750	82
Total	6	12634	376

Source: The districts' livestock and fishery development office, 2019

Additionally, other actors like fatteners from each kebeles (5), traders (10), butchers (5), local abattoir, hotels/restaurants (6) and consumers (5) involved in the beef cattle value chain from each district were included for the study. Therefore, Total sample size = 376 + (5 x 6) + (27 x 2) = 376 + 30 + 54 = 460

Methods of Data Analysis

The collected data was analyzed using descriptive and inferential statistics, gender analysis frameworks.

Descriptive and inferential analysis

Descriptive and inferential statistics such as mean, percentage, t-test and chi2-test were computed by using STATA software. During the data analysis that was dealt with analysis of gender roles in beef cattle value chain; simple descriptive statistics such as percentage and mean and inferential statistics such as t-test and chi2-test were employed by using STATA software and was presented in the form of tables and figures. This was used in the description of socio-economic and demographic characteristics of the respondents and test significance difference of variables between the districts, gender groups using appropriate techniques. Mean and t-test was used in continuous variables while percentage and chi2-test in categorical variables.

Gender analysis frameworks

There are a number of different frameworks for undertaking gender analysis. They represent step-by-step tools for carrying out gender analysis, which assist in raising questions, analyzing information and developing strategies to increase women's and men's representation and participation in policies, projects and programmes. These frameworks have been developed to address different aspects of gender equality and are therefore useful for different policy priorities, programmes or projects.

The following are the best known gender analysis frameworks, which are often included as tools for gender mainstreaming and linked to gender planning frameworks and gender impact assessment frameworks. Some frameworks, such as the Harvard Analytical Framework, Levy framework, the capacities and vulnerabilities approach and the 4R method also address the questions of organizational change. To employ gender analysis along the core functions of the beef cattle value chain, such as gender roles and relations within the beef value chain, gendered access to and control of resources and benefits that accrue from use of these resources were analyzed by using Harvard analytical framework which is appropriate for this study.

The Harvard Analytical Framework, also called the Gender Roles Framework, was one of the first frameworks developed to identify and understand the differences between men and women in their participation in the economy. It is used to collect information from the community and from households. The Harvard Analytical Framework describes who does each activity, who has access to and control of resources and the influence on gender roles. To do this, the framework is made up of interrelated components such as: the 'activity' profile answers the question of 'Who does what?' for all relevant productive and reproductive tasks. The 'access' and 'control' profiles identify the resources used in the identified tasks; define by gender who has access to these resources and control over their use; and define the benefits that result from each activity and those who have access to and control over these benefits.

Results and discussion

This section presents the major findings and interpretation of the study. It has two main sections. The first section deals with descriptive and inferential statistics of the sampled households. The second section presents gender roles and access to, control over and benefit from resources along the beef cattle value chain.

Socio-Economic and Demographic Characteristics of the Respondents

Socio-Economic and Demographic Characteristics of the Sampled Household Producers

Socio-economic and demographic characteristics of the sampled household producers are given in the tables below (Table 2 & 3). Table 2 showed that the total mean age of the household head respondents was 42.59 years. The mean age of the respondents in Toke Kutaye district was 43.39 years and 41.59 in Bako Tibe district. Age of the respondents in the two districts has significance difference at less than 5% significance level. According to Ulfina Galmessa., *et al* (2019), the overall average ages of the respondents in the studied households were 43 years which is almost similar with the present study.

The total mean of household size for the sampled household producers was 7.24. The mean household size of the respondents in Toke Kutaye and Bako Tibe districts was 7.78 and 6.55, respectively. Household size showed significance difference at less than 1% significance level in the two districts. The overall mean family size of the respondents in the studied households was 5.4 persons (Ulfina Galmessa., *et al* 2019). According to Belay *et al.* (2012), the average family size was 5.6 in Dendi district. Due to the fact that agricultural and other activities in the study areas are labors demanding, the average family size was high. The mean of total number of cattle owned by the household respondents in the year was 10.80. The mean of number of cattle owned by the household respondents in Toke Kutaye and Bako Tibe districts in the year was 9.37 & 12.61, respectively and there was a significance difference at less than 1% significance level in the two districts. The mean annual sampled household income in Toke Kutaye and Bako Tibe districts was ETB 64507.14 and 48775.30, respectively and the total mean annual income in the two districts was ETB 57561.70. Mean annual sampled household income in the two districts has significance difference at less than 1% significance level. The mean of total land owned of household respondents in the two districts was 2.25 hectares and there was significance difference at less than 1% significance level between the two districts. The mean number of beef cattle sold in the year of household respondents in Toke Kutaye and Bako Tibe districts was 1.58 and 1.90, respectively. The mean of total number of beef cattle sold in the year in both districts was 1.72 and has significance difference at less than 5% significance level.

Table 2. Socio-Economic and Demographic Characteristics of the sampled Household producers (Continuous variables)

Variables	Mean of household respondents in the districts			
	Toke Kutaye (N = 210)	Bako Tibe (N = 166)	Total (N = 376)	T-value
Age of household head in years	43.39	41.59	42.59	2.13**
Household size in numbers	7.78	6.55	7.24	5.48***
Total number of cattle owned in numbers in the year	9.37	12.61	10.80	-6.85***
Total annual income in birr	64507.14	48775.30	57561.70	3.91***
Total land owned in hectares	2.73	1.64	2.25	8.53***
Grazing land owned in hectares	0.51	0.47	0.49	0.90
Cultivating land owned in hectares	2.22	1.17	1.76	10.37***
Total number of beef cattle sold in numbers in the year	1.58	1.90	1.72	-2.51**
Average selling price of beef cattle in the year in birr	11126.67	9793.97	10538.3	4.90***

*** = significant at p 1% level, ** = significant at p 5% level

Table 3 showed that about 93.62% of the sampled household respondents in the two districts was male headed while the remaining (6.38%) was female headed household. From this about 93.33% was male headed households and only 6.67% was female headed in Toke Kutaye district and 93.98% was male headed and 6.02% was female headed household in Bako Tibe district. Sex of household head has no significance difference between the two districts. Majority (55.59%) of sampled household heads' education level was primary school which is followed by secondary school (22.34%), illiterate (21.28%) and certificate (0.80%). Education level of household head has significance difference at less than 5% significance level in the two districts. Other study conducted in Dano and Dire Inchini of the same zone with the present study by (Ulfina Gelmessa *et al.,* 2019) reported that majority of the respondents (41.0%) can read and write, others (29.2%) attended primary education and significant number (5.6%) also attended secondary education. The same table showed that 92.82% of the respondents were married and 7.18% of them were divorce and there was no significance difference between the two districts. Majority of the sampled household heads' religion were Protestant (49.73%) and Orthodox (36.97%) and the remaining were Wakefata (11.44%) and Muslim (1.86%). Religion of sampled household head has significance difference at less than 1% significance level in the two districts. According to Samuel (2007), almost 68% of the respondents were followers of Orthodox Christianity while the remaining 32% were Muslims, Protestants and others in Addis Ababa city.

Table 3. Demographic Characteristics of the sampled Household producers (Categorical variables)

Variables	Categories	Percentage of sampled household producers in the two districts						
		Toke Kutaye (N = 210 (55.85%))		Bako Tibe (N = 166 (44.15%)		Total (N = 376 (100%))		X^2-value
		%	N	%	N	%	N	
Sex of household head	Men	93.33	196	93.98	156	93.62	352	0.06
	Women	6.67	14	6.02	10	6.38	24	
Education level of household head	Illiterate	24.29	51	17.47	29	21.28	80	9.05**
	Primary school	57.14	120	53.61	89	55.59	209	
	Secondary and preparatory school	18.57	39	27.11	45	22.34	84	
	Certificate/diploma and above	0.00	0	1.81	3	0.80	3	
Marital status of the respondents	Married	93.33	196	92.17	153	92.82	349	0.19
	Divorce	6.67	14	7.83	13	7.18	27	
Household head's religion	Protestant	39.52	83	62.65	104	49.73	187	33.64***
	Wakefata	13.33	28	9.04	15	11.44	43	
	Muslim	0.00	0	4.22	7	1.86	7	
	Orthodox	47.14	99	24.10	40	36.97	139	

*** = significant at p ≤ 1% level, ** = significant at p ≤ 5% level

Demographic characteristics of other beef cattle value chain actor respondents

The Table (4) showed that about 91.67% of the other actor respondents in the two districts was male while the remaining (8.33%) was female respondents. From this about 90.48% was male respondents and only 9.52% was female in Toke Kutaye district and 92.86% was male and 7.14% was female respondents in Bako Tibe district. Sex of respondents has no significance difference between the two districts. Majority (52.38%) of other actor respondents' education level was primary school which is followed by secondary and preparatory school (29.76%), degree and above (7.14%), illiterate (5.95%) and certificate/diploma (4.76%).

Table 4. Demographic Characteristics of other beef value chain actor respondents in the two districts (Categorical variables)

Variables	Categories	Percentage of other actor respondents in the districts						X^2-value
		Toke Kutaye (N = 42 (50%))		Bako Tibe (N = 42 (50%))		Total (N = 84 (100%))		
		%	N	%	N	%	N	
Sex of respondents	Male	90.48	38	92.86	39	91.67	77	0.15
	Female	9.52	4	7.14	3	8.33	7	
Education level of the respondents	Illiterate	11.90	5	0.00	0	5.95	5	7.07
	Primary school	47.62	20	57.14	24	52.38	44	
	Secondary and preparatory school	28.57	12	30.95	13	29.76	25	
	Certificate/diploma	2.38	1	7.14	3	4.76	4	
	Degree and above	9.52	4	4.76	2	7.14	6	
Marital status of the respondents	Single	26.19	11	19.05	8	22.62	19	2.87
	Married	69.05	29	80.95	34	75	63	
	Divorce	4.76	2	0.00	0	2.38	2	
Respondents' religion	Protestant	40.48	17	50	21	45.24	38	11.68***
	Wakefata	21.43	9	0.00	0	10.71	9	
	Muslim	0.00	0	4.76	2	2.38	2	
	Orthodox	38.10	16	45.24	19	41.67	35	

*** = significant at p ≤1% level, ** = significant at p ≤5% level

Education level of other actor respondents has no significance difference in the two districts. The same table showed that majority (75%) of the respondents was married and about 22.62% and 2.38% of them were single and divorce, respectively. For the marital status of the other actor respondents there was no significance difference between the two districts. Also the results showed that majority of the other actor respondents' religion were Protestant (45.24%) and Orthodox (41.67%) and the remaining were Wakefata (10.71%) and Muslim (2.38%). Religion of other actor respondents has significance difference at less than 1% significance level in the two districts.

Demographic characteristics of other beef cattle value chain actor respondents along the value chain stages were described as (table 8) below. The results showed that all traders, local abattoirs and butcher respondents were male, almost all (96.67%) fattener respondents were male and majority of hotels/restaurants (66.67%) and consumer (80%) respondents were male. In case of education level of other actor respondents along the value chain stages, majority of traders (90%), butchers (60%), hotel/restaurant respondents' education level was primary school. Majority (46.67%) of fattener respondents' education level was secondary and preparatory school and followed by primary school (40%) and illiterate (13.33%). Education level of local abattoir respondents' were certificate/diploma (50%) and degree and above (50%). About 40% of sampled consumers' education level was degree and above which is followed by certificate/diploma (30%) and primary & secondary school (30%).

Table 5. Demographic Characteristics of other beef value chain actor respondents along the value chain stages (Categorical variables)

Variables	Categories	Percentage of other actor respondents along the value chain stages						
		Trader (N=20)	Fattener (N=30)	Local abattoir (N=2)	Butcher (N=10)	Hotel/restaurant (N=12)	Consumer (N=10)	Total (N=84)
Sex of respondents	Male	100	96.67	100	100	66.67	80.00	91.67
	Female	0.00	3.33	0.00	0.00	33.33	20.00	8.33
Education level of the respondents	Illiterate	0.00	13.33	0.00	10.00	0.00	0.00	5.95
	Primary school	90.00	40.00	0.00	60.00	66.67	0.00	52.38
	Secondary and preparatory school	10.00	46.67	0.00	20.00	33.33	30.00	29.76
	Certificate/diploma	0.00	0.00	50.00	0.00	0.00	30.00	4.76
	Degree and above	0.00	0.00	50.00	10.00	0.00	40.00	7.14
Marital status of the respondents	Single	10.00	43.33	0.00	0.00	16.67	20.00	22.62
	Married	90.00	50.00	100	100	83.33	80.00	75.00
	Divorce	0.00	6.67	0.00	0.00	0.00	0.00	2.38
Respondents' religion	Protestant	45.00	53.33	50.00	40.00	33.33	40.00	45.24
	Wakefata	0.00	20.00	50.00	0.00	16.67	0.00	10.71
	Muslim	5.00	0.00	0.00	0.00	0.00	10.00	2.38
	Orthodox	50.00	26.67	0.00	60.00	50.00	50.00	41.67

Gender roles along the beef cattle value chain

Gender roles are shared cultural expectations which are performed by individuals based on their society identified gender (William *et al.,* 2009). According to Rubin *et al*., (2008) gender roles are behaviour tasks and responsibilities that are considered appropriate for women and men because of social, cultural, norms and beliefs. Culture, norms and beliefs of societies differ and this implies that no generalization can be made on gender roles. Roles played by men, women, boys and girls cannot be generalized across different societies of cattle keepers. This means it is difficult to say this is the sole role of male and female along the beef cattle value chain. Because of that this study is focused on the major roles of gender along beef cattle value chain's major activities in the study areas.

The study results (table (6) showed about 63.30% of respondents responded that purchasing feed for beef cattle production and fattening was the major roles of men in the study areas. There is a significance variation at less than 1% significance level between Toke Kutaye and Bako Tibe districts on the purchasing feed activities. Regards to beef cattle feeding, majority of respondents

(37.50%) agreed on that there was a similar gender role and there is a significance difference at less than 1% significance level between the two districts on the feeding beef cattle. In Toke Kutaye district majority of the respondents (32.86%) said that feeding beef cattle was the major roles of men and in Bako Tibe district majority of them (37.35%) said it was the major roles of women. Majority of the respondents (77.6%) from Dano district reported that women are responsible for feed preparation and feeding as opposed to only 40% in Dire Inchini district (Ulfina Gelmessa *et al.,* 2019). About 60.90% of the respondents responded that keeping cattle/herding was the major roles of boys and there is no significance variation between the two districts. Watering cattle was also another major role of boys' activities. Abebe and Gamessa (2011) found that women were responsible for barn cleaning, milk selling and feeding. Njarui *et al*., (2012) reported that women played their roles with the assistance of children in milking, feeding and watering of animals. Men's roles were taking care of sick animals, fodder collection and storage. In mixed crop livestock systems, livestock management practices were mainly carried out by women including feeding, cleaning, watering and milking (Zahra *et al.,* 2014) whereas men concentrate on a few roles involved in herd management, sale of animals, purchase of feed and sale of milk in intensified systems (Tangka et al. 2000). Herding was mainly done by men and boys (Zahra *et al.*, 2014). Girls assist in herding, especially of small ruminants (Tangka *et al.,* 2000).

About 81.38% of the respondents agreed on that constructing cattle house was the major roles of men, but majority (53.46%) of them said that cleaning of cattle house was the major roles of women and there is a significance variation at less than 10% and 1% significance level between the two districts on the constructing cattle house and cleaning of cattle house, respectively (table 6). Similarly, 90.8% of the sample households from Dire Inchini and 88.2% sample households from Dano reported that construction of dairy cattle house was the mere responsibility of men (Ulfina Gelmessa *et al.,* 2019). This indicates that at the lower level activity (production activities) of beef cattle value chain, there were contributions of all gender categories (men, women, boys and girls) in the study areas.

(Table 6) showed that majority (78.19%, 88.56% and 87.50%) of the respondents responded that transport/trek cattle to the market, selling cattle and purchasing cattle were the major roles of men, respectively and there is no significance difference between the two districts on these activities. This means the marketing stage activities of beef cattle value chain was dominated by men's role in the study areas. Women who participated in livestock value chain were confined to lower levels of the chain and suffered more inequalities in the upper levels of the value chain where benefits are shared and distributed (Njarui *et al.,* 2012).

In case of processing stage of beef cattle value chain, almost all (87.50%) of the respondents responded that slaughtering beef cattle was the major roles of men, but majority (70%) of the respondents said that beef food preparation was the major roles of women and there is no significance difference between the two districts on slaughtering beef cattle and beef food preparation in the study areas.

