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Social Perception Towards Impact of Soil Erosion and Drought on Livelihood of Smallholder Farmers in Shashemene Wereda, West Arsi Zone, Oromia, Ethiopia

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Abstract
Soil erosion derived soil/land degradation is becoming the overriding agricultural problems of Shashemene woreda (table 2). Any rainfall occurrence is creating overland flow that results in loss of fertile topsoil. The research has been intended to investigate social perception of impact on soil erosion and drought on livelihood of smallholder farmers in Shashemene Wereda, West Arsi Zone, Oromia Regional State. Questionnaires were prepared for face to face personal interview and focus group discussion. Further data was collected through field observation to the real conditions found on the ground. Social perception data analysis has been done on Percentage bases. The climate data was analyzed using standard rainfall anomaly. Figures and tables were prepared by excelling Microsoft. Rainfall quantity of the site shows serious decline since 1997 (figure 2). The study area was vulnerable to drought to moderate risk level (figure 3) indicating prevalence of agricultural water scarcity. The subsistence farming system of smallholder farmers in the research site was explored negative impact on soil erosion and drought on their livelihood through its pressure on agricultural production. Lack of relevant education, prevalence of traditional tillage, topographic position, soil texture (sandy soil), small land holding size, absence of soil and water conservation measures, large family size, expensiveness of fertilizers versus reduction of households' purchasing power have intensified poverty that led to food aid. Most of the time shortage of food commences in social instability. Scope of the problem is expanding timely affecting natural resources and the precious human life. To terminate such solemn and burning social problems; coordinated, relevant and focused efforts should be made through training and provision of material support to the community.
Keywords: food shortage, bad year, low rainfall, vulnerability, poverty

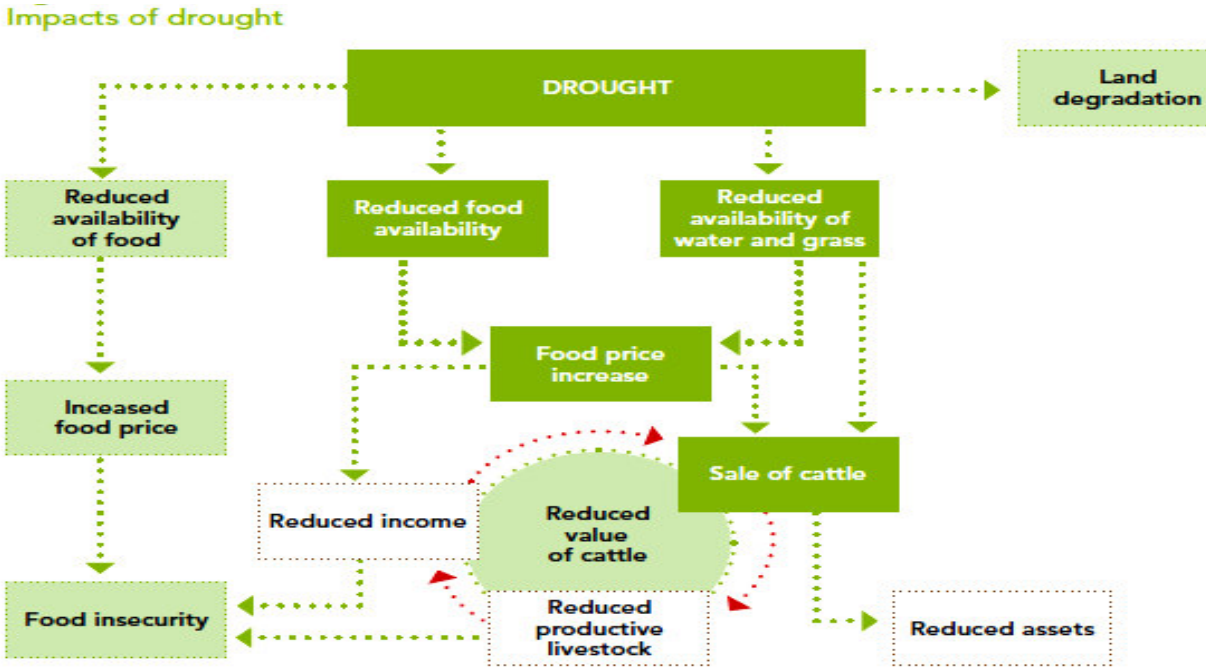
INTRODUCTION

Long ago soil erosion has been documented as severe problem for sustainable growth of the globe (Pimentel and Burgess, 2013; Long and Davis, 2016). Widespread environmental destruction, degradation and soil loss because of population pressure are pushing natural resource to its edge. Biosphere environment of humans would collapse with devastating effects on humanity. Soil fertility and productivity habitually associated with heavy loss in agricultural productivity due to soil erosion (Morgan, 2005). However the problem differs based on changes in climate, topography, land cover, soil, lithology and human activities (Ananda and Herath, 2003).

Human livelihood is strictly connected to soil which contributes food, water, air that is a chief carrier for natural resource (Keesstra et al., 2016). Many people in the world remain seriously reliant on soil resources as their key source of livelihood that lead to high soil erosion. Developing countries are being affected by high erosion rates mostly due to intensive deforestation, tilling of degraded lands and high climate hazards (Morgan, 2005). Agricultural activity of long history with a high level of population pressure and exploitive nature of the practices has led to prevailing exhaustion of native vegetation covers and over-utilization of land resources. This leads subsequently to high soil erosion principally on agriculture and grazing lands. Soil erosion is worldwide environmental problem that threatens the lives of most smallholder farmers (Gessesse et al., 2016 and (Prosdocimi et al., 2017).

Futurity of agricultural production is affected by soil erosion (Food and Agriculture Organization of the United Nations, 2014). The thoughtful overuse of land is led by agricultural sector. In developing countries where farmers are extremely dependent on integral land proprieties and unable to boost soil fertility by application of bought inputs, the impact of soil erosion shall be aggressive. Soil degradation via soil erosion is a thoughtful and continual environmental problem all over the world specifically in developing countries like Ethiopia (Amsalu and Mengaw, 2014). In Ethiopia soil erosion is a great problem, when more land is cultivated than ever in pursuit of feeding more people. Soil erosion in upland areas of Ethiopia is a direct result of historic expansion of human settlement for its suitable climatic conditions, political factor and fertile soil as documented by many literatures (Morgan, 2005; Keesstra et al., 2016). Lack of soil management has resulted in soil erosion. Soil erosion is the principal problem resulting in on-site and off-site effects. This phenomenon has disturbed by large population density, overgrazing, deforestation, land fragmentation, steep terrains, and cultivation on marginal and fragile lands. Smallholder farmers' food insecurity is highly driven by such factors which exacerbate soil erosion and declines productivity (Keesstra et al., 2016). Ultimately soil erosion is caused by

man's contribution (60% to 80% of all soil erosion and soil degradation) (Amsalu and Mengaw, 2014). Soil erosion can decline soil moisture availability, resulting in more drought-prone conditions (Morgan, 2005). Such situations are very commonly existed in Shashemene Wereda affecting livelihood of thousands of smallholder farmers.



Source: Gitz and Meybeck, 2012

Drought and associated risk is a yield of the exposure to the natural hazard and the susceptibility of the society to the event. Continued or repetitive drought has enduring degradation effects on land. The integration of drought and overgrazing/deforestation, destroys the vegetation cover and increases soil erosion during intensive rainy season (Morgan, 2005; (Food and Agriculture Organization of the United Nations, 2014). The overall impacts of climate change on agriculture are expected to be negative. For instance, frequency of extreme climatic events and climate variability, like droughts, flooding and soil erosion, will affect precipitation. Higher temperatures may affect yields negatively and favor the growth of weeds and the propagation of crop pests. Moreover, crop failures and long-term declines in productions will occur. The impact of climate change is hardest and food security will be most threatened. Thus, leaders and planners in drought-prone regions should conduct risk assessments in order to better understand drought hazards and identify the factors and procedures regarding who and what is mostly at risk to drought and why. Revelation to drought varies regionally and over time, and there is little, that can be done to change its existence. It is also crucial to understand precipitation and temperature trends, including changes in variability, because these basic meteorological variables can show potential fluctuations in the frequency and severity of future drought events. Changes such as increased regularity of droughts, exciting heat, and delay in the arrival of rainy season, scarcity and unpredictability of rains are known of farmers to decline agricultural productivity. These perceptions about the changes in the timing, intensity and regularity of climatic hazards are steady with scientific data. Such changes are stated to have significant impacts on farmers. Therefore, this study has been intended to investigate social perception towards soil erosion impact and drought on livelihood of smallholder farmers in Shashemene Wereda, West Arsi Zone, Oromia Regional State.