Gender control over resources in the value chain:

The (table 8) below showed about 65.16% of the respondents responded that allocation of land use for grazing was more controlled/decided by men than women and there is no significant variation between the two districts on land use for grazing. The large proportion of land and large animals are owned by men (82.6%) while only (17.4%) owned by

women (Ulfina Gelmessa *et al.,* 2019). From the same (table 8), it was possible to understand that purchasing inputs (purchasing feed and drugs) and the marketing activities of beef cattle (purchasing cattle, selling cattle and determining selling/buying price of cattle) were more controlled/decided by men than women and there is no significant difference between the two districts on the activities except purchasing of cattle. This showed that the resources and activities along the beef cattle value chain were more controlled /decided by men as compared with women. It means there are no equal gender control /decision making on resources along the beef cattle value chain in the study areas. According to Ulfina Gelmessa *et al.,* (2019), from over all respondents about 85.5% of male are decides about selling of cattle and 15.5% of women decides about selling of cattle and 88.1% men decides about labor in put while women decides 11.9% about labor input and 35.1% of husband sell any animals without consulting his wife but he told her. This is because women are the main caretakers of household members (especially children and the aged) in most of the developing countries of the world. It appears that studies in Ethiopia on decision-making in livestock production, marketing and management of income from livestock are consistent. Men are largely the decision makers for livestock production (Mulema *et al.,* 2017), husbandry activities associated with better financial income (Mulugeta and Amsalu 2014), sale of livestock (marketing), collection of money (Hebo 2014), and spending the income earned from livestock (Zahra et al., 2014). Women in many countries are constrained ownership or control of important resources due to cultural beliefs (Letty and Bayer, 2010). Inequality in property rights contributes to women's generally low status and vulnerability to poverty compared with men. FAO (2012) reported that in many African traditions, women and their belongings including livestock that they may have received from their parents or purchased themselves are the property of men.

Table 6. Gender roles along the beef cattle value chain in the study areas

Major activities in beef cattle value chain	Districts and test	Percentage of respondents in the two districts				
		Major roles of:				
		Men	Women	Boys	Girls	Similar roles
Purchasing feed	Toke Kutaye	53.81	13.81	0.00	0.00	32.38
	Bako Tibe	75.30	6.02	2.41	0.00	16.27
	Total	63.30	10.37	1.06	0.00	25.27
	X^2-value	26.77***				
Feeding	Toke Kutaye	32.86	16.67	4.76	0.00	45.71
	Bako Tibe	24.10	37.35	9.64	1.81	27.11
	Total	28.99	25.80	6.91	0.80	37.50
	X^2-value	33.37***				
Keeping cattle/herding	Toke Kutaye	13.81	4.76	60.48	15.24	5.71
	Bako Tibe	18.07	2.41	61.45	16.87	1.20
	Total	15.69	3.72	60.90	15.96	3.72
	X^2-value	7.68				
Constructing cattle house	Toke Kutaye	83.33	5.24	10.00	0.00	1.43
	Bako Tibe	78.92	3.61	17.47	0.00	0.00
	Total	81.38	4.52	13.30	0.00	0.80
	X^2-value	7.02*				
Cleaning cattle house	Toke Kutaye	3.81	46.19	7.62	18.57	23.81
	Bako Tibe	7.83	62.65	3.01	21.69	4.82
	Total	5.59	53.46	5.59	19.95	15.43
	X^2-value	33.03***				
Watering	Toke Kutaye	10.48	21.90	23.81	11.90	31.90
	Bako Tibe	18.67	24.10	39.76	6.02	11.45
	Total	14.10	22.87	30.85	9.31	22.87
	X^2-value	32.67***				
Transport/trek cattle to the market	Toke Kutaye	80.48	4.29	15.24	0.00	0.00
	Bako Tibe	75.30	3.61	21.08	0.00	0.00
	Total	78.19	3.99	17.82	0.00	0.00
	X^2-value	2.20				
Selling cattle	Toke Kutaye	90.00	8.57	0.00	0.00	1.43
	Bako Tibe	86.74	9.04	1.81	0.00	2.41
	Total	88.56	8.78	0.80	0.00	1.86
	X^2-value	7.04				
Purchasing cattle	Toke Kutaye	86.19	9.52	0.00	0.00	4.29
	Bako Tibe	89.16	7.23	1.81	0.00	1.81
	Total	87.50	8.51	0.80	0.00	3.19
	X^2-value	6.25				
Purchase drugs	Toke Kutaye	55.24	12.38	4.76	0.00	27.62
	Bako Tibe	62.05	10.84	4.22	0.00	22.89

	Total	58.24	11.70	4.52	0.00	25.53
	X^2-value	1.80				
Milking cows	Toke Kutaye	2.38	87.14	0.00	10.48	0.00
	Bako Tibe	6.02	77.71	0.00	15.66	0.60
	Total	3.99	82.98	0.00	12.77	0.27
	X^2-value	7.30*				
Slaughtering cattle	Toke Kutaye	85.00	0.00	15.00	0.00	0.00
	Bako Tibe	90.00	0.00	10.00	0.00	0.00
	Total	87.50	0.00	12.50	0.00	0.00
	X^2-value	0.00				
Beef food preparation	Toke Kutaye	20.00	60.00	0.00	20.00	0.00
	Bako Tibe	0.00	80.00	0.00	20.00	0.00
	Total	10.00	70.00	0.00	20.00	0.00
	X^2-value	1.14				
Beef food consumption	Toke Kutaye	65.00	15.00	15.00	5.00	0.00
	Bako Tibe	55.00	20.00	15.00	10.00	0.00
	Total	60.00	17.50	15.00	7.50	0.00
	X^2-value	0.48				

*** = significant at p ≤1% level, ** = significant at p ≤5% level

Table 7. Gender access to services along the beef cattle value chain in the study areas

Major access to services in beef cattle value chain	Districts and test	Percentage of the respondents in the two districts		
		More access to:		
		Men	Women	Both equal
Access to credit	Toke Kutaye	63.33	7.14	29.52
	Bako Tibe	73.49	2.41	24.10
	Total	67.82	5.05	27.13
	X^2-value	6.53**		
Access to training	Toke Kutaye	66.67	3.33	30.00
	Bako Tibe	81.33	3.61	15.06
	Total	73.14	3.46	23.40
	X^2-value	11.59***		
Contact extension agents /veterinary service provider	Toke Kutaye	83.81	12.38	3.81
	Bako Tibe	86.75	13.25	0.00
	Total	85.11	12.77	2.13
	X^2-value	6.48**		
Access to market information	Toke Kutaye	78.57	1.90	19.52
	Bako Tibe	84.94	4.22	10.84
	Total	81.38	2.93	15.69
	X^2-value	6.61**		

*** = significant at p 1% level, ** = significant at p 5% level

Table 8. Gender control over resources along the beef cattle value chain in the study areas

Major control over resources in beef cattle value chain	Districts and test	Percentage of the respondents in the two districts		
		More control/decided by:		
		Men	Women	Both equal
Land use for grazing	Toke Kutaye	62.38	8.10	29.52
	Bako Tibe	68.67	9.64	21.69
	Total	65.16	8.78	26.06
	X^2-value	3.00		
Purchasing feed	Toke Kutaye	68.57	7.14	24.29
	Bako Tibe	59.04	10.84	30.12
	Total	64.36	8.78	26.86
	X^2-value	3.93		
Purchasing drugs	Toke Kutaye	60.95	9.05	30.00
	Bako Tibe	57.83	12.65	29.52
	Total	59.57	10.64	29.79
	X^2-value	1.29		
Purchasing cattle	Toke Kutaye	79.05	6.19	14.76
	Bako Tibe	87.95	6.02	6.02
	Total	82.98	6.12	10.90
	X^2-value	7.38**		
Selling cattle	Toke Kutaye	84.76	6.19	9.05
	Bako Tibe	87.95	6.02	6.02
	Total	86.17	6.12	7.71
	X^2-value	1.21		
Use of improved inputs	Toke Kutaye	58.57	7.14	34.29
	Bako Tibe	56.63	6.02	37.35
	Total	57.71	6.65	35.64
	X^2-value	0.48		
Determining selling/buying price of cattle	Toke Kutaye	75.24	6.19	18.57
	Bako Tibe	75.30	6.02	18.67
	Total	75.27	6.12	18.62
	X^2-value	0.01		

*** = significant at p ≤1% level, ** = significant at p ≤5% level

Gender benefits from resources of the value chain:

The study results (table 9) showed about 50.80% of the respondents said that men were more benefit from income of cattle sold than women; about 42.02% of them said both equally benefit and the others (7.18%) said women were more benefit from the income. On the income use from cattle sold, there is no significant difference between the two districts. In other case on the cattle products and by products' use, about 48.94% of the respondents responded that both men and women were equal benefit; about 46.54% of them responded that women were more benefit than men and less (4.52%) of them said that men were more benefit than women and there is no significant variation between the two districts on the cattle products and by products' use in the study

areas. These points showed that there is a probability that both men and women have almost equal benefit from resources along the beef cattle value chain in the areas. This may be the assumptions of if husband was benefited, wife also benefited simultaneously since they use the resources in the house together. Traditionally, women control income from sale of milk, cheese and butter (Zahra *et al.,* 2014; Kinati and Mulema 2016). However, when rearing of animals and their products becomes a more important source of family income, ownership and control turns to men (Zahra *et al.,* 2014). Good examples include cooperative-based milk marketing in Ethiopia (Hebo 2014; Birhanu *et al.*, 2016) where men take over the control of income from milk which traditionally fall under the domain of women. With commercialization of dairying, women may lose 'control' over cash incomes to men due to the institutional requirements for household heads, who are mostly men, to register and collect payments from the delivery of milk to the Dairy Development Enterprises in Ethiopia (Tangka et al. 2002). This could bring about stresses on gender relations and family harmony resulting from the scramble to control income earned from selling of milk and livelihoods (Hebo 2014). As Coles and Mitchell (2011) highlight, gendered patterns of benefit distribution in the value chain does not always translate into gains to all individuals. In the same vein, non-participation in particular value chain does not equate to a lack of benefit. What matters is not simply the level of income derived from value chain activities, but a combination of factors related to the perception of ownership or management of a particular commodity, the scheduling of payment, and the point of entry into the chain.

Table 9. Gender benefits from the resources along the beef cattle value chain in the study areas

Major benefits in beef cattle value chain	Districts and test	Percentage of the respondents in the two districts		
		More benefit for:		
		Men	Women	**Both equal**
Income use from cattle sold	Toke Kutaye	49.52	8.10	42.38
	Bako Tibe	52.41	6.02	41.57
	Total	50.80	7.18	42.02
	X^2-value	**0.72**		
Cattle products and by products' use (milk, hide)	Toke Kutaye	2.86	40.00	57.14
	Bako Tibe	6.63	54.82	38.55
	Total	4.52	46.54	48.94
	X^2-value	**13.83*****		

*** = significant at p ≤1% level, ** = significant at p ≤5% level

Conclusions and recommendations

The overall conclusion from the results was that there is a variation of gender roles at different stages of beef cattle value chain in the study areas. At the lower level activity (production activities) of beef cattle value chain stage, there were contributions of all gender categories (men, women, boys and girls) and the marketing activities of beef cattle value chain was mostly dominated by men's role in the study areas. Additionally, men have more access to credit, training, market information and contact with service providers than women and there is no equal gender access to resources along the beef cattle value chain in the study areas. The resources and activities along the beef cattle value chain were more controlled /decided by men as compared with women. There is a probability that both men and women have almost equal benefit from resources along the beef cattle value chain in the areas. Therefore, based on this study; encouraging women participation in beef cattle marketing activities, access to training, credit and market information for women by improving the linkage between them and service provider institutions and empowering women on access to and control of resources along the beef cattle value chain are recommended

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RESEARCH PAPER

Quantitative Trait Loci mapping of agronomic traits in a cowpea (Vigna unguiculata L.) bi-parental cross

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Abstract

Although Cowpea is an important food legume with multiple benefits in sub-Saharan Africa (SSA) its productivity on farmers' fields is very low due to biotic and abiotic stresses, and by the paucity of useful trait-linked genetic markers or QTLs for agronomic traits. Hence, the objective of this study was to construct genetic linkages map of cowpea and identify regions of the genome associated with agronomic traits of cowpea in the F2 population (200 progenies) developed from a cross between a cowpea line (TVu2185) and a yard-long bean line (TVu6643). Diversity Array Technology genotyping platform was used for SNP genotyping the DNA samples. The linkage map and QTL analysis were performed using Join Map® 4.1, and MapQTL® 6 QTL mapping programs, respectively. The linkage map spanned 689 cM of the cowpea genome. Major and minor QTLs (15 in total) were detected for the agronomic traits studied on 6 of the 11 LGs in cowpea. The major seed traits related QTLs were present on LG8 along with that for pod length. The highest phenotypic variance explained (PVE) by individual QTL was 31.2% for seed length followed by 21.1% for seed number per pod on LG8. The phenotypic variance explained by all QTLs per trait ranged from 10.2% for SPW to 48% for SL. The QTLs with large effect detected for pod length and seed traits indicates that the QTLs are potential candidates for marker development and marker assisted selection in cowpea.

Keywords: Cowpea, molecular mapping, Single Nucleotide Polymorphism, linkage map, yield

Introduction

Cowpea [*Vigna unguiculata* (L.) Walp] (2n=22) is an important food and forage legume which is adapted and grown in tropics and sub-tropics. It is a versatile crop cultivated between 35°N to 30°S of the equator including Africa, Asia, the middle East, southern Europe, southern USA and central and south America (Singh, 1997). This crop plays crucial role in the lives of millions of people in Africa and other developing countries as it is used as cheap source of dietary protein (17-24%) which nutritionally complements staple low-protein cereal and tuber crops, generating income to farmers, enhancing soil fertility and serving as fodder for livestock. Hence, cowpea has a key role in sustaining food security for both human being and their livestock (Boukar *et al*., 2011; Fatokun *et al*., 2002).

Cowpea production has been estimated to be nearly 6.5 million metric tons of dry cowpea grain annually on about 14.5 million hectares worldwide. More than 80% of this production comes from west and central Africa indicating that Africa takes a lion's share of the global cowpea production (Boukar, *et al*., 2016). However, its productivity is still low in Africa. An estimated potential yield of up to 2 tons per hectare in well-managed experimental stations can be obtained but globally the average yield is up to 450kg/ha. This average, in spite of its importance and wide cultivation, is lower in Africa with average yield ranging from 100 to 400 kg/ha (Singh, 2006). According to Fatokun *et al*., (2012) global cowpea production has increased in the past three decades in both

quantity of seed produced and total area of production; however, the increment in yield has resulted mainly from expansion of area under production and less from improved yield per unit area (productivity) which is partly attributable to cultivars the farmers use. Farmers' traditional cultivars are known to be well adapted to the low input conditions; however, they are generally poor in yield and highly susceptible to the major pests and diseases (Aliyu & Makinde, 2016). Developing improved varieties that give high yield per unit area and resistant to biotic and abiotic stresses using molecular techniques to accelerate cowpea improvement may help to achieve the anticipated increase in global cowpea demand because of the increasing world population.

Several agronomically important traits are governed by many genes, and hence they are called quantitative traits (or polygenic or complex traits). The parts on the genome containing genes associated with a given quantitative trait are termed as quantitative trait loci (QTLs). Identification of QTLs on the genome of an organism is very essential in accelerating improvement of crops by facilitating the marker assisted selection/breeding (MAS). Such identification of QTLs can hardly be done with conventional phenotypic evaluation alone (Sehgal *et al*, 2016). Molecular markers are utilized in construction of genetic linkage maps, and this linkage map, in turn, is utilized to identify regions on the chromosomes that contain genes governing quantitative traits. Single Nucleotide Polymorphism (SNP) marker is one of such molecular markers which is abundant and produces high number of polymorphism in the genome. Due to the abundance of SNPs and development of sophisticated high-throughput SNP detection systems, these markers have got a lot of applications in recent genetic mapping studies (; Mammadov *et al.*, 2012; Gupta *et al.*, 2001). Molecular markers with greater abundance in the genome of an organism have been found particularly useful for generating dense genetic linkage maps that can help breeders in their selection process. Once markers closely linked with the traits of interest have been identified, through QTL mapping, selection for the desired traits can be made indirectly by selecting for those markers. Before the advent of QTL mapping concept, analysis of quantitative traits was performed by using statistical techniques based on means, variances and covariances of relatives without actual knowledge of the number and location of genes (polygenes) underlying the traits (Semagn *et al.*, 2010; Kearsey & Farquhar, 1998;). However, currently the concept of QTL mapping, the process of constructing linkage maps and analyzing QTLs so as to identify the region on the genome associated with a particular trait of interest, is implemented to study such traits (Collard *et al.*, 2005; Lander & Botstein, 1989).