METHODOLOGY

Site Description

The study was conducted in Shashemene Wereda kebeles; where severe land degradation has resulted mainly from soil erosion are apparent (Figure 1) in southern Oromia Region. Main soil types are Luvisols, nitosols, phaeozems, and vertisols. Agro-climatically the area is characterized by a 'tropical highland monsoon'. The area has a bimodal rainfall pattern; on average 80% of the total annual precipitation occurs between June and September and the rest during autumn (Figure 2). Variability of rainfall amount is very experienced. The maximum and minimum annual rainfall was 1267mm during 1982 and 366mm during 2011 respectively. Proportions of annual rainfall when compared with long term mean precipitation across observation is 53% above and 47% below the mean. Since 2000 year, a linear decline of rainfall quantity is occurring in the study area. These show that there were rainfall variability throughout the observations made and drought vulnerability

within the study area. Temperature of the area shows large daytime but small seasonal changes with an annual average of 20 °C. Except to the south east where hilly mountain chains are apparent, undulating topography is dominant. Plain areas are dominantly agricultural lands, where some *ficus*, *acacia* and *eucalyptus species* are scattered along the farm plots edges. Alongside *Abaro* Mountain, the hillside areas are covered dominantly with few remnant native forests and plantations *(Cupresus lustanica* and *Eucalyptus* plantations). The livelihood of the local people is mainly based on subsistence mixed agriculture (most commonly maize, wheat, haricot bean and potatoes are the staple crops). The prevalent land-use /land cover changes during the last four decades and the consequent poor land management in the steep slope areas of the catchment has resulted severe soil erosion and land degradation. The problems of soil erosion and degradation have manifested various on-site and off-site effects in the area (Amare et al., 2014).