Despite all the aforementioned importance of cowpea in the developing countries this crop is still underexploited. Its low productivity can be attributed to biotic (insects, diseases, parasitic weeds, and nematodes) and abiotic (drought, low soil fertility and heat) factors. Moreover, farmers producing cowpea also have limited access to improved cowpea varieties. Currently, several research works are going on under the cowpea breeding and improvement programs in order to avert these problems. Among the major goals of cowpea breeding and improvement programs is stacking of desirable agronomic traits and accelerating cowpea improvement through implementing molecular breeding techniques such as Marker Assisted Recurrent selection and Marker Assisted Backcross. In a review about current status and prospectus of molecular breeding of cowpea in sub-Saharan Africa Gedil *et al.*, (2016) indicated that enriched genomic resources can provide more opportunity to accelerate genetic gain, stack traits, characterize existing diversity in cultivated cowpea and wild relatives, and pyramid favorable gene/alleles in farmer preferred varieties. However, implementation of these molecular techniques in cowpea is severely limited by the paucity of useful trait-linked genetic markers or QTLs for various agronomic traits (Timko *et al.*, 2008; Fatokun *et al.*, 1997). Different types of molecular markers have been developed and used in cowpea, such as Restriction Fragment Length Polymorphism (RFLP) (Menanciohautea *et al.*, 1993), Random-Amplified Polymorphic DNA (RAPD) (Ba *et al.*, 2004) and AFLP (Ouédraogo *et al.*, 2002). But these developed markers were not sufficiently informative and

highly polymorphic, and hence SSR markers, which are highly abundant and well distributed throughout the genome, has been developed and used recently (Chen *et al*., 2017). However, it was reported that identification of polymorphic SSR markers in cowpea is difficult due to the narrow genetic variability (self-pollinating nature) of cowpea (Chen *et al*., 2017). Consequently, single nucleotide polymorphism (SNP) markers have gained an increasing importance due to their bi-allelic nature, higher frequency in the genome than SSRs and other markers, and due to their easily automated genotyping (Carvalho, *et al*., 2017). Hence, the objectives of this study were to construct genetic linkage map of cowpea and identify regions of the genome (QTLs) associated with some agronomic traits of cowpea in the F_2 population developed from a cross between a cowpea line (TVu2185) and a yard-long bean line (TVu6643).

Materials and methods

Experimental site

The experiment was conducted at International Institute of Tropical Agriculture, Ibadan, Nigeria (7º29'11.99''N, 3º54'2.88''E) from September 2016 to August 2018.

Plant material and development of mapping population

A cowpea (Vigna unguiculata ssp. unguiculata) line (TVu2185), and a yardlong bean (Vigna unguiculata ssp. sesquipedalis) line (TVu6643) were used as parents. They were obtained through screening of the germplasm available at International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria which maintains more than 15,000 accessions of cultivated cowpea and more than 2,000 wild relatives. The two parents were selected based on several contrasting agronomic traits especially pod length and seed related traits. The two lines were crossed to generate F1, and which in turn is allowed to self-fertilize to develop F2 mapping population. F2 individuals were planted in pots in the screen house, and the resulting F2:3 seeds were sown in progeny rows in the field.

DNA extraction, quantification and quality

A newly expanded trifoliate leaf was harvested from each F2 plant four weeks after planting for DNA extraction. Total genomic DNA was extracted from leaves of 200 F2 population and 2 parental lines using Diversity Arrays technology (DArT) DNA extraction protocol (https://www.diversityarrays.com/files/DArT_DNA_isolation.pdf).

A leaf sample of approx. 1g was placed into 2ml Eppendorf tubes containing 2 steel grinding balls (size 2.4mm), and grinding was done at 1000 strokes/minute for 1 min using a GENOGRINDER 2000® instrument (BT and C Inc., New Jersey), a machine specially designed for high throughput DNA extraction. The fresh buffer solution used for DNA extraction was prepared from extraction buffer (0.35 M sorbitol, 0.1 M TrisHCl, 5 mM EDTA pH 8.0), lysis buffer (0.2 M TrisHCl, 0.05 M EDTA pH 8.0, 2 M NaC1. 2% CTAB), sarcosyl 5% (w/v), sodium disulfite 0.5% (w/v) and Polyvinylpyrrolidone (PVP) 2%. This buffer solution was pre-heated to 65ºC in water bath for dissolving, and 1ml of it was aliquoted to each tubes. This mixture was then incubated at 65ºC for 1 hour in water bath with gentle shake. After incubation the samples were cooled down for 5 minutes at room temperature (RT), and then 1 ml of chloroform: isoamyl alcohol (CIA) (24:1) mixture was added. This was mixed well for 30 minutes, and then centrifuged for 20 minutes at 10,000 x g, RT. The aqueous phase (600ml) was transferred to another tube; equal volume (600ml) of ice-cold isopropanol was added to precipitate DNA, and the tubes were inverted about 10 times, and then centrifuged again for 30 minutes at 10,000 x g at RT. The supernatant was then discarded and the pellet was washed with 2ml of 70% ethanol (EtOH). The EtOH was discarded; the pellets were air dried in the fume hood at room temperature; 10µl of RNAse enzyme was added and then dissolved in 150µl of milli-Q water.

DNA was quantified spectrophotometrically i.e. using Nanodrop (NANODROP 2000c spectrophotometer, Thermo scientific, USA). For checking the quality of the extracted

genomic DNA both gel 0.8% (w/v) agarose electrophoresis and Nanodrop were used.

Genotypic data

The DNA samples were genotyped using DArTseq genotyping by sequencing system. SNP markers with high quality of genotype calls and are heterozygous in at least one parent were retained for linkage analysis. Firstly, SNP markers polymorphic (opposite allele calls in parents) between the parents were screened. In other words, SNP data were first converted into parental genotypes for polymorphic SNPs with no missing or heterozygous genotypes for both parents. Markers with proportion of missing data points of >10% (Edae et al., 2017) were excluded from further analysis as they are not informative for linkage mapping. A total of 1,525 SNP markers that passed such filtering criteria were used for linkage mapping and further analysis.

Phenotypic data and trait analysis

The two parents together with 200 F2:3 progenies were evaluated in the field using alpha-lattice design with two replications. Each plot had 4.0m length with a spacing 0.75 cm between rows and 0.5m within rows. Phenotypic data were collected on the following traits: days to flowering (DF) - recorded as the number of days from planting to first flowering; pod length (PL) - recorded as the average length of 10 fully matured pods for each individuals/genotype; 100-seed weight (HSW) - recorded as the weight in grams of 100 seeds; pod number per plant (PN) - recorded as the total number of pods per individuals; seed number per pod (SN) - recorded as total number of seeds in a pod. Seed length (SL) and seed thickness (ST) - recorded as the average length and thickness of ten seeds per individuals were measured with electronic digital calipers. In addition, data on derived traits: pod to seed weight ratio (SPW) - calculated as the weight of 10 pod walls weight (TPWW) divided by the weight of 10 pods seed weight (TPSW). Pearson's correlation coefficient among each traits and the frequency distribution of each of these trait means was analyzed using R statistical package.

Linkage map construction

Linkage analysis of the entire markers, their subsequent grouping into respective linkage groups and construction of genetic linkage map was done using a computer program called JoinMap® 4.1 (Van Ooijen, 2006). Determining linkage groups of the markers was based on recombination frequency test statistics (of JoinMap). To calculate map distance and loci order Kosambi's mapping function (Kosambi, 1943) was used. For analyzing segregation distortion of markers significant deviation from the expected Mendelian genotypic frequencies (1:2:1 genotypic ratio for F2 population) was tested using chi-square goodness of fit test. The segregation distortion values provided as Chi-square (X2) values were used to identify distorted markers.

QTL mapping

Mapping of the quantitative trait loci was done using MapQTL® 6 (Van Ooijen, 2009). QTL mapping was performed by initially scanning the entire genome using the interval mapping. The interval mapping model was used initially to locate the putative QTL regions and to select cofactors (other markers in the surrounding with significant LOD values) for further analysis. This was followed by multiple QTL model (MQM) analysis to increase power of QTL detection. The method internally controls false discovery rates (FDR) and tests different QTL models by elimination of non-significant cofactors (Arends et al., 2014). Determination of appropriate significance threshold of the LOD value was performed by using permutation analysis with 1000 random data shuffles as described by Churchill & Doerge, (1994) to provide genome-wide 0.05 significance level using MapQTL program.

Results

Variability for phenotypic traits among the parents and individuals in the F2 population

Considerable variation in mean values between the two parents and among the individuals in F2 population (Table 1) were recorded for traits including pod length, days to flowering, 100 seed weight, pod number and seed length. However, there was no much difference between the parents for seed number per pod and seed thickness. Frequency distribution of all the traits in the F2 generation showed continuous variation (Figure 1). However, the distributions were skewed towards the lower values for days to flower, peduncle number per plant and pods per plant whereas hundred seed weight, seed length and seed thickness followed almost normal distribution. Ranges of mean values of the F2 population exceeded the mean values of the parents. For PL, about, 78.5% of the F2 progenies had mean values below the mid parent (i.e. closer to the short poded parent). For days to flowering, 85% of the F2 individuals had values lower than the early flowering parent while almost none of them exceeded the late flowering parent. For pod length, none of the F2 plants had longer pods than the parent with long pods (yardlong bean/sesquipedalis subspecies) nor shorter than that of the parent with short pod (cowpea/unguiculata ssp.). For HSW, 11.5% and 20% of the population had mean values less than the small seeded parent and higher than the large seeded parent, respectively. For seed length 20% had seeds shorter than the short parent while none of them produced seeds longer than the seeds of the long-seeded parent. The two parents produced almost similar number of seeds per pod. However, 38% of the progenies produced seed number lower than the parent with lower SN while 52% exceeded the high seeded parent. Similarly, for seed thickness the parents were not so different; however, 53.5% had seed thickness lower than the parent with low seed thickness while 27% had higher seed thickness than the better parent. For peduncle number, 25% of the population had peduncle numbers higher than the better parent while 19% had peduncle number lower than the other parent. For Pod number, 62% of the progenies higher values than the better parent whereas only 3% had pod number lower than the poor parent. There was significant (P=0.01) correlation among the agronomic traits evaluated in this study (Table 2). Positive and significant phenotypic correlations were observed between some of the measured traits such as between PL and SL (0.42), PL and HSW (0.41), SL and ST (0.56), HSW and ST (0.68), and HSW and SL (0.7) (Table 2). There were also significant negative correlations between SN and SL (-0.42), SN and SPW (-0.45), and PN and DF (-0.2).

Polymorphism and informativeness of the SNP markers

DArTseq genotyping generated a total of 3,103 SNP markers, out of which 1,627 (52%) were polymorphic. The SNP genotyping results showed very high call rates which had an average of 98%. The polymorphic information content (PIC) values of the markers ranged from 0.02 to 0.5, with an average of 0.39. Based on chi-square goodness of fit test, 79% of the polymorphic markers segregated according to 1:2:1 Mendel's segregation ratio for F_2 population while the remaining 21% of the markers showed significant deviation (P=0.05) from the expected ratio.

Genetic linkage map of cowpea F2 population

Six hundred and seventy-two SNP markers out of 1,525 polymorphic SNP markers were mapped into 11 (haploid chromosome number of cowpea) linkage groups (LG) (Table 3; Figure 2). The linkage group designation was based on the chromosome number the markers are located which was retrieved from Phytozome using markers' sequences. Hence, each of the markers in the linkage groups corresponds to their respective chromosome number, or in other words, the 11 LGs in this linkage map correspond to the eleven

Table 1. Comparison of parental means, and ranges, mean and standard deviation of F_2 progenies

		Parents		**F_2 Progenies**			
Traits	Abbreviation	P1 (TVu2185)	P2 (TVu6643)	Min	Max	Mean	STDev
Pod length (cm)	PL	9.9	39.6	11.60	41.70	21.86	4.66
100_seed weight (g)	HSW	11.3	17.9	6.90	26.90	15.45	3.34
Pod number per plant	PN	8.2	2.6	1.00	23.00	9.87	4.68
Seed number per pod	SN	7.0	7.2	1.00	14.00	7.69	2.55
Peduncle number	PeN	9.6	4.2	1.00	17.00	7.57	3.48
Seed length (mm)	SL	7.8	12.5	7.60	13.20	10.73	1.09
Seed thickness (mm)	ST	4.5	4.6	2.80	5.60	4.41	0.40
Days to flowering	DF	84.6	61.2	43.00	96.00	55.72	7.87
Seed pod weight ratio	SPW	0.2	0.6	0.10	1.30	0.45	0.18

TVu2185 is a cowpea line; TVu6643 is a yard-long bean line. Min, Max Mean STDev indicates the minimum, maximum, mean and standard deviation of a trait for F2 progenies. Total number of observations, N=200.

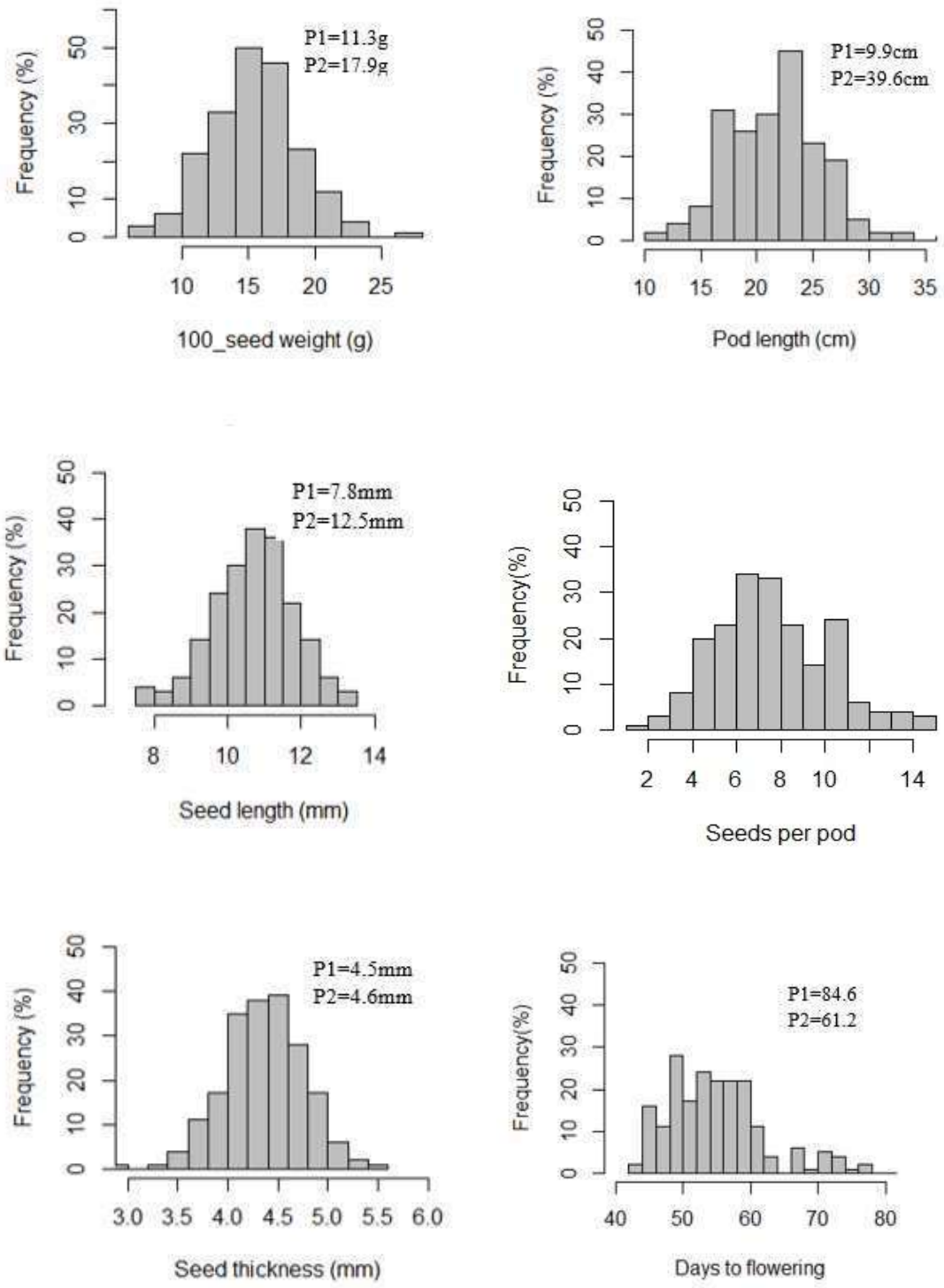

Figure 1. Histogram showing distribution of traits' means of cowpea F2 progenies. Frequency represents number or proportion of F2 progenies.

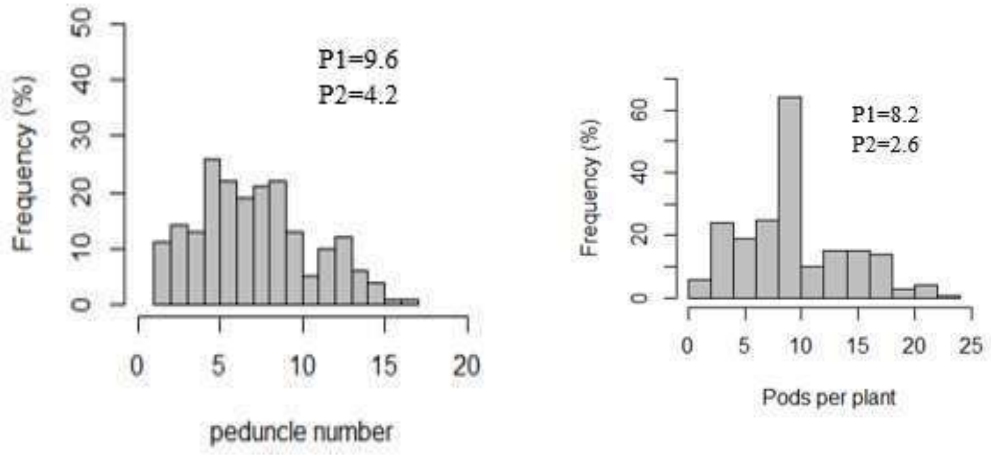

Figure 1 continued

chromosomes per haploid cowpea genome. The linkage map spanned 689cM of the cowpea genome. The size of linkage groups ranged from 34.79 cM for LG10 to 115.14 cM for LG7, with an average of 62.64 cM. The average distance between adjacent markers (marker density) ranged from 0.75 cM for LG8 to 2.03 cM for LG1 with an average distance of 1.19 cM.