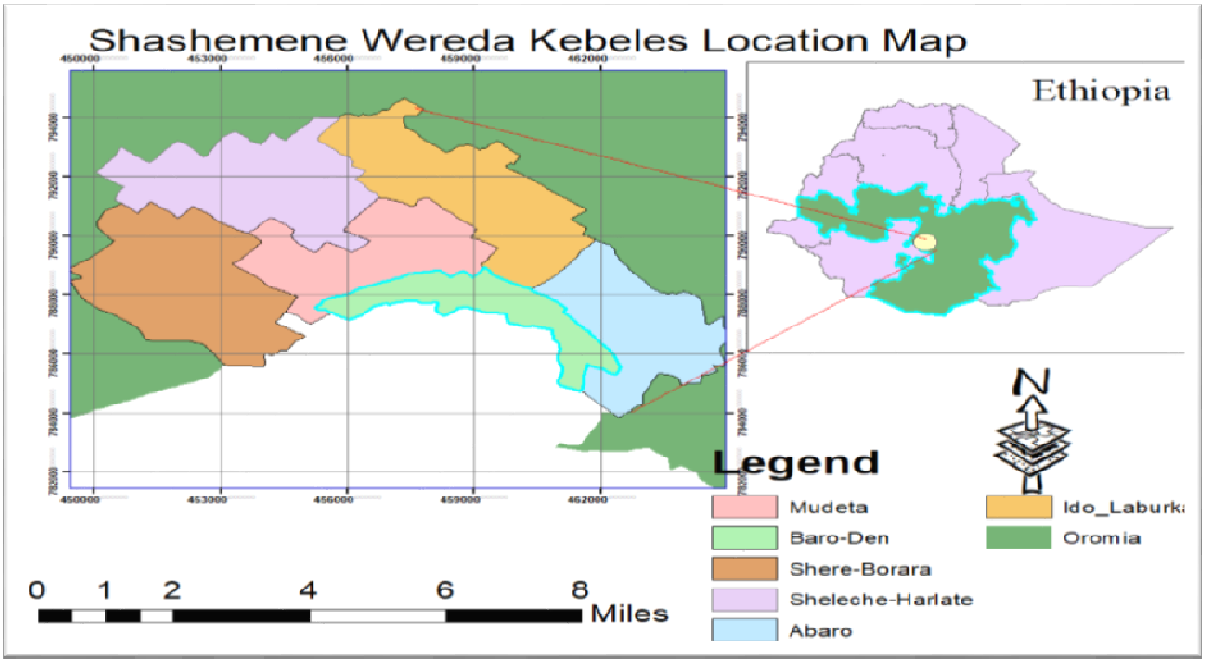


Figure_1. Study Map of Shashemene Wereda Kebeles, West Arsi Zone

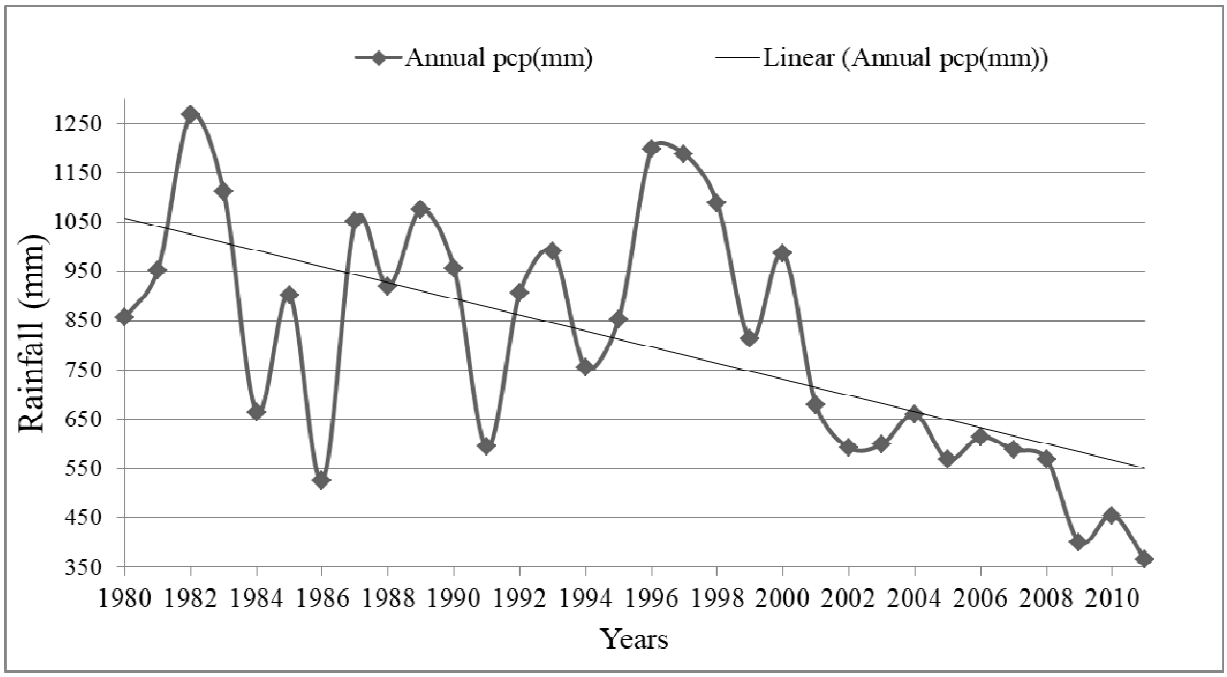


Figure-2. Average annum rainfall distribution (1980-2011)

Data Collection and Analysis Techniques

At the beginning, discussions has been made with 12 focus group members encompasses elderly persons,

community leaders, development agents and district experts. The results of the discussion were instrumental for the formulation of a well thought out formal questionnaire. The formal questionnaire survey has been used to determine the socio-economic situation and collect relevant data on household characteristics, farm sizes, soil erosion hazards, crop farming systems, the perceptions of the smallholder farmers. Trends of agricultural problems such as drought, impacts of soil erosion, past/current and the challenges for livelihood and the coping strategies used by the different households were examined. Further the perceived causes of drought and overall causes for low crop productivity and its negative impact on livelihood of smallholder farmers were navigated. Both open and closed ended questionnaires were prepared to gather quantitative and qualitative data from social survey research. Accordingly, 96 householder farmers had been interviewed being stratified by wealth, location (upper slope, lower slope), educational status and experience. Descriptive statistics was used to analyze the quantitative social survey data on percentage bases thus figures and tables has been used to present results. Qualitative data of the socioeconomic survey analysis was done via Explanatory technique. ArcGIS software is applied to prepare study area map.

Climate conditions of the local area should be considered to cross check the social survey data. For this precipitation is the primary determinant for agricultural production in Ethiopian rift valleys. Thus long term precipitation data between 1980 up to 2011 was collected and used to analyze rainfall variability and drought vulnerability of smallholder farmers in Shashemene Wereda kebeles. Microsoft excel was used to analyze and produce figures. The annual rainfall fluctuations and its pattern had been evaluated by calculating standardised rainfall anomaly (SRA) Eq. 1 (Agnew and Chappell, 1999).

$$SRA = \frac{(P_t - P_m)}{\sigma}$$

Where SRA is standardised rainfall anomaly, P_t is annual rainfall in year t, P_m is long-term mean annual rainfall and σ is standard deviation of annual rainfall over the period of observation.

RESULTS AND DISCUSSIONS

Rainfall Variability and Drought Vulnerability of smallholder farmers

Consequent rise in frequency of extreme weather events and rainfall variability, comprising droughts and floods combined with increased evapotranspiration demand, will have an impact on every section in agricultural ecosystems: crops, livestock, and rural communities. Water scarcity is already the key challenge facing agriculture in many river basins. In areas where water is scarce, climate change is expected to exacerbate tensions and increase race for water. Agricultural societies most at risk are those that rely exclusively on farming for their livelihood, have little scope for expansion and are highly open to climate variability (Food and Agriculture Organization of the United Nations, 2014). Based on the long-term rainfall data analysis made, the probable risk level of drought had been determined. Drought had several classes namely extreme drought ($SRA <$ -1.65), severe drought (-1.28 $> SRA >$ -1.65), moderate drought (-0.84 $> SRA >$ -1.28), and no drought ($SRA >$ -0.84) (Agnew and Chappell, 1999). The standardized RF anomaly in Shashemene Wereda was -1.26 (figure 3). This falls among 0.84 to -1.28 drought classes indicating the research site is vulnerable to drought to moderate risk level. Several portions of Sub-Saharan Africa are susceptible to devastating impacts of climate variability and extreme events like drought. Climate variability and relative changes causes negative effects upon agricultural activities (Below et al., 2010). In SSA the effect of climate change on farming; nourishment and livelihoods shall not be under estimated moreover. This is because there is a universal contract in the scientific community that temperatures have raised, and will further upsurge in the nearby, mid and end century (O'Loughlin et al., 2014; Egeru et al., 2014). Increment of temperature above the global average is expected in SSA with diverse performance in precipitation and seasons across the region (Shiferaw et al., 2014).

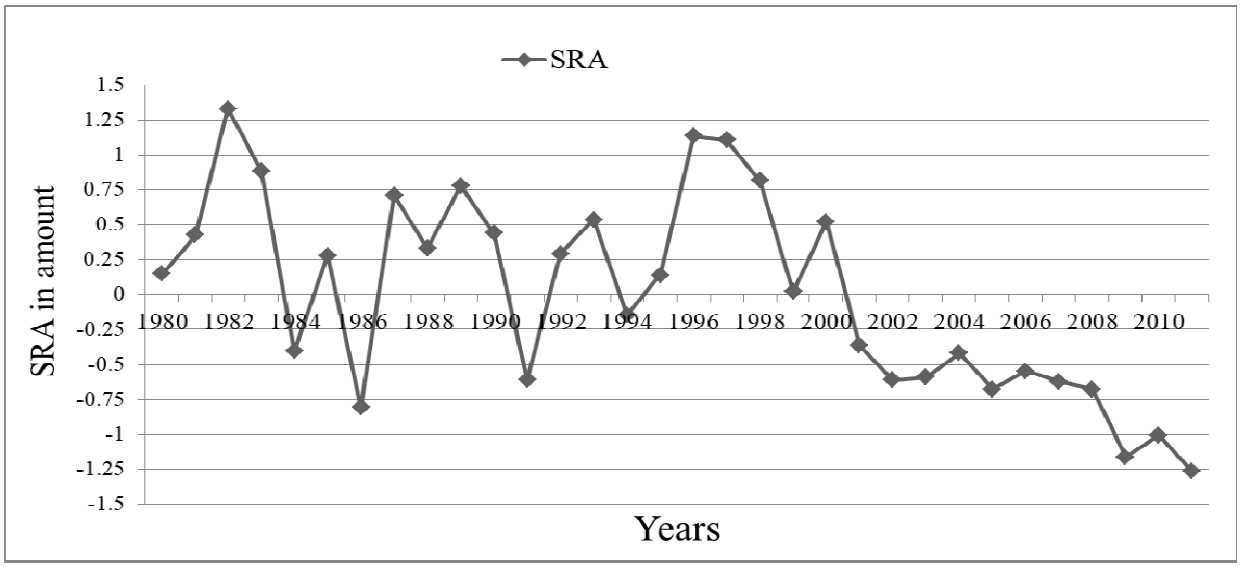


Figure 3. Drought vulnerability analysis using SRA in Shashemene (1980-2011)

Households Characteristics and Socio-Economic Survey

The smallholder farmers dwelling in Shashemene watershed (figure 1) were interviewed about impacts of soil erosion and drought on their livelihood. Household information was collected in order to know their background. Male householder farmer was dominant (table_1) showing field work and family organization were being performed by the header. Gender of the household heads regardless of the age group is an important variable influencing the participation and decision in farming sector (Kinfe, 2012). The marital status of the householder farmers were highly prevailed by one to one correspondence or marriage (table-1). This had its own implication on socio-economic situation. Wealthy characteristics of the households were grouped into three categories based on local principles. This encompasses many money, different type and many number of animals, pair of oxen, who educate his/her children and who had half hectare of farm land were grouped as rich farmer. Medium class occurs if he/she had average of the properties listed above. In opposite to the above condition if the householder had nothing except house placement area the appropriate category was poor wealthy condition. Meantime, the wealthy status of the households of the area were prevailed with medium farmers and followed by poor condition. These imply that farmers of the study area (table 1) live in poverty environment. Most of the time existence of smallholder farmers is supported by food aid. More of the householders were born within the research area. This implies that the interviewee has appropriate information or fair understanding about the situations taking place within the study area. Educational background of the local communities was determined from social survey. Thus primary level was the most education status of the householder farmers'. This has assisted them to have good power of reasoning to the questions in target.