Quantitative trait loci (qtls) mapped

QTLs were detected for all the agronomic traits studied in this work except for days to flowering (Figure 4.3). Generally, 15 QTLs were detected for 8 agronomic traits on six linkage groups (LGs): 3, 5, 7, 8, 9 and 10 (Table 4.4). The number of QTLs detected ranged from one for SN, PN and PeN to four for PL. The highest phenotypic variance explained (PVE) by individual QTL was 31.2% for seed length on LG8 followed by seed number per pod at 21.1 on LG8. Pod length showed the lowest PVE by a QTL at 7.8cM on LG%. However, pooled PVE by QTLs per trait ranged from 10.2% for SPW to 48% for SL. Eleven of these QTLs showed major effects accounting for >10% phenotypic variation.

Two major QTLs were detected on LG3 & LG8, and two minor ones on LG5 & LG10 for pod length all accounting for a total of 47% of the phenotypic variation in the trait. One major QTL was detected for each of PeN, SN and PN on LG8 at map positions 31.1cM, 33.6 and 38.4cM, respectively. For HSW one major and one minor QTL on LG8 and LG10, respectively, were detected explaining a total of 28.4% of phenotypic variation for the trait. For SL, two major QTLs were detected on LG7 and LG8 explaining 48% of the variation for the trait in the F2 population. For seed thickness, 2 major QTLs on LG8 & LG10 and a minor QTL on LG9 were detected which explained 39% of the variation for the trait. For seed size (HSW), QTLs were detected on LG8 and LG10. The QTLs on LG 3, 5 and 8 for PL had positive additive effect whereas QTL on LG10 had negative additive effect which can be seen from their additive effects (Table 4). The QTLs detected for SN, PN, PeN and SPW had negative allelic contribution to the traits. For HSW and ST, QTLs from LG8 had positive effect whereas QTLs from LG10 had negative allelic contribution for the traits.

Table 2. Pearson's correlation coefficient values between agronomic traits of cowpea.

	DF	PL	SN	PeN	PN	HSW	SL	ST	SPW
DF									
PL	-0.01								
SN	0.17*	0.26**							
PeN	-0.02	-0.01	0.1						
PN	0.2**	-0.07	0.07	0.63**					
HSW	0.09	0.41**	-0.17*	0.03	0				
SL	0.15*	0.42**	0.42**	-0.08	-0.11	0.7**			
ST	0.04	0.33**	-0.16*	0.16*	0.16*	0.68**	0.56**		
SPW	0.16*	0.32**	0.45**	-0.14*	0.19**	0.25**	0.4**	0.16*	

*, ** indicates significance at P=0.05 and P=0.01, respectively. DF=days to flowering; PL=pod length; SN=seed number per pod; PeN=peduncle number; PN=pod number per plant; HSW=hundred seed weight; SL=seed length; ST=seed thickness, and SPW=seed pod weight ratio.

Table 3. Distribution of SNP markers over the 11 linkage groups of cowpea

LG	**No. of markers mapped**	**Map length (cM)**	**Aver. marker density (cM)**	**Intervals >5cM**
1	34	66.95	2.03	1
2	58	73.37	1.29	3
3	66	88.22	1.66	4
4	42	35.67	0.87	-
5	41	57.30	1.43	2
6	50	39.34	0.80	2
7	97	115.14	1.20	2
8	55	40.24	0.75	-
9	54	74.52	1.41	2
10	94	34.79	0.81	-
11	81	63.52	0.79	-
Total	**672**	**689.07**	**-**	
Average		**62.64**	**1.19**	

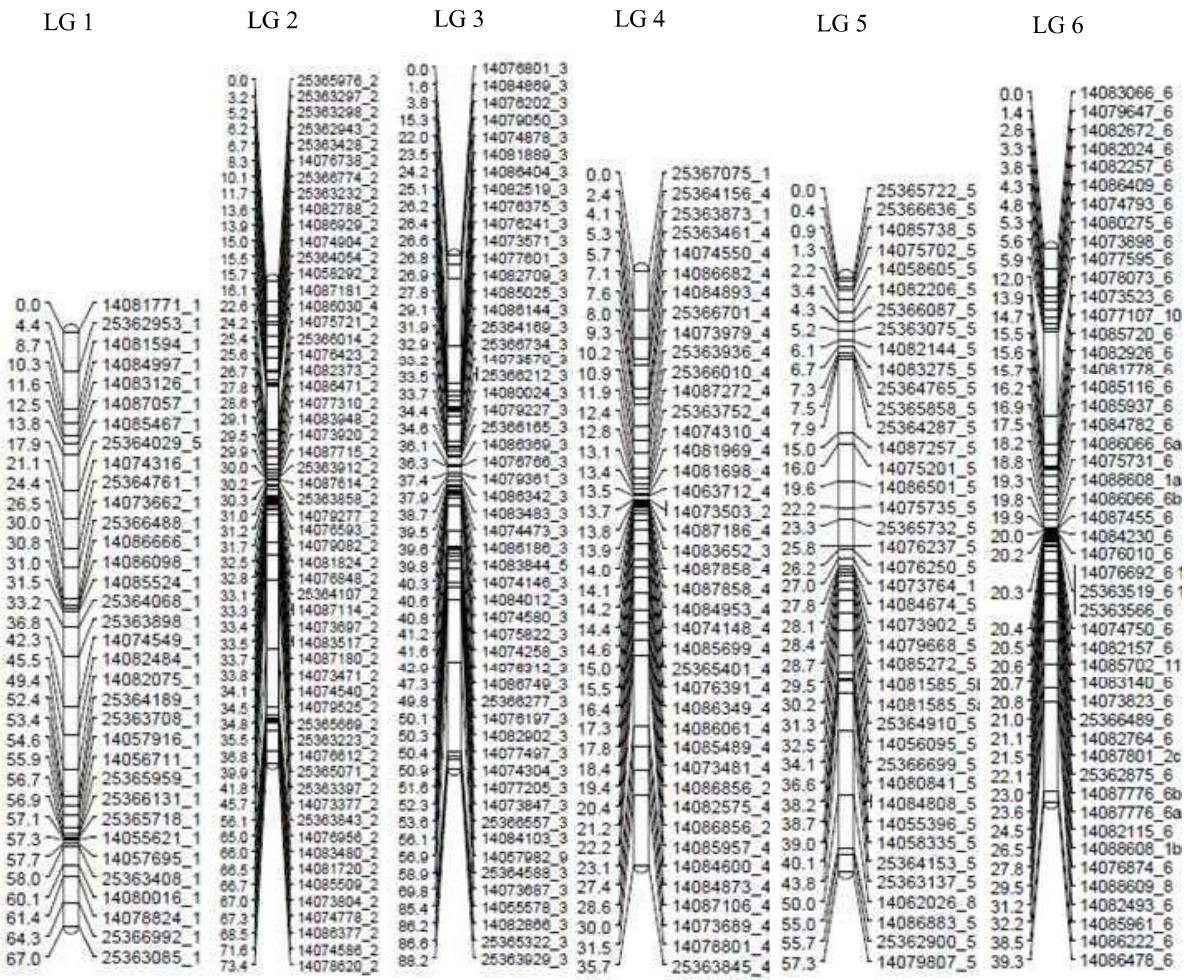

Figure 1. Genetic linkage map of Cowpea F_2 population developed from bi-parental cross between a cowpea line (Tvu2185) (*Vigna unguiculata* ssp. *Unguiculata*) and a yardlong bean line (TVu6643) (*V. unguiculata* ssp. *sesquipedalis*) based on SNP markers. Marker names are indicated on the right side, and map length (cM) on the left side of each linkage group (LG).

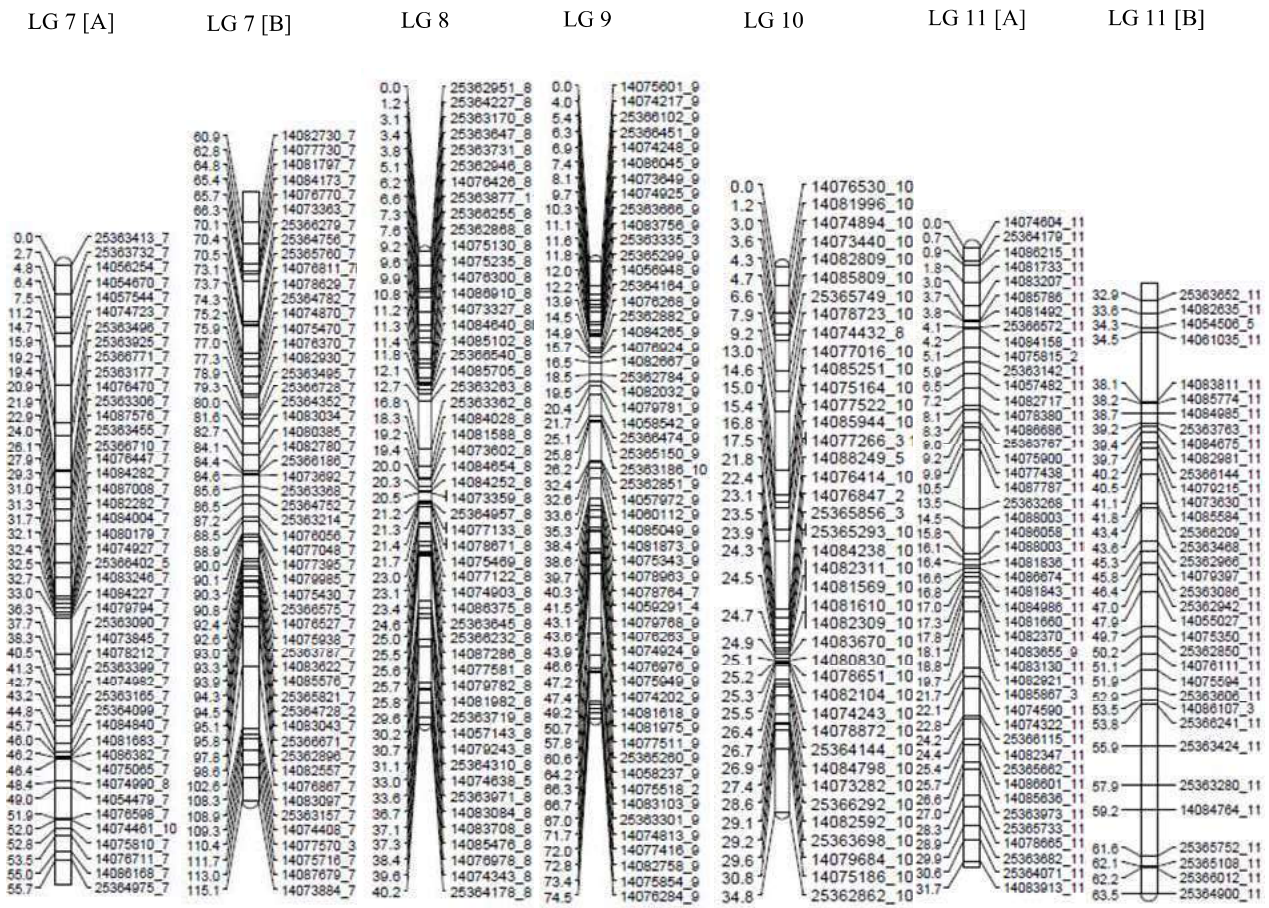

Figure 2 continued

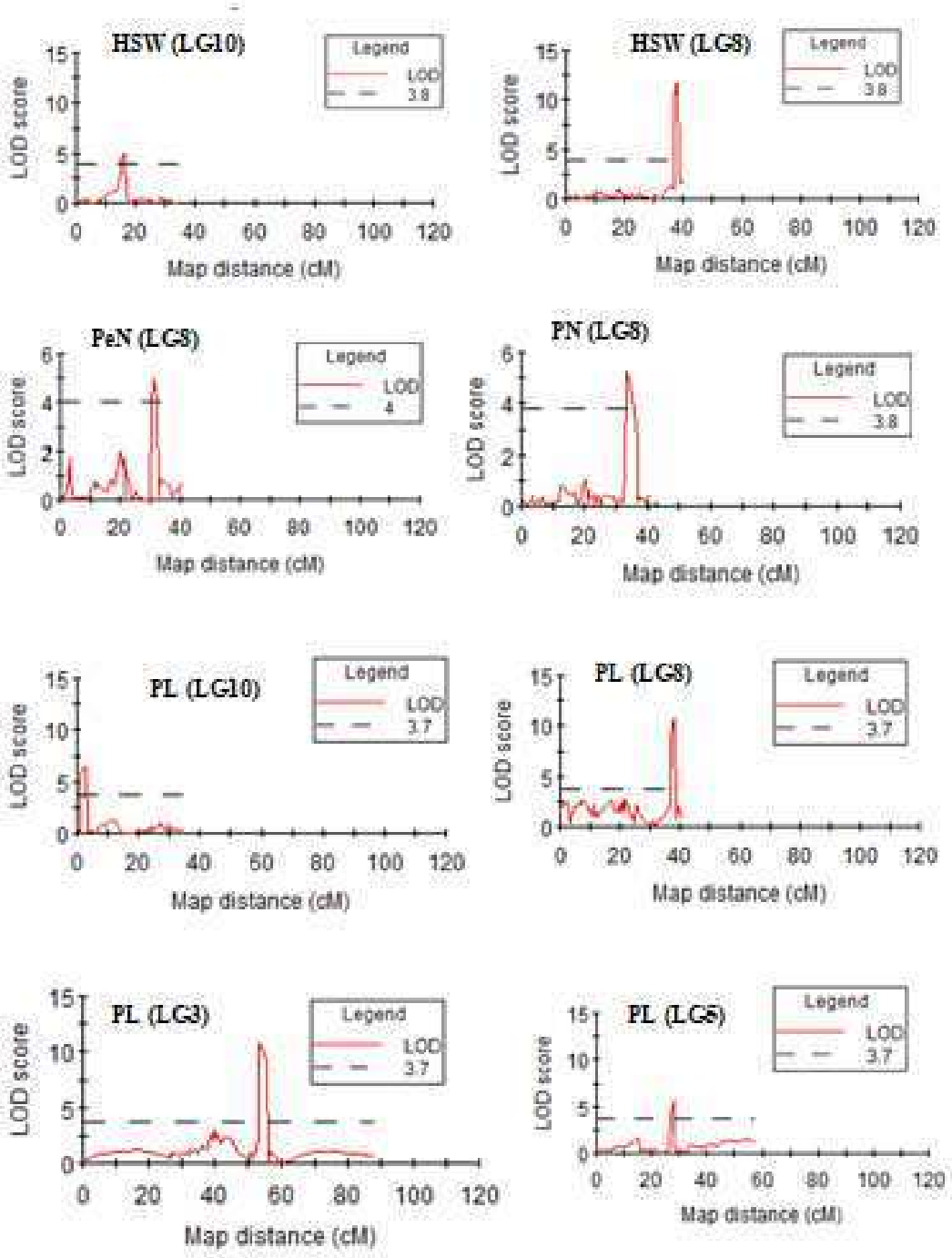

Figure 3. Chromosomal locations of detected QTLs for each agronomic traits of cowpea F2 population developed from a cross between a cowpea (Tvu2185) and a yard-long bean (TVu6643). QTL mapping was done using interval (MQM) mapping. Threshold LOD is determined for each trait separately. The genomic region where LOD peak is located indicates the position of QTL. Dashed broken lines indicate LOD threshold used to declare presence and statistical significance of the QTL

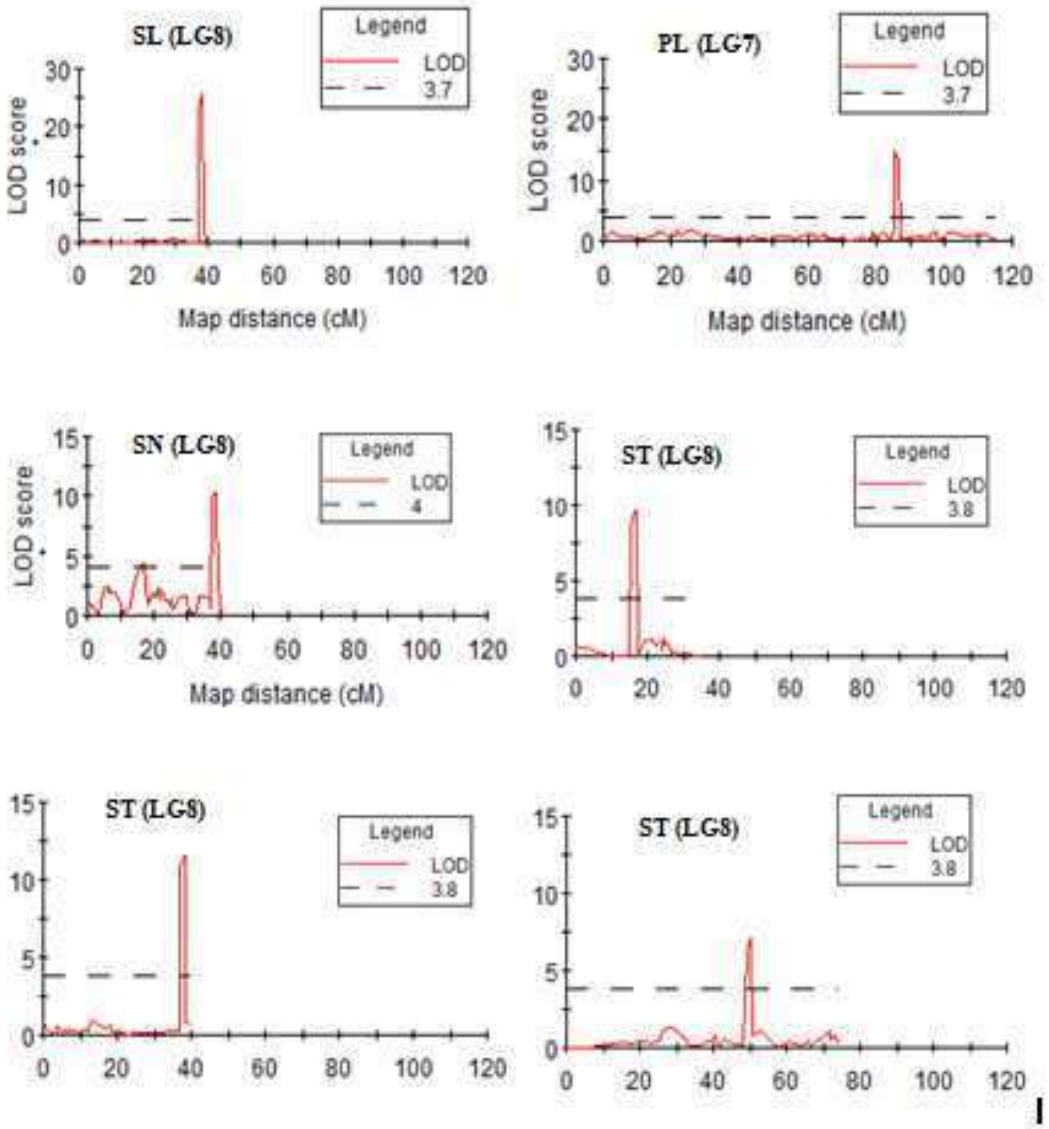

Figure 3 Continued.

Table 4. Summary of QTLs detected for agronomic traits of cowpea F2 population developed from Tvu2185 x Tv6642 crossing

Trait	QTL[a] name	LG	Locus	Map Pos. (cM)	LOD score	PVE[b] %	Additive effect
Pod length	qPL_1	3	25366557_3	53.6	10.73	15.7	2.65
	qPL_2	5	14084674_5	27.8	5.65	7.8	1.84
	qPL_3	8	14085476_8	37.3	10.08	14.6	2.28
	qPL_4	10	14074894_10	3.0	6.41	8.9	-1.47
Seed no. per pod	qSN	8	14076978_8	38.4	10.27	21.1	-1.4
100_Seed Weight	qHSW_1	10	14077522_10	15.4	4.44	7.9	-1.38
	qHSW_2	8	14083708_8	37.1	10.74	20.5	2.07
Seed length	qSL_1	7	25363368_7	85.6	14.75	16.8	0.65
	qSL_2	8	14085476_8	37.3	23.58	31.2	0.91
Pods per Plant	qPN	8	25363971_8	33.6	5.31	11.5	-1.79
Peduncle no.	qPeN	8	25364310_8	31.1	4.98	10.8	-0.47
Seed thickness	qST_1	8	14085476_8	37.3	11.05	16.3	0.22
	qST_2	9	14081618_9	49.2	6.28	8.9	-0.15
	qST_3	10	14085944_10	16.8	9.54	13.8	-0.2
Seed pod weight ratio	qSPW	8	14057143_8	30.2	5.75	10.2	-0.24

a QTLs were named by taking first 'q' for QTL and abbreviation of the trait names followed by serial number indicating QTLs. b=Phenotypic Variation Explained.

Discussion

All the agronomic traits examined in this study showed continuous variation. The continuous variation of the traits observed indicates polygenic nature of the traits and their quantitative inheritance. Substantial diversity of expression of the traits was observed between F2 segregants and the two parents. The transgressive segregation observed for traits was expected as this phenomenon is often observed in the progenies resulting from crosses involving different subspecies of a genus (DeVicente & Tanksley, 1993). The transgressive segregation observed for some traits may suggest the presence of complementary QTL alleles in the two parents. For pod length (PL), Kongjaimun et al., (2012) observed similar trend of no transgressive segregation in a cross between cultivated yard long bean and a wild cowpea as observed in this study. Although no transgressive segregation was observed for PL, the higher proportion of the F2 progenies with mean values below the mid parent (i.e. closer to the short poded parent) may suggest partial dominance of the short pods over the long pods. This result is in agreement with findings by Hazra et al. (2007) who reported predominance of additive gene effects for pod length, with short pod characteristic of cowpea (unguiculata) being partially dominant over long pods of sesquipedalis (yardlong bean). Similarly, the proportion of F2 segregants for DF may indicate partial dominance of the alleles for early maturity and short pods. This result is in agreement with the work of Ubi & Obigbesan (2001) who reported partial dominance for days to flowering in cowpea.

The number of polymorphic markers detected between the two lines was relatively low. However, Kongjaimun et al. (2012) has reported a polymorphism level of 13% using micro-satellites and RIL mapping population of cowpea. The low level of polymorphism in cowpea can be attributed to the highly self-pollinating nature and narrow genetic base of the crop. (Li et al., 2001) have also reported low genetic diversity among cowpea lines using SSR markers. Moreover, stocks used as parents for developing the mapping population were not taxonomically distant as both of them are in the same genus Vigna and the same species unguiculata though the subspecies are different (V. unguiculata subsp. unguiculata vs V. unguiculata subsp. unguiculata sesquipedalis). Fatokun et al. (1993) indicated that the more distantly related two sexually compatible individuals are taxonomically, the higher the frequency of polymorphism detectable between them. Higher polymorphism rate would have been observed if the cross were between two different species (inter-species) of genus Vigna genus. In a QTL mapping study, Sassoum et al., (2015) crossed cultivated and wild cowpea and found 35% rates of polymorphism (using SNP markers) in the mapping population. In another mapping study using RILs developed from a cross between a breeding line and a perennial wild cowpea, only 31.6% SSR markers were found to be polymorphic between the parents (Andargie et al., 2011) though the marker type used was different.

Segregation distortion is a common phenomenon which is usually observed in wide intra- and interspecific crosses of several plants (Song et al., 2006). Distorted segregation of markers has been reported in Vigna species for genetic maps of cowpea, yard-long bean, mungbean and adzuki bean ranging from 9.7% to 30.8% (Kongjaimun et al., 2012; Nagata and Widholm, 2005). So, the segregation distortion observed in the current study is within the range that was reported for species in Vigna.

The map length obtained from this work was comparable to the linkage maps reported previously by Muchero et al., (2009) (680 cM), Ubi et al., (2000) (669.8 cM), Menendez et al., (1997) (972 cM); and Xu et al., (2011) (745 cM) regardless of the mapping population and marker types used. Also, distances between markers in the current study were mostly (97%) less than 5cM. Moreover, the average marker density is also comparable to that of consensus genetic linkage map for cowpea by Muchero et al. (2009) which had 0.73cM indicating good marker density of the linkage map. Other

studies have reported average marker distances as large as 9.9cM (Ubi et al., 2000).

The number of QTLs detected for PL in this work is comparable to that reported by Ubi et al. (2000) who detected 4 QTLs controlling the trait in a RIL population developed from a cross between cultivated cowpea (14.5 cm pod length) and wild cowpea (7.1 cm pod length). However, Kongjaimun et al. (2012) detected 7 QTLs for PL in a cross between yard long bean and cowpea. PL is the trait for which the highest number of QTLs, four on four different LGs, were detected as compared to other traits studied in this work. This can be explained by the fact that the two parents used for the cross had very huge difference in terms of the pod length (Cowpea/P1=9.9cm; yardlong bean/P2=39.6cm). Mackay & Powell (2007) indicated that the number of QTLs detected for a trait in bi-parental population depends on the number of contrasting alleles of the trait controlling loci between the two parents. The most obvious distinguishing character between cowpea and yardlong bean is the pod length and is the most important domestication trait of yardlong bean.

Detection of QTLs for seed size (HSW) on LG8 and LG10 is in agreement with the work reported by Andargie et al. (2011) where they have also detected QTLs for seed size on LG10. For days to flowering, failure to detect QTL(s) was unexpected as the two parents had considerable differences in days to flowering: 44 and 54 days to first flowering for TVu2185 and TVu6643, respectively. However, it could partly be caused by the stringent LOD threshold used (3.8) for this trait against the threshold of 2-3 used by previous studies to declare significant QTL. A putative QTL position with a LOD of 2.5 was observed on LG5. Likewise, the same stringency was applied for other traits too, and LOD values even higher than 2.5 were observed but not declared as significant QTL as they appeared below the threshold. The threshold LOD value was determined for each trait separately (mostly between 3.7 and 4) using their phenotypic data.

Although QTLs were detected on 6 linkage groups, most of them were clustered on LG8 (8 of the 15 QTLs). The major seed traits (SL, ST, HSW and SN) related QTLs were present on LG8 along with that for pod length. The genomic region from 30.2 to 38.4 cM of LG 8 is where most of the above-mentioned QTLs have mapped. QTLs for PL, HSW and ST were co-localized on LG10. Kumawat et al. (2012) reported similar observations of clustering of QTLs where they reported ten of the thirteen QTLs mapped to only two LGs in their mapping study in pigeon pea (Cajanus cajan L. Millsp.). According to Aastveit & Aastveit (1993), the clustering of QTLs within close regions on linkage groups can arise due to pleiotropic effect of a single regulatory gene/locus or due to close genetic linkage of distinct genes. The occurrence of pleiotropy could be explained in a way that certain traits are phenotypically correlated with each other due to the presence of certain genes coexisting in these QTLs. Hence, the strong positive and significant correlation observed between the agronomic traits may confirm the presence of pleiotropic effect. QTL clustering for agronomic traits have been observed in various crops (Wang, et al., 2012; Chen et al., 2007; Beattie et al., 2003). Fine mapping of these identified QTLs would provide a better understanding of whether linkage of distinct genes or pleiotropic effect of one gene are responsible for their clustering (Verma et al., 2015).

The positive additive effect observed for some traits such as PL, SL and HSW implies TVu2185 (P1) had positive allelic contribution for these trait means; however, negative additive effects were also observed for PL and HSW at few loci indicating TVu6643 (P2) also had positive effect for these two traits. The negative additive effect for the rest of the traits implies TVu6643 had positive allelic contribution to the means of these traits.

In general, detection of a few major and minor QTLs (15 in total) for eight agronomic traits (some of which are agronomic traits) distributed in only six of the eleven linkage groups in the present study agrees with the previous findings from many mapping studies that revealed domestication related traits in

cowpea are controlled by a few major genes and some minor genes and they are distributed on narrow regions on linkage groups (Kongjaimun et al., 2012; Andargie et al., 2011; Gepts, 2004).

Conclusion

Availability of genetic linkage maps for crops facilitates localization and mapping of genomic regions (QTLs) associated with one or more of the agronomic traits of interest using phenotypic data of the segregating population. Mapping of QTLs related to agronomic traits can enable dissection of their genetic control and molecular mechanism which may render the possibility to develop varieties with improved seed yield. A genetic linkage map of cowpea has been constructed using SNP markers, and the number of linkage groups coincided with the haploid number of cowpea chromosomes. In addition, several major and minor QTLs were detected for eight agronomic traits and distributed on six of the eleven linkage groups (LGs). Although QTLs were detected on six LGs, clustering of some of the QTLs in one of the LGs was observed. The fact that the same genomic region influenced more than one agronomic traits coupled with the strong and positive correlation among the traits reflects pleiotropic effect. Potential genomic regions of cowpea associated with some agronomic traits (QTLs) were identified in this study. QTLs with large effect such as qPL_1, qSN, qHSW_2 and qSL_2 are potential candidates for marker development and marker assisted selection.

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RESEARCH PAPER

Determinants for Households' Dependency on Natural Resources of Arsi Mountain National Park: a Case of Chilalo-Galema Block, Ethiopia

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Abstract

For sustainable environmental management, protected areas should improve the socioeconomic living conditions of local communities in addition to their envisioned goal for biodiversity conservation. The main objective of this study was to assess the determinants of households' dependency on natural resources of Arsi Mountain National Park. In order to address the major objective of the study, data were collected from 128 sample respondents through survey instrument, two focus group discussion and eight in depth interview. Determinants for households' dependency on natural resources of the block were analyzed by using binary logistic regression analysis model. Qualitative data were analyzed alongside quantitative data. The finding of the study revealed that adjacent households were highly dependent on natural resources derived from Chilalo-Galema block. That means, on average 55% of their annual income were derived from Chilalo-Galema block. Land holding size, age, household size, proximity to the local market and proximity to the block significantly determined their dependency. At the end, the study recommends that command and control approach of natural resources conservation (fortress conservation) will promote park- people conflict or it affects both resources users and natural resources itself; hence, managers of the park must employ a proactive approach and work with local people through addressing their socioeconomic concern.

Keywords: Determinants, Dependency; Natural Resources; Park-Management, Ethiopia.

Introduction

Protected areas such as parks and wildlife sanctuaries are areas of land especially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources and managed through legal or other effective means (McNeely and Harrison1994).They are considered as a cornerstone for biodiversity conservation and means of reducing environmental degradation.

Deforestation is the major factor for losing endemic animals and natural resources. To conserve these endemic animals and natural resources, different countries implemented policies or programs that serve to conserve nature. In most cases, the management approach implemented to conserve nature excluded local people from areas that they have previously used to gather resources such as fuel wood, material for shelter and farming, fodder and non-timber forest products. Wells and McShane (2004) indicated that long-term survival of protected area is not assured without recognizing local peoples' dependency on natural resources of the protected area.

In Ethiopia, majorities of parks and wildlife sanctuaries were protected by eviction and exclusion of local people from areas that they have previously used to gather resources s such as fuel wood, material for shelter and farming, fodder and non-timber forest products (Abiyot 2009; Asebe 2012; Bayissa 2013). As a result both the protected area and the livelihood of local people have been in a great crisis. For sustainable environmental management, it is expected that protected areas should improve the socio-economic living conditions of local people in addition to their envisioned goal for biodiversity conservation. This is because; natural resources within the protected areas are source of livelihood for adjacent households (Cullen 2007). However, in most cases management approach implemented to conserve natural resources within protected area excludes local people by overlooking their socio-economic living conditions and conservationist mainly focus on conserving/protecting biodiversity within protected area. Similarly, Arsi Mountain Park which contains four blocks is being managed by the Ethiopian Wolf Conservation Program (EWCP). The major aim of EWCP is conserving wolves and their Afro alpine ecosystem. The management process of Arsi Mountain National park started by eviction and exclusion of local people. This situation created a great crisis both on local people and the park.

Maintaining the sustainability of protected area like Arsi Mountain National park requires understanding the attributes of local people around the park and their dependency on natural resources. This in turn helps to provide alternative means of livelihood and/or implement natural resources management approach that embrace local people's concern in management process. Therefore, this study aimed to attract the attention of park managers of the study area to review their management strategies and reshape it to be consistent with local people's socio-economic living condition. Furthermore, disclosing contributing factors for household's dependency on natural resources of the park could serve as important input for knowing on which parts of household characteristics need to be worked on so as to reduce their dependency.

Worldwide various researches revealed that the socio-economic factors are determinant for depending on natural resources of the park. For example Gunatilake (1998) in Siral lank, Cavendish (2000) in Zimbabwe, Adhikariet al (2004) in Nepal, Masozera and Alavalapti (2004) in Rwanda and Cullen (2007) in Indo pacific island indicated that, adjacent households' socio economic living condition is a major factor for their being highly reliant on natural resources of protected area and became detrimental to effectively manage the protected area. However, the socio economic living condition of households around protected area is varying from context to context and when we come to see these from Ethiopian context, there is no (little) consideration is given.

Majority of Ethiopian literatures confined in studying the management system of protected area. For instance, Asebe (2012) studied how the local community and the state perceived

conservation process differently. Abiyot (2009) found that the major reason for resettlement of Guji Oromo is embedded in conservation ideology, perception of mode of life of the Guji and local political contexts. Solomon et al (2014) indicated that Awash national park is being deteriorated due to expansion of grass and farm land. All of the above studies (Abiyot 2009; Asebe 2012; Solomon et al (2014) did not look at households' dependency on natural resources of the park; and the contributing factors for their dependency. Therefore, the current study aimed to fill in the knowledge gap in existing literatures through mainly focusing on determinants for households' dependency on natural resources of Arsi Mountain National park.