Table 1. Description of sample households' characteristics in Shashemene Wereda

Category	Percent n=96	Cumulative Percent
male	83.7	83.7
Female	16.3	100.0
married	81.4	81.4
divorced	2.3	83.7
polygamy	7.0	90.7
widowed	9.3	100.0
Rich	20.9	20.9
medium	46.5	67.4
poor	32.6	100.0
Immigrant	4.7	4.7
Born here	95.3	100.0
no education	30.2	30.2
Primary	44.2	74.4
Secondary	25.6	100.0

Landholding of Smallholder Farmers in Research Site

Agricultural land is the main requirement of existence in developing countries like Ethiopia because it is the only

income source to smallholder farmers. However so many factors are affecting availability of this resource. Farmers of the study area were owned small sized farm lands mostly one plot (one-day oxen plough) (figure 4); which is one-fourth of a hectare (0.25ha). This means, majority of dwellers are small landholder in addition to house placement plot. In other words there were overcrowded conditions caused by population pressure (large family size per household ranging from 6 – 14 children). Lack of family planning (child-policy) had enhanced the situation. Such farmhouses though contain small parcels and patches of land with inhibited input resources. Smallholder farmers of Africa are occasionally known as "resource poor" (Food and Agriculture Organization of the United Nations, 2014).

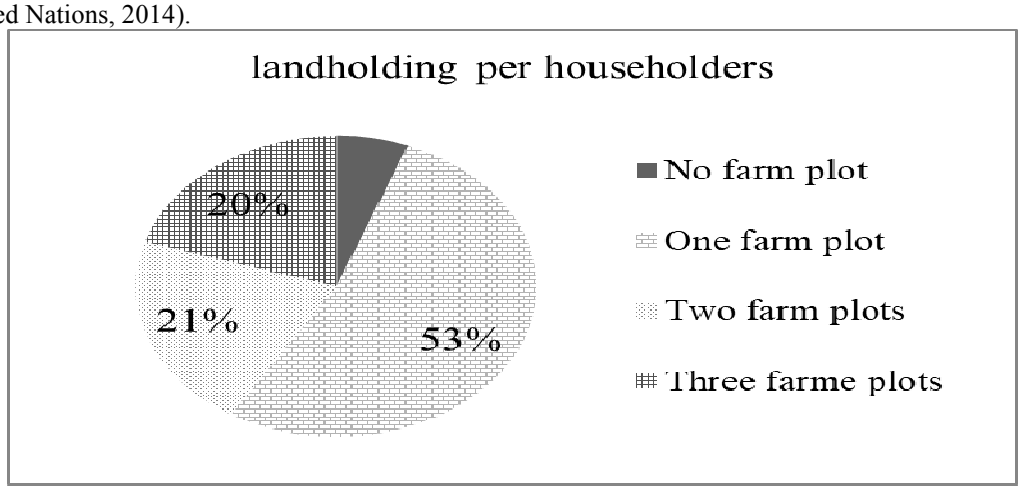


Figure 4. Farm plot owned by householder farmers in Shashemene Wereda

Soil Erosion and Its Consequences in study area

The most prevailing problem in this research site was soil erosion. Since 1969 several changing conditions has prevailed. Following heavy rainfall unexpected runoff resulted in loss of human life and other properties (focus group discussion). Through changing local conditions the problem was continued causing several challenges. Consequently fertile top soil was lost and this has strongly affected agricultural production. At this moment the problem has reached beyond reclamation or rehabilitation potential of local farmers. The main cause of the problem encompasses deforestation, land position, up and down land plough and inadequacy or lack of soil and water conservation practices (figure 5). The topography of a landscape, its rainfall all combines to influence the land's susceptibility to soil erosion (Pimentel and Burgess, 2013). Soil erosion is closely related to rainfall partly through the contribution of rain to runoff and partly via the detaching power of raindrops striking the soil surface (Morgan, 2005). Soil erosion is particularly severe on smallholder farms that are often located on marginal lands where the soil quality is poor and the topography is steep in developing countries (Lal, 1990). Poor farmers cultivate row crops like corn and beans; which are highly susceptible to erosion because crop doesn't cover the entire tilled soil surface (Lubowski et al., 2006). About 60% of the cropland was abandoned due to soil erosion and inappropriate agricultural practices left the land devastated by water and wind erosion in the Sierra Region of Ecuador, (Pimentel and Burgess, 2013).

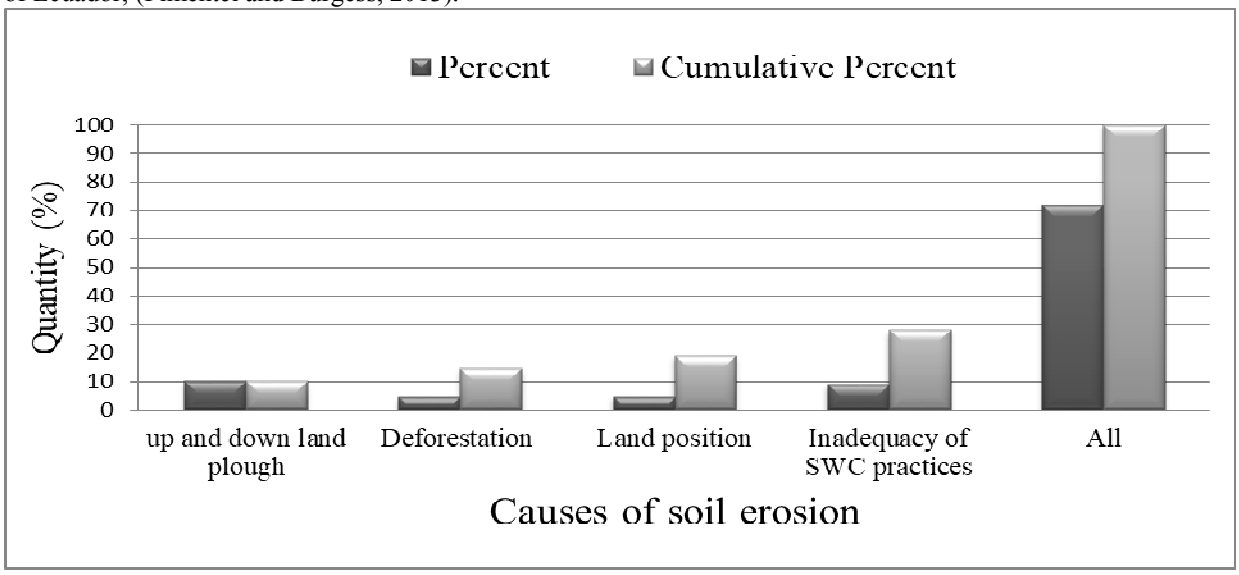


Figure 5. The main causes of soil erosion in study area

Householder farmers have identified risk level of soil erosion on the farmland. There of soil erosion has been explained based on consecutive yield reduction from individual farmers plot. Majority of farmers said that agricultural production was affected by highly risk level at upper slope; due to consecutive loss of fertile top soil (table 2). Erosion results in the degradation of a soil's productivity in several ways. It reduces nutrient concentration, restricts plants' rooting depth, declines soil's water-holding capacity and or decreases permeability, increases runoff, and reduces infiltration rate (Morgan, 2005).

Table 2. Risk level of soil erosion as to farmers understanding

Category	Percent n=96	Cumulative Percent
No risk	34.9	34.9
Moderate risk	2.3	37.2
High risk	62.8	100.0

Harshness of soil erosion is time dependent. Temporal variation in loss of soil is very common in the research site. As to farmers, severe soil erosion or loss appears during heavy rainfall and followed by when crop roots are shallow and soils are fragmented (figure 6). Massive soil transportation is very common during this period and even it closes roads, ditches and lower farm lands. Soil erosion is caused and exacerbated by the erosive forces of water following heavy rainfall (Food and Agriculture Organization of the United Nations, 2014). Soil erosion starts by detachment of soil particles, continues with the transportation, and ends with the deposition of it in a new location.