Dependent and independent variables of the study

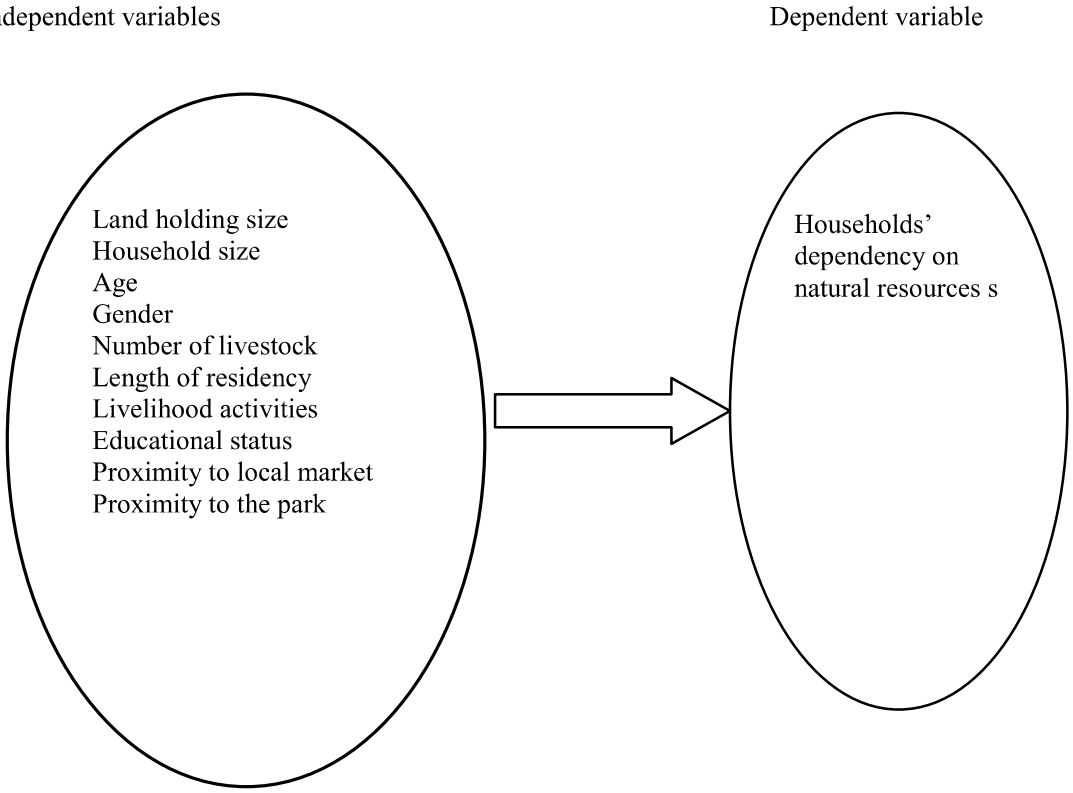


Figure1.diagrammatical presentation of the relationship between independent and dependent variables

Operationalization and measurement of key variables

Table 1 below shows the identification of variables from concepts, indicators of the variable and level at which indicates are measured.

Concepts	Variables	Indicators	Level of measurement
Socio economic status	Land holding size	Absolute value of land under the control of the household in hectare	Scale
	Number of livestock	Total number of livestock owned by the household	Scale
	Length of residency	Number of years a person lived in the area	Scale
	Livelihood activities	Livelihood activities practiced by households	Nominal
	Proximity to the block	Time spent to reach to park	Scale
	Proximity to the local market	Time spent to reach to local market	Scale
	Age	Length of year that one has been alive	Scale
	Household size	Number of people living in one home	Scale
	Educational status	Level of education attained	Scale
Dependency	Level of dependency on natural resources derived from Chilalo-Galama block	The extent of relying on natural resources derived from Chilalo-Galama block for earning income	Ordinal High/low

Materials and methods

Overview of the study area

Arsi zone is one of the zones that are found in Oromia national regional state in Ethiopia and located in the southeastern part of the country. It is bordered on the south by Bale zone, on the south west by West Arsi zone, on the North West by East Shewa zone, on the north by Afar region and on the east by West Harage zone. The administrative center of this zone is Asella. Arsi Mountain National Park is located in Arsi zone. The park is bounded with 14 woredas and 70kebeles of the Zone. The total area was 931km2 having different area coverage, unique ecology, climate, wildlife and plant species. The physical setting of Arsi Mountain National Park is Mountainous with plateaus, hills, canyons, undulating scenery and flat surface. The park is composed of 4 blocks. These are: DeraDilfekar, Chilalo-Galema, Kaka, and Honkolo blocks (**www.oromiaforest.g ov.et**). Chilalo-Galema block was selected for this study. The rationale behind selecting this block is that, it is the widest block from the rest and thus, large number of household lives adjacent to it. This block is bounded by nine woredas

and 45 kebeles. The total area of the block is about 792 km2. The center of the block is about 200 km from Addis Ababa and 40 km from Asella (zonal town) in south east direction. The block endowed with various vegetables such as *Giant lobelia, Hygiena abyssinica, Podocarpus falcatus, Juniperus procera, Hypericum* etc. There are also more than 40 highland wild mammals and various birds. Moreover, the afro alpine ecosystem regulates water flow from the highland and this regulation supply many downstream users.

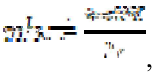
Research approach

In this study the researcher employed both quantitative and qualitative research approaches (triangulation). "Triangulation is primarily a way of assuring the validity of research results through the use of different methods and approaches" (Yeraswork 2010:66). Besides, it has also additional advantage of allowing the researcher to cover different aspects of her/his research objectives or research questions by employing different sources, data and research methods (Yeraswork 2010:66). Therefore, the rationale of triangulating data sources and methods in this study was primarily to address various aspects of research objectives of the study. In addition, it allows the researcher to substantiate quantitative data with qualitative one as each of them has their own pitfall.

Sampling Design and Sample Size Determination

Both probability and non-probability sampling techniques were employed for selecting respondents. From probability sampling techniques, multistage random sampling which allows the selection of sample at different stage was utilized. Accordingly, the first stage of the sampling constituted random sampling of one woreda (shirka) out of nine woredas that surrounded Chilalo- Galema block. At the second stage, three kebeles (Gademsa, Aria and lebu) were randomly selected out of eight kebeles of shirka woreda that bounded the block. The selected woreda and kebeles are limited to one and three respectively due to time and financial constraints. Then, at the last stage, sample household heads from each kebeles were selected using simple random sampling technique. To do so, a list of household heads (sampling frame) was obtained from each kebele offices. The household heads contacted were husband except for female headed households. However, in the absence of household heads (i.e both male and female), the younger member of the household was contacted. Household heads were preferred over other members of their household with the assumption that they know better about issues under investigation.

Before doing this, the researcher calculated the sample size by using the online sample size calculator http://www.raosoft.com/samplesize.hpml. Then, the sample size for 1559 household heads becomes 128. Since each kebeles has different number of household head (Gademsa=390 household heads, lebu=692 household heads and Aria=477 household heads), proportional allocation to size (PAS) formula was used to select appropriate number of sample from each kebeles. Based on PAS, the total study subject (128) was distributed to each kebeles using the following formula.



Where;

nk: is the required sample size from each *kebeles*

n is the total sample size (128)

Nk is the total household heads in each kebeles (Gademsa=390 household heads, lebu=692 household heads and Aria=477 household heads).

N is total number of households (1559).

Therefore, when applying this formula for each *kebeles*, required sample size from Gademsa, lebu and Aria*kebeles* is 32, 57 and 39 household heads respectively.

Additionally, from non- probability sampling technique purposive and snow ball sampling were employed. Focus group discussants and in

depth interviewees were selected by using snow ball sampling technique since they are individuals who evicted due to demarcation and conservation process. Accordingly, two focus group discussions and six in depth interview participants were selected through snow ball sampling technique. In most cases, FGD and in depth interview is conducted with people who directly related with the issues under investigation. Hence, individuals who evicted due to demarcation and conservation process of the block are the people who directly affected by the process. Since they are evicted from their previous place, it is difficult to access them; thus snow ball sampling technique was used to select them. Two Key informants (one from government officials and the other from EWCP office) were purposively selected. The key informants were purposively selected on the basis of the position they hold and knowledge they have about the issues under investigation.

Data collection instruments

Data concerning socio-economic features of the household heads, type of natural resources utilized from Chilalo-Galema block and households' dependency on natural resources of the block were collected through structured questionnaire. The questionnaire generally has two parts. The first part of the questionnaire asked the socio-economic characteristics of the respondents. The second part contains question related to households' dependency on natural resources s of the block. The survey team consisted of the researcher and three enumerators. The enumerators were first degree holds and have good experience in data collection from the rural setting. The researcher as well as the enumerators was fluent in local language (Afan Oromo). Furthermore all assistant were given adequate orientation by the researcher concerning ways of approaching the respondents and informed consent of the respondents. The administration of Survey instrument was undertaken through face- to face interview since majority of respondents were unable to read and write.

In depth interview was held with sample respondents. This data collection method is used to generate in-depth information about issues under investigation. Totally, six in depth interview were undertaken. FGDs were held to generate qualitative data to supplement and substantiate data obtained from survey instrument. Accordingly, two focus group discussions were held with households of the study area. Each focus group discussion was containing 8 members of discussants. The distinction of FGD was based on gender with the assumption that gathering homogenous people will make them free to discuss their concern without any social or cultural barrier especially for female discussant. Both of the focus group discussions were held in local language (Afan Oromo) and were facilitated by the researcher herself.

Method of data entry and analysis

In order to analyze quantitative data, the collected data were cleaned, coded and entered into Statistical Package for Social Science (SPSS) for analysis. The descriptive analyses involved use of frequencies, percentage and mean distribution. Besides, tables and charts were employed for data presentation.
In addition, in order to know determinants of households' level of dependency on natural resources of the block, binary logistic regression analysis were employed. This is because the outcome variable was dichotomous (either low level of dependency or high level of dependency) rather than continuous assuming the usual multiple regression models for the probability of households' level of dependency could lead to predict values of the probability outside interval (0, 1).

Households' natural resources dependency variable transformed into dichotomous as high and low level of dependency using 0.5 incomes as a cut-off point. Therefore, it is appropriate to use binary logistic regression analysis in which the expected value is the probability that the variables take the value one (high level of dependency on natural resources of the park). Qualitative data collected through interview and focus group discussion were presented and analyzed alongside quantitative data gathered through survey.

Conceptual Model of the Study

The functional form of binary logistic regression model is specified as follows

(Gujarati, 2004; Landau & Crc, 2004).

$$P_i = E(Y = 1/X_i) = \frac{1}{1 + e^{-(\beta_o + \beta_i X_i)}} \quad (1)$$

For ease of exposition, (1) is written as:-

$$P_i = \frac{1}{1 + e^{-Z_i}} \quad \ldots\ldots\ldots\ldots (2)$$

The probability that a high dependency is expressed by (2) while, the probability for low dependency is expressed by:-

$$1 - P_i = \frac{1}{1 + e^{Z_i}} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

Therefore we can write:-

$$\frac{P_i}{1 - P_i} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} \quad (4)$$

Now, $\frac{P_i}{1-P_i}$ is simply the odd ratio in favor of high dependency; the ratio of the probability that high dependency to the probability of low dependency. Finally, taking the natural log of equation (4) we obtain:-

$$L_i = \ln\left[\frac{P_i}{1-P}\right] = Z_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n \quad \ldots (5)$$

Where Pi = is a probability of dependency ranges from 0 to 1

Zi = is a function of "n" explanatory variables (x) which is also expressed as:-

$$Z_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n \quad \ldots\ldots (6)$$

ß0 is an intercept

ß1, ß2 ------ ßn are slopes of the equation in the model

Li = is log of the odds ratio, which is not only linear in Xi but also linear in the parameters.

Xi = is vector of relevant Socio-economic characteristics

If the disturbance term (Ui) is introduced, the logistic regression model becomes:

$$Z_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + U_i \quad \ldots\ldots\ldots\ldots (7)$$

Result and discussion

Table 2.Socio-economic profile of sample household heads

Variable	Categories	n (sample size)	Percent (%)
Gender	Female Male	29 99	22.7% 77.3%
Age	>50yearsold <50 years old	67 61	52.3% 47.7%
Educational status	Can't read and write Primary Secondary Certificate and above	76 22 21 9	59.4% 17.2% 16.4% 7%
Household size	>7members < 7 members	65 63	51% 49%
Length of residence	>30years < 30 years	81 47	63.3% 36.7%

Number of livestock	>30livestock < 30livestock	70 58	54.7% 45.3%
Landholding size	<0.75 hectare >0.75 hectare	79 49	61.7 38.3
Proximity to block time taken)	< 30 minute >30 minute	68 60	53.1 46.9
Proximity to market time taken)	< 30 minute >30 minute	70 58	54.7% 45.3%
Livelihood activities	Farming (crop production and animal husbandry)	128	100%

Types of natural resources utilized from chilalo-galema block

Data obtained from in-depth interview revealed that before restriction imposed, natural resources utilized from Chilalo-Galema block were source of livelihood for many households residing around it. They used to utilize various natural resources like fodder, land for farming, fuel wood, honey etc. Especially, since the land of Chilalo-Galema is fertile, it is mainly used to cultivate vegetable like carrot, cabbage, potato, onion, endive etc. which were mostly needed by local vegetable traders. Hence, households around it used to earn more income from these livelihood activities.

Table 3 below shows, multiple responses on natural resources utilized from Chilalo-Galema block before restriction.

Type of natural resources s used to utilized from Chilalo Galema block	**n (sample size)**	**Percent**
Fuel wood	53	41.4%
Land for farming	81	63.3%
Charcoal	24	18.8%
Fodder	128	100%
Thyme plant	43	33.6%
Honey	13	10.2%
Total	342	267.2%

*Multiple responses

As observed in table 3 above, 100% sample households used to utilize fodder from Chilalo-Galema block before restriction, followed by land for farming (63.3%), fuel wood (41.4%), thyme (33.6%), charcoal (18.8%) and honey (10.2%) respectively. From this it is clear that majority of households in the study area had mostly been using Chilalo-Galema block for fodder, cultivation (land for farming) and fuel wood.

Data collected from in depth interview augmented this finding (i.e. survey). Data obtained from in-depth interview revealed that people around Chilalo-Galema block used to utilize fodder in two terms: one, households who were very proximate to the area used to utilize it on daily basis while those who were

distant used to utilize two months per year (during summer season). Besides, since there was no other source of energy used for household consumption, household who lives adjacent to Chilalo-Galema used to collect fuel wood on daily basis.

The survey finding indicated that, 53.1% of sample respondents used to visit Chilalo-Galema on daily basis, where as 46.9% of them used to visit two months per year. From this we can conclude that majority of household around Chilalo-Galema used to visit Chilalo-Galema on daily basis. These shows, most of activities undertaken by the adjacent households were related with natural resources derived from Chilalo-Galema block. Data from FGD indicated that, households adjacent to the block perform all most all of their activities in the Chilalo-Galema block i.e. they farm, graze their livestock, collect fuel wood for their meal etc. in block. Therefore, their visit to the block has a great relation with the benefit they gained from the area.

Households' level of dependency on natural resources of Chilalo-galema block

Households' level of dependency on natural resources of Chilalo-Galema block was determined by calculating ratio of annual income derived from natural resources of Chilalo-Galema block to the total annual income of the households. In this study 0.5 of the ration income is considered as the cut- off value. Therefore, households' whose income from natural resources of Chilalo-Galema block accounts to 0.5 and lower in their total income are considered less dependent and the rest are considered as highly dependent on natural resources of the block.

As observed on figure 2, 54.69% of sample household heads were highly dependent on natural resources of the block while 45.31% were low dependent. On the other hand, 54.69% of the sample household heads derive more than 50% of their total annual income from natural resources of Chilalo-Galema block before restriction. The average annual income derived from natural resources of Chilalo-Galema block was 55%. From this, it is evident that the majority of households around Chilalo-Galema derive their major annual income from natural resources of the block.

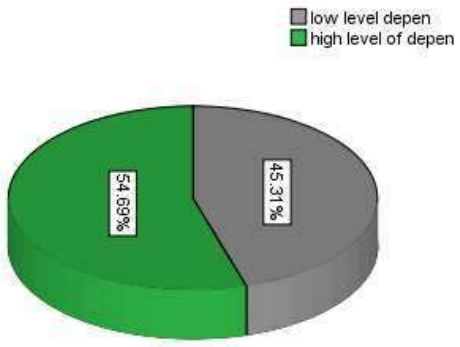


Figure 2. Pia chart for household's level of dependency on natural resources s of Chilalo-Galema block

Evidence collected from in depth interview augmented this finding (i.e. survey). Data obtained from in-depth interview participants revealed that, before restriction imposed, Chilalo-Galema was source of livelihood for many households residing around it. They used to utilize various natural resources s like fodder, land for farming, fuel wood, honey, thyme etc. Especially, since Chilalo-Galema's land is fertile, it is mainly used to cultivate vegetable like carrot, cabbage, potato, endive, onion etc which were mostly needed by local vegetable traders. Hence, households around it used to earn more income from these livelihood activities. Regarding income households used to gain from natural resources of Chilalo-Galema block, a 60 years old male interviewee from Aria Kebele indicated that:-

> *In our area, there are many vegetable traders who buy our farm products and supply it to Adama and Addis Ababa. Although there is fluctuation of price from year to year, on the minimum, one tore of carrot was sold for 1000 birr, 'goomani fe'a farda tokko' litrarly one pack of horse cabbage was sold for50 birr and one dibe of potato and beet root were sold for 500*

and 300 birr respectively. Since the land of Chilalo Galema is fertile, I used to cultivate these vegetables in large volume and my households' major income was gained from this livelihood activity. For example, last year I sold 15 'tore' of carrot, 5 dibe of potato and 3 'dibe' of beet root and I gained around 18,400 birr. Besides, I used to sell cabbage on daily basis; hence I was able to provide things needed for my household without any problem.

Similarly, a 50 years old female interviewee from Lebukebele indicated her views as follows

ChilaloGalama was my factory. Although my husband died three years ago, I used to cultivate vegetable in my garden and raise sheep without any problem. Since the vegetable traders paid me good price, I used to earn better income. For example last year I sold 20 'tore' of carrot and 10 dibe of potato. In addition, I used to sell cabbage on daily basis.

Additionally, a 37 years old female from Lebukebele indicated as follows:-

We (self and her household) used to cultivate vegetables in large volume since vegetable traders took our products in good price. If you saw my garden last year, you would be surprised. There was no empty space without vegetables; I had been selling cabbage on daily basis and I did not ask my husband for money to buy things needed for household consumption. Besides, we (self and her household) used to take sheep from far way households for share (rebi local language). Thus, we had been gaining more income from vegetable cultivation and sell of sheep.

Generally, from the above quotes we can understand that, natural resources derived from Chilalo- Galema block was the main source of income for surrounding households. As the participants of in depth interview explained in their quotes, the fertile nature of Chilalo-Galema land and the presence of vegetable traders who took their farm product in good prices highly encouraged households to undertake this livelihood activities as their major source of income.

To sum up on natural resources use and dependency, the result of this study supports the findings from many other studies. In particular, the study supports the notion that many rural population are highly dependent up on natural resources for their livelihood Gunatilake (1998); Cavendish (1999), Cavendish (2000); Fisher (2004); Masozera and Alavalapati (2004); Cullen (2007); Sapkota and Oden (2008); and Bwalya (2011).

Determinants of households' level of dependency on natural resources the block

In order to know the impact of explanatory (independent) variables on dependent variable, binary logistic regression were employed. This is because the dependent variable is binary (high level of dependency and low level of dependency). Accordingly, a total of 128 cases were included in logistic regression analysis model without any missing values.

The analysis began with assessing unadjusted relationship between outcome (dependent) variable i.e. households' level of dependency on natural resources of the block, and each potential predictor variables singly. Then, adjusted relationship was conducted for potential confounding effects. From unadjusted binary logistic regression analysis result, only variables that have p value less than 0.2 were transformed to adjusted binary logistic regression analysis. On tables four and five, both unadjusted and adjusted binary logistic regression analysis were presented sequentially and results from adjusted binary logistic regression were used for interpretation.

Table 4: Unadjusted binary logistic regression output showing predictor variables associated with households' level of dependency on natural resources s utilized from Chilalo-Galema block

Variable	Categories	Level of dependency		COR (95%CI	p-value
		High	low		
Gender	Female Male (RC)	17 53	12 46	1.230 (0.532-2.842)	0.629
Age	>50yearsold <50 years old (RC)	55 15	12 46	14.056(5.983-33.022)	0.000
Educational status	Can't read and write Primary Secondary Certificate and above(RC)	43 11 13 3	33 11 8 6	2.606(0.606-11.202) 2(0.396-10.090) 3.250 (0.629-16.789)	0.513 0.198 0.401 0.159
Household size	>7members < 7 members(RC)	45 13	20 50	8.654 (3.865-19.377)	0.000
Length of residence	>30years < 30 years(RC)	39 31	42 16	0.479 (0.228-1.009)	0.053
Number of livestock	>30livestock < 30livestock(RC)	60 10	10 48	28.800 (11.081-74.854)	0.000
Landholding size	<0.75 hectare >0.75 hectare (RC)	61 9	18 40	15.062(6.160-36.825)	0.000
Proximity to block time taken)	< 30 minute >30 minute (RC)	58 12	10 48	23.200(9.225-58.346)	0.000
Proximity to market time taken)	< 30 minute >30 minute (RC)	57 13	13 45	15.178 (6.407-35.954)	0.000

As shown on table 4, from nine variables that entered singly in logistic regression model, gender, educational status and length of residency were found insignificant in predicting households' level dependency on natural resources of Chilalo-Galema block since their p value were greater than 0.05, even without adjusting their effect. The cutoff point used for inclusion in adjusted binary regression analysis model was 0.2. Hence, the valid variables when tested individually- age (p value =0.000 and COR=14.056), household size (p value=0.000

and COR=8.654), landholding size (p value=0.000 and COR=15.062), proximity to the block (p value=0.000 and COR=23.200), proximity to the local market (p value= 0.000 and COR=15.178) and length of residency(p value=0.053 and COR=0.479) were entered into adjusted binary regression model. While gender and educational status were excluded since their p value was greater than the cutoff point used for inclusion in adjusted binary regression analysis model.

Furthermore, although number of livestock owned has p- value less than the cutoff point used for inclusion, it was dropped from the adjusted regression model due to multicollinearity problem. Multicollinearity among explanatory variables was seriously tested prior to run adjusted binary logistic regression. Number of livestock owned found to be highly correlated to land holding size. Although it was preferred than landholding size to determine households level of dependency on natural resources of Chilalo-Galema block, it drastically reduced the significance and magnitude of household size variable. Thus, it was dropped from the adjusted binary logistic regression model to avoid muticollinearity.

Table 5.adjusted binary logistic regression output showing predictor variables associated with household's level of dependency on natural resources s of Chilalo-Galema block

Variable	Categories	Level of dependency		AOR (95%CI)	p-value
		High	low		
Age	>50yearsold <50 years old (RC	55 15	12 46	10.437(2.565-42.463)	0.001
Household size	>7members <7 members(RC)	45 13	20 50	7.473(1.792-31.164	0.006
Length of residence	>30years < 30 years (RC)	39 31	42 16	0.354(0.088-1.418)	0.142
Landholding size	<0.75 hectare >0.75 hectare (RC)	61 9	18 40	9.746(2.224-42.701)	0.003
Proximity to block	< 30 minute >30 minute(RC)	58 12	10 48	13.852 (2.993-64.111)	0.001
Proximity to market	< 30 minute >30 minute (RC)	57 13	13 45	5.453(1.322-22.496)	0.019

As it can be observed on table 5, one variable (i.e. length of residence) which is also insignificant in unadjusted logistic regression analysis became again statistically insignificant (p-value >0.05) in predicting households' level of dependency on natural resources derived from Chilalo-Galema block when it entered to adjusted logistic regression analysis. In the following subsection each independent variables are presented in relation to the outcome variable (dependent variable).

Age and households' level of dependence on natural resources of Chilalo-Galema block

As it can be observed in table 5 above, age is a determinant factor (p-value= 0.001) for households' level of dependency on natural resources derived from Chilalo-Galema block. Adjusted odds ratio was 10.437 with (95% CI of 2.565-42.46). This indicates that, respondents who were greater than 50 years old were 10.437 times more likely to depend on natural resources derived from Chilalo-Galema block than reference category-respondents who were less than 50 years old. From this it is evident that old aged people were more dependent than youngsters. This is happened due to the fact that, majority of activities undertaken in the study area was animal husbandry and vegetable cultivation. Hence, in relation to other activities, these activities were less strenuous and old age people can easily perform it. This finding contradicts with findings of Masozera and Alavapati (2004) who found the younger households were highly dependent than the older. It is rather in line with reports of Cavendish (2000) and Alphonse et al (2009) who found the same finding.

Household size and households' level of dependence on natural resources of the block

Household size proved to have statistically significant association with households' level of dependence on natural resources s of Chilalo-Galema block (p-value <0.05). The resulting adjusted odds ratio was 7.473 with (95%CI of 1.792-31.164). This implied that in relation to reference group (respondents' who had less than 7 members of household size); respondents who had greater than 7 members of household size were 7.473 times more likely to depend on natural resources of Chilalo-Galema block. Obviously, non-proportional household size with annual income of a given household causes problems which may force the members to rely on natural resources in their locality. This is in fact, large household size generally require many resources to satisfy their daily needs. Especially, when large household size accompanied by small land holding size and lack of alternative means of livelihood other than farming, relying on natural resources of their locality become the only option. Likewise, majority of sample households of this study had less than 0.75 hectare of land though their main livelihood strategies was farming (crop production and animal husbandry). At the same time, the average household size was 8 members. Therefore, there was a high tendency to extract natural resources from Chilalo-Galema block so as to satisfy the needs of these household members. This finding is similar with findings of Masozera and Alavalapato (2004); Sapkota and Oden (2008); NahayoAlphonse (2009) who found that having large household size has an association with households' high level of dependency on natural resources of protected area.

Landholding size and households' level of dependency on natural resources of Chilalo- Galema block

Landholding size is classified as less than 0.75 hectare and greater than 0.75 hectare of land and proved to be a determinant factor (p value=0.003) for households' level of dependence on natural resources of Chilalo-Galema block. The adjusted odds ratio were 9.746 with (CI 95%=2.22442.701). This indicated that as compared to households who had greater than 0.75 hectare of land, households who had less than 0.75 hectare of land were 9.746 times more likely to depend on natural resources s derived from Chilalo-Galama block. This is in fact, as farming (crop production and animal husbandry) is the main livelihood activity of the household, land is imperative natural resources for adjacent households. However, as explained in Table 2 more than half of respondents of the study area had less than 0.75 hectare of land holding size; which is small land holding size for a given household from study area' context. Therefore, for the sake of overcoming their livelihood impediment and to meet the basic needs of the household members, households who had small land holding size became highly dependent on natural resources of Chilalo-Galema block.

Proximity to local market and households' level of dependence on natural resources of Chilalo-Galema block

Proximity to the local market of this study was measured by time spent to reach to the local market. Accordingly, it is classified as less than 30 minutes and above 30 minutes. The p-value is 0.019 which indicates as it has statistically significant association with outcome variable. The adjusted odds ratio was 5.453 with (CI 95% of 1.32222.496). This implied that households' who spent less than 30 minutes to reach to the local market were 5.453 times more likely to depend on natural resources derived from Chilalo-Galema block than households' who spent more than 30 minutes. In other words, households' proximate to local market was more dependent than distant households. In support of this idea, data from in depth interview indicated that, the presence of Gebra kirstos market (local market) to their proximity have encouraged adjacent households' to cultivate various vegetables like carrot, cabbage, potato, onion etc. In Gebrakristos (village name), there were vegetable traders who buy various vegetables from the farmers and supply it to Adama and Addis Ababa. The transaction of these vegetable is undertaken on daily basis. As indicated earlier, Chilalo-Galema's land is highly comfortable for production of vegetables since it has fertile soil. On top of this, the distance between Chilalo-Galema and the local market is very small (around 5 Km) (from own observation). Thus, households who were close to the block were also close to the local market. Consequently, their farm production (vegetable) can be sold on daily basis and this encouraged them to cultivate more vegetable. Furthermore, Chilalo-Galema block is also very close to the road that links the two woredas namely shirka and lemuf bilbilo. Hence in addition to proximate to local market, the available infrastructure or physical asset facilitates the exchange process effectively. This finding contradicts with Cullen's (2007), Gunatilake's (1998) and Masozera and Alavalapati's (2004) arguments that indicated people living in isolated areas with limited access to external markets and infrastructure facilities are likely to remain poor and will continue to depend on surrounding natural resources . It rather consistent with findings of Alphonse et al (2009) who found, access to local market encourage people to extract and sell various natural resources of their locality.

Proximity to the block and households' level of dependence on natural resources of Chilalo-Galema block

Just like proximity to the local market, proximity to the block was also measured by the time spent to reach to the block. Thus, it is classified as less than 30 minutes and above 30 minutes and, it is proved to have statistically significant association with outcome variable of the study (p-value <0.05). The adjusted odds ratio was 13.852 with (95% CI of 2.993-64.111). This implied that households who spent less than 30 minutes to reach to the block were 13.852 times more dependent on natural resources derived from Chilalo-Galema block than those who spent greater than 30 minutes. Having survey finding in mind, the researcher undertook in- depth interview with selected informants to know how their proximity to Chilalo-Galema block was helping them. With regard to this, a 40 years old male interviewee from Gademsa kebele indicated that:-

> *Majority of households (including myself) who were living near to Chilalo-Galema used to benefit a lot. Chilalo-Galema were mostly benefiting us through its fodder, land for cultivating various vegetables and fuel wood for household consumption. Since we were very proximate to it, we had been taking sheep from far away households for share (rebi local language). And then, we were raring these sheep and used the income gained from selling sheep to meet our household member's needs.*

In support of this idea the chi square test on the following table revealed that there is statistically significant (X2 =17.666, sig. (2-tailed) = 0.000) relationship between proximity to the block and number of livestock owned by the households.

Table 6.Cross-tabulation of number of livestock owned by respondents proximate to Chilalo-Galama block

			Proximity to Chilalo Galema		Total
			Less than 30 minute	Above 30 minute	
Number of livestock owned by respondents	Above 30	Count	49	21	70
		% within livestock category	70.0%	30.0%	100.0%
	Less than 30	Count	19	39	58
		% within livestock category	32.8%	67.2%	100.0%
Total		Count	68	60	128
		% within livestock category	53.1%	46.9%	100.0%

X2 =17.666, sig. (2-tailed) = 0.000

As observed on the above cross-tabulation (table 6), 53.1% of respondents were reaching to Chilalo-Galema block with less than 30 minutes. Of this, 70% of them had above 30 numbers of livestock while 32.8% of them had less than 30 numbers of livestock. On the other hand, 46.9% of respondents were spending more than 30 minutes to reach to Chilalo-Galema. From this, 30% had above 30 numbers of livestock and 67.2% of them had less than 30 numbers of livestock. From this it is evident that households who were proximate to Chilalo-Galema block had more livestock than distant. This implied that, the easy access of fodder that exists due to very near to the block encourages people to have large number of livestock.

Conclusion

Biodiversity Conservation is crucial for human being. This is because human being especially rural community fulfills its need mainly from natural resources. In addition, endemic animals and plants help to attract various tourists and this in turn help the local community in

various ways. It is indicated that protected areas are expected to improve the socio-economic living conditions of local people in addition to their envisioned goal for biodiversity conservation. Because, natural resources within the protected areas are source of livelihood for adjacent households (Cullen 2007). However, in most cases management approach implemented to conserve natural resources within protected area excludes local people by overlooking their socio-economic living conditions and conservationist mainly gives great emphasis for significance of conserving biodiversity.

The purpose of this study was to examine determinants for households' dependency on natural resources of Arsi Mountain National park. The finding of the study revealed that

adjacent households were highly dependent on natural resources derived from Chilalo-Galema block. That means, on average 55% of their annual income were derived from Chilalo-Galema block. Land holding size, age, household size, proximity to the local market and proximity to the block significantly determined their dependency. Even though the finding of the study indicated the dependency of adjacent households' on natural resources of the park, the Ethiopian Wolf Conservation Program (EWCP) mainly focused on conserving wolves and their Afro alpine ecosystem by overlooking the contribution of the park for local community. This will create hostile relationship between local community and the natural resources of the area and this in turn affects both the resources users as well as the natural resources s of the park.

Recommendation

Management of natural resources including wildlife has both regional and international significance. However, this management cannot be achieved without involvement of adjacent people in the sustainable use of these resources s. Since the livelihood of local people around the protected area is dependent on natural resources within it, excluding or restricting them may affect their livelihood and it also leads to destruction and overexploitation of natural resources itself.

Therefore, in order to maintain the sustainability of protected area which is the envisioned goal of biodiversity conservation, understanding the attributes of local people around the park and their dependency on natural resources is crucial so as to provide alternative means of livelihood and/or implement natural resources management approach that embrace local people's concern in management process. In this regard, the finding of this study may attract the attention of Ethiopian Wolf Conservation Program (EWCP) to review their management strategies and reshape it to be consistent with local people's socio-economic living condition. Furthermore, disclosing contributing factors for household's dependency on natural resources of Chilalo-Galama could serve as important input for knowing on which parts of household characteristics need to be worked on so as to reduce their dependency. It can also serve similar purpose for other organizations working on conservation to work with the local communities so as to ensure better reciprocal benefits. It can also inform the country's policy on addressing local communities' needs in addition to conservation efforts. Generally, command and control approach of the natural resources conservation (fortress conservation) will only promote park- people conflict. Hence, managers of the park must embrace a proactive approach and work with local community to address their socio-economic concern.

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RESEARCH PAPER

Loan Repayment Performance of Awash Saving and Credit Cooperatives Union, Oromia Regional State, Ethiopia.

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Abstract

This study aimed to assess loan repayment performance of Awash saving and credit cooperatives union, Oromia regional state, Ethiopia. This study is delimited to loan repayment performance and loan repayment trends of Awash saving and credit cooperative union of the last ten consecutive years (2010-2019 GC). Descriptive research design was used in this study. Moreover, both quantitative and qualitative research approaches were used for triangulation purpose. Both primary and secondary data were used to address the desired research objectives. Primary data were collected through focus group discussion (FGD) and key informant interviews (KII). Whereas secondary data were obtained from annual audited financial statement of the union. The collected data were analyzed using both descriptive and linear regression analysis accordingly. The study result indicates that, though the loan performance of the union improving year after year in the study period, disparity of the amount loan planned, amount distributed and amount collected becoming wider and wider starting from 2015 G.C. Moreover, the researchers conclude that, institutional factors (lack of qualified and adequate man power) members' factors (lack of business know how and low income) and external factors (political instability) are major hindering factors that are affecting loan repayment performance of the members. To overcome these problems, adequate and competent cooperative professional employee should be recruited for loan supervision and collections and regular training should be given for the members on credit usage and repayment..

Keywords: Loan repayment performance, loan repayment trend, saving and credit cooperatives society

Introduction

Cooperative societies are an autonomous association of persons united voluntarily to meet their common economic and social needs through jointly owned and democratically controlled enterprises, which are organized and operated under the principles of cooperatives (ICA, 2005). In Ethiopia, the history of saving and Credit Cooperatives goes back to the Emperor Haile Selassie regime. The first urban saving and credit cooperative in Ethiopia was established in 1966 by the Ethiopian Road Authority workers and followed by the Ethiopian Airline workers in 1972 (Daniel, 2008).

Cooperatives societies are playing lion-share roles in the development of national economy in both developed and developing countries. According to the 2014 International Co-operative Alliance's, the turnover of the largest 300 cooperatives in the world grew by 11.6% to reach $2.2 trillion in 2012, equivalent to the gross domestic product (GDP) of Brazil (Kiptoo, 2015).

According to the World Council of Credit Unions (WOCCU, 2014) there are 57,000 saving and credit unions across 6 continents and 105 countries. These credit unions constitute the savings of $ 1.5 trillion (US dollars), and an asset base of $ 1.8 trillion (US dollars) out of which $ 1.2 trillion (US dollars) constituted the loan portfolio.

According to Hesse and Cihak (2007), cooperative financial institutions hold a considerable market share, with the International Monetary Fund (IMF) estimates that across all banking sector assets in developing countries, the market share of co-operative finance was equivalent to 14 percent in 2004. Despite saving and credits cooperatives societies (SACCO's) are having this significant contribution in the economy of the nation loan repayment performance of the borrowers becoming threats across the world. Members' Loan repayment performance is an important factor for the success of saving and credit cooperatives union. According to Okurut and Kinyondo (2009), the higher loan repayment performance leads the higher profitability of the collecting interest revenues and lower loan losses in a lending institution. Loan repayment performance measures how much borrowers or members are capable in settling up amount they borrowed with its interest amount in full as per the loan contract.

Financial institutions are considered as an important development tool, through improving access to financial services, creating employment opportunities for the unemployed and increases their income and consumption (Arega, 2007).Like any other financial institutions' cooperative financial institutions (saving and credit cooperatives) are subjected to credit default risk. Comparing saving and credit cooperative societies and Micro Finance institution (MFI) loan repayment performance of the borrowers, saving and credit cooperative societies are highly exposed to loan default due to low loan repayment of members. Loan default seems to be higher in saving and credit cooperative societies over Micro Finance institution (MFI) default rate. While the reason being that most of their loans were issued to borrowers (members) of the saving and credit cooperative organizations (SACCO's) irrespectively of the condition of having business or not (Kassim, 2013).

Several researchers revealed that the issues of credit risk management is becoming doubtful in saving and credit cooperative organizations (Absanto and Aikaruwa, 2013; Lagat et al, 2013, Magali and Qiong, 2014). Saving and credit cooperative organizations (SACCO's) are contributing to social and economic developments in both developed and developing countries of the world, however SACCO's operating in developing countries have continued experiencing deteriorating financial performance due to issues of loan repayment (Nguta and Guyo, 2013). Credit default problems destroy lending capacity of saving and credit cooperative organizations (SACCO's) as the flow of repayment declines, transforming lenders into welfare agencies, instead of a viable financial institution (Hunte, 1996).

The loan recovery performance of any financial institutions including rural saving and credit cooperatives should be good unless otherwise their sustainability falls under question. Even though the loan recovery performance of rural saving and credit cooperatives was better, still the loan recovery performance of the rural saving and credit cooperatives was not as intended (Dejen,2015).

To my knowledge, there is no research yet done on loan repayment performance of Awash saving and credit cooperative union which covers last consecutive ten years loan repayment performance trends. This indicates that, there is research gap on this particular area and specifically on this topic. Therefore, to fill this research gap on this particular area, this study was aimed to assess loan repayment performance and loan repayment trends of Awash saving and credit cooperative union for the last ten consecutive years (2010 -2019 G.C) . in addition to this, this study tried to identify factors affecting loan repayment performance of the members of the union.

Research methods

Research design

According to Derrheim (2004) research design is a strategic framework for action that serve as a bridge between research questions and execution or implementation of the research strategy. So for this study purpose, descriptive research design was used as it is the most appropriate research design for describing last ten years' loan repayment performance and factors affecting loan repayment performance of the members of the union.

Research Approach

To carry out this study, mixed research approach (the combination of both qualitative and quantitative approach) was used to provide further explanations and new insights into issues concerning the loan repayment performance of selected saving and credit union. The purpose of using a mixed approach is to gather data that could not be obtained by adopting a single method and for triangulation. Moreover, the advantage of a mixed approach is to mitigate the bias in adopting either quantitative or qualitative approach (Creswell, 2003)

Data sources and data collection methods

To address the desired research objectives both primary and secondary data were used. Primary data were collected through focus group discussion and key informant interview. In focus group discussion, discussion about loan repayment performance of members and factors affecting loan repayment performance of members were made with board of directors and representatives affiliated primary saving and credit cooperatives societies. In addition to this key informant interview were made with General Manager, Finance manager and Loan manager. Secondary data were taken from consecutive ten years (2010-2019 G.C) audited financial statements of the union regarding to loan planned, loan distributed, loan collected and loan uncollected.

Sampling procedure

Awash saving and credit cooperative union is the only union in East Shoa zone. In this union there are 111 affiliated primary saving and credit cooperative societies. In this study, purposive sampling technique was employed. Hence, Awash saving and credit cooperative union were purposively selected as study area. Because Awash saving and credit cooperative is a giant saving and credit union in terms of area of operation and year of establishment. In addition to this Awash saving and credit cooperatives union were consequently audited from its establishment and having well documented financial statements.

Board of directors (9) and representatives of affiliated primary SACCO's (36) are purposively selected for focus group discussion (FGD) and General Manager, Finance manager and Loan manager were purposively selected for key informant interview (KII) with presupposing they have sufficient information about the loan repayment performance of the union.

Data Analysis

Data analysis was performed using Statistical package for Social Science (SPSS) version 21. Descriptive results were presented using frequency table and loan performance trend was shown by line graph to explore the pattern of loan performance of the union for the last ten years. Simple linear regression was used to measure loan collection performance of the union from the consecutive ten years audited financial statements.

Results and discussions

Descriptive analysis

As it can be seen from table 3.1, the union's loan planned was 4,000,000 birr at baseline year (2010 G.C) and reached 60,000,000 after ten years (2019 G.C). The average loan planned during ten years of performance was 28,400,000 birr. However, the union's average loan distribution during the ten years was 24,042,987.40-birr accounting about 85% of its plan. When loan collection performance is concerned, the union average loan collection was 22,315,495.80 birr which accounts about 93% of amount actually distributed to the members. The remaining 7% (1,727,491.6 birr) was uncollected loan on average during the last ten years.

Table 1. Summary of ten years Loan collection performance of Awash saving and credit Cooperative union

Loan Performance	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Loan planned	10	28,400,000.00	20,651,607.42	6,530,611.68	13,626,730.02	43,173,269.98	4,000,000	60,000,000
Loan distributed	10	24,042,987.40	16,907,794.25	5,346,714.00	11,947,880.02	36,138,094.78	3,750,603	48,500,000
Loan collected	10	22,315,495.80	14,937,653.28	4,723,700.73	11,629,742.37	33,001,249.23	3,638,085	42,195,000
Loan uncollected	10	1,727,491.60	2,446,091.040	773,521.91	-22,336.52	3,477,319.72	92,200	6,305,000

Trend of loan collection performance for the last ten years (2010-20019)

As it can be observed from the graph below loan performance (in terms of loan planned, loan distributed and loan collected) has been increasing overtime during the last ten years. The graph shows that throughout the ten years' periods, loan distributed was below loan planned. Similarly, loan collected was less than loan distributed and the difference became wider and wider after 2015 G.C. In addition to this, starting from 2018 G.C though the amount of loan planned was increasing with slight decreasing, the amount of loan distributed and loan collection was falling. During focus group discussion and key informant interview the researcher asked further explanation of why the amount of loan distributed and collected was decreasing in the year 2018 and 2019G.C. Respondents indicated that due to the political instability of 2018 and 2019 G.C the amount of loan provided to the members was decreased and also the productivity of the borrowers/members decreased hence members couldn't pay back their loan on maturity date.

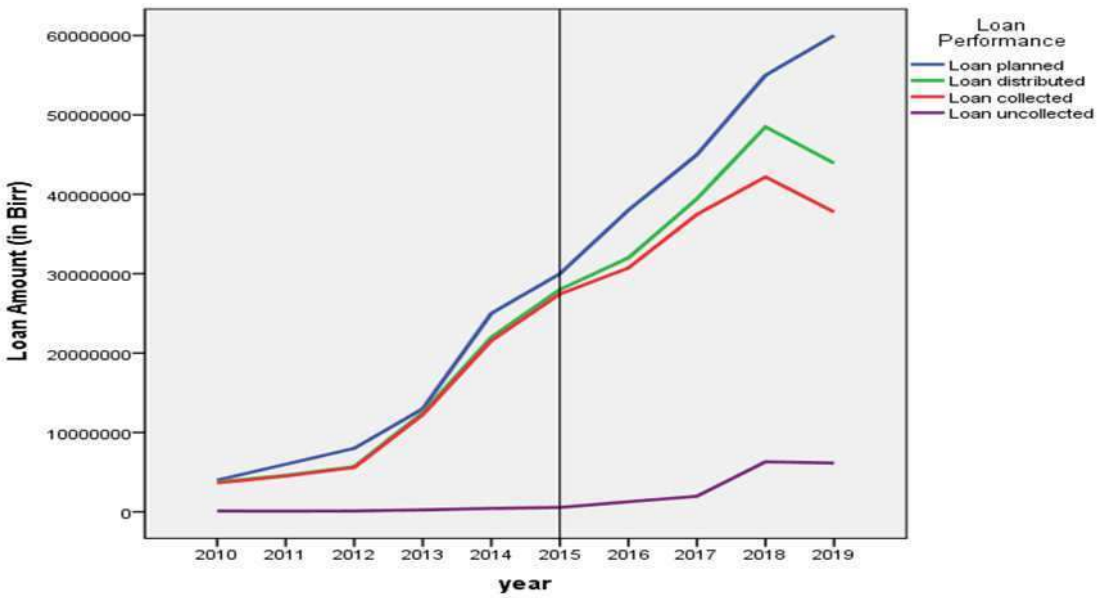

Figure 1. Trend of Loan Collection Performance for the last ten consecutive years (2010-2019)

Regression analysis

Loan distribution performance

The correlation coefficient shows that there was a strong positive linear relationship between loan distributed and loan planned (r=0.989). The simple linear regression model showed that loan planned explained 97.7% of the observed variations in loan distributed (R2=0.977).

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.989[a]	.977	.974	2710359.070

a. Predictors: (Constant), Loan Planned
b. Dependent Variable: Loan distributed

Loan Distributed= 1058548.282+ 0.81Loan Planed

According to the regression result, the average loan distributed increases by 0.81 birr for each 1-birr increase in loan planned. In another way out of 1-birr loan planned 0.81 birr were distributed in average during the last ten years.

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1058548.282	1509378.551		.701	.503
	Loan Planned	.809	.044	.989	18.500	.000

a. Dependent Variable: Loan distributed

Loan collection performance

Based on consecutive ten years' loan collection performance data, simple linear regression result shows that there was a positive linear relationship between loan collected and loan distributed (**R=0.996**). Moreover, it is observed that, loan distribution explained 99.2% of the variations in loan collected (***R^2=0.992***).

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.996[a]	.992	.991	1443870.843

a. Predictors: (Constant), Loan distributed

b. Dependent Variable: loan collected

As the regression output shows, the average loan collected increases by 0.88 birr for each 1-birr increase in loan distributed. This means, the union has been collecting 88% of the amount it has been distributing to its members.

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1162449.889	822725.086		1.413	.195
	Loan distributed	.880	.028	.996	30.908	.000

a. Dependent Variable: loan collected

Loan collected= 1162449.889 + 0.88 Loan distributed

Factors affecting loan repayment performance of members

According to data obtained from FGD and KII there were three major factors that have been affecting loan repayment performance of the union. These factors are:

Institutional factors (both at union and primary SACCO's level)

At organization level there are so many factors that have been affecting loan repayment performances. For instance, there is lack of qualified and adequate man power both at union and primary level for follow-up and supervision of loan collection. Although continuous follow up and supervision is important for loan repayment, there is no enough supervision made by loan officers (Dula, 2012)

Most of the time, especially in rural primary saving and credit cooperative societies managers, board of directors and loan officers are uneducate or less educated one. Hence, they don't have know-how of loan processing and collection. In addition, there is lack of trained man power and shortage of capital for provision of training for members on credit utilization and loan repayment. Poor credit appraisal mechanism is also another major hindering factor in poor loan repayment performance of the union.

Members' factors

From the members' perspectives there are many factors that are affecting loan repayment performance of the members of the union.
First, due to lack education and training, most of the borrowers do not have business know-how which leads them to invest on unproductive activities, which finally results in inability to repay their loan on time. There is no training provided for the borrowers/members from the government, NGO or from the union on how to use the capital and when they should repay back the loan. a more educated borrower is expected to use the loan effectively as compared to a less educated one (Dula ,2012).

Second, the level of income of the borrowers is also another critical factor that affecting the loan repayment performance of the members. When the amount of income decreases their loan repayment performance decreases and vice-versa. The study of Tundui et al (2013) confirms that increase in household income leads to low default rate. Thirdly, Extravagant practices of the members for different ritual and religious purpose is also becoming bottle neck for the union to collect the loan on time. Fourthly, carelessness of few members and delinquent in repaying their loan liability on time, results in low loan repayment performance of the union.

External factors

In addition to problems of the institution and members related factors, there are also factors which could not be controlled at institutional level. These factors are: Political instability of the country, which is having an impact on macro-economy of the country, which can affect members' loan repayment performance, Bureaucracy or wearisome of cooperative promotion office in administering and facilitating the activities of cooperatives societies is also having its own negative impact up on the loan repayment performance of members

Conclusion

The study indicates that, in the last ten consecutive years, the amount of loan planned increases from 4,000,000 to 60,000,000 birr and the amount of loan distributed were increased from 3,750,603 to 48,500,000 birr. As per the result from the study, loan collection is increased from 3,368,085 to 42,195,000 birr. This indicates that, as loan planned is increased members might get more opportunity to get loan and as loan provided is increased loan collection is also increased. As loan collection increased the interest collection is also increased and this is a means through which the union's net income is increased. The profitability of the union is an indicator for the strong performance of loan repayment. However, starting from 2015 G.C the disparity between amount of loan planned, loan distributed and amount of loan collected

become highly visible and in year 2018 and 2019 G.C the amount of loan distributed and amount of loan collected shows falling pattern.

Lack of qualified and adequate work force, lack of training for members, political instability and extravagant practices of members were identified as the major hindering factors for low loan repayment performance of the members.

Recommendations and future directions

Based on the finding of the study, the researchers would like to forward the following recommendations:

As linear regression coefficient indicates, there is strong positive relationship between amount of loan planned, loan distributed and loan collected during the last ten-years consecutive period, so the union has to increase its capacity of annual loan plan by solving its capital shortage through increasing saving of members. Both at union and primary saving credit cooperatives level, competent and qualified employees should be recruited in order to solve workforce problem for follow up and supervision then results in speed up loan collection performance of the union.

The union has to design strong and functional credit appraisal mechanism which is very help full in screening the borrowers to measure the potential capacity of the borrower to repay the loan on time. It's better if Comprehensive type of training given for the members/borrowers by different stake holders (Government, NGOs, union) on business activities, credit utilizations and how they could repay their loan liability on maturity date. Government should do on stabilizing the political situation of the country and smoothening of the bureaucracy in cooperative promotion offices that will lead to increasing of the productivity and loan repayment capacity of the members.

The researchers would also like to recommend that further study should be under taken by considering more than one union and by including more variables/ factors that are affecting loan repayment performance which are not considered in this study to generalize about saving and credit cooperative organizations (SACCO's) loan repayment performance.

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