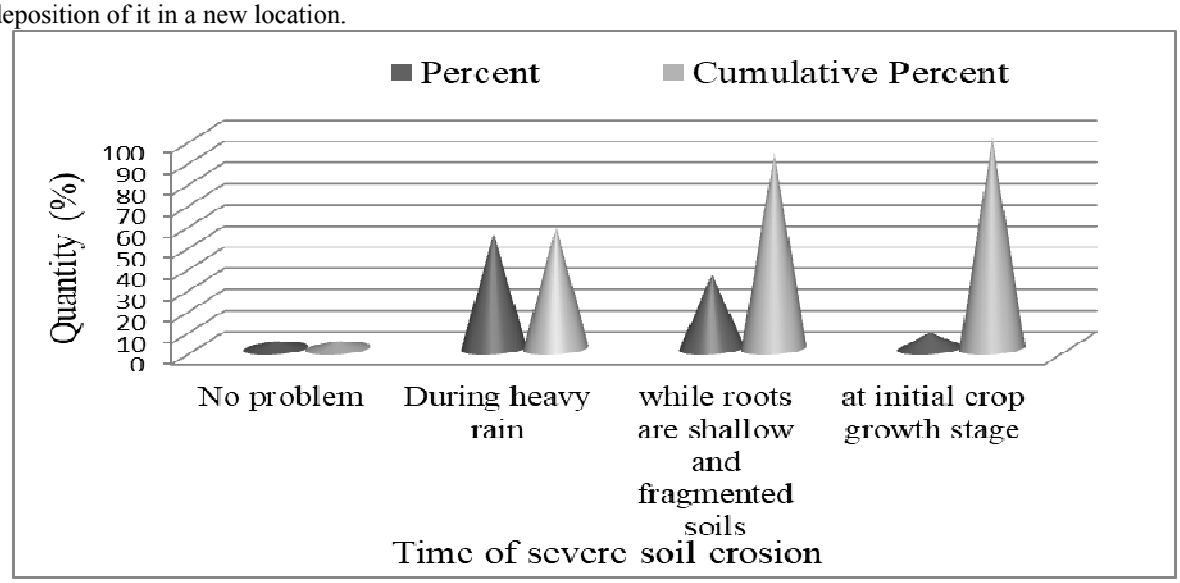


Figure 6. Period of severe soil erosion

Livelihood of households of the study area was being suffered from staple food shortage occurring at different periods of time to varied extent. Gap of food was happening only in bad years in which agricultural water is very scarce (figure 7). No river flow was found in the area. Precipitation is the only source for crop production. Inadequate and extreme fluctuations in the amount of water available in the root-zone is a major constraint to productivity and profitability of agriculture making smallholder farmers remain at subsistence level and in perpetual poverty. Consequently, high risk of frequent failures of crop and livestock production limits financing of investments in the semi-arid areas. This condemns the majority of inhabitants of these areas to precarious survival without savings, credit, investments, infrastructure and trading links. To most development planners it seems irrational to invest for the poor in less favored environment (Food and Agriculture Organization of the United Nations, 2014).

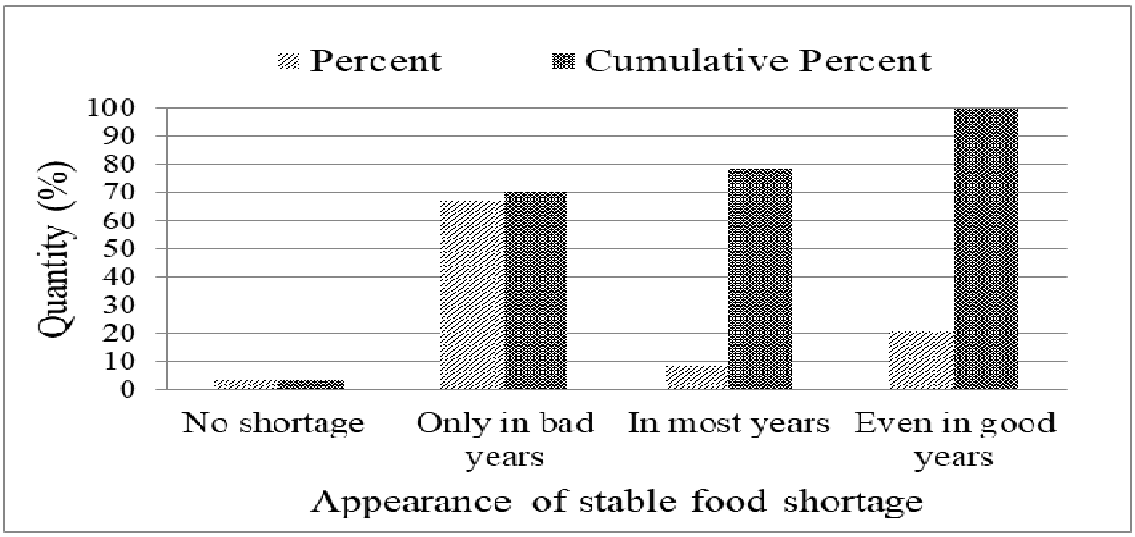


Figure 7. Frequency of staple food shortage for households in study area

The households' food insecurity situations have been investigated. Communities living in the research site are commonly food aid. Overcrowded population, fragmented land holding, eroded soil (less fertile), and lack of relevant training how to act in changing climates are drivers not to be secured in food. Consequently, most of respondents replied that agricultural production wishes, but often fails to produce subsistence food needs and depends on emergency aid (figure 8). Not only food insecurity but also hand to mouth (food for work) is very challenging at this time. Single deviation in rainfall pattern interrupts agricultural activity resulting in crop failure. Coping strategies are very poor. Inter-annual and seasonal rainfall variability is high and droughts are frequent in many parts of the Ethiopian where agriculture is mostly rain-fed. Such timely occurring couple impacts, change on cultivation comprising midst others; losses in crop and livestock productivity and a periodic poverty (Food and Agriculture Organization of the United Nations, 2014). Smallholder farmers focused on soil degradation, lose their food security and in years when the market price for the crop is low are unable to provide the necessary inputs to maintain soil fertility and conservation structures (Morgan, 2005).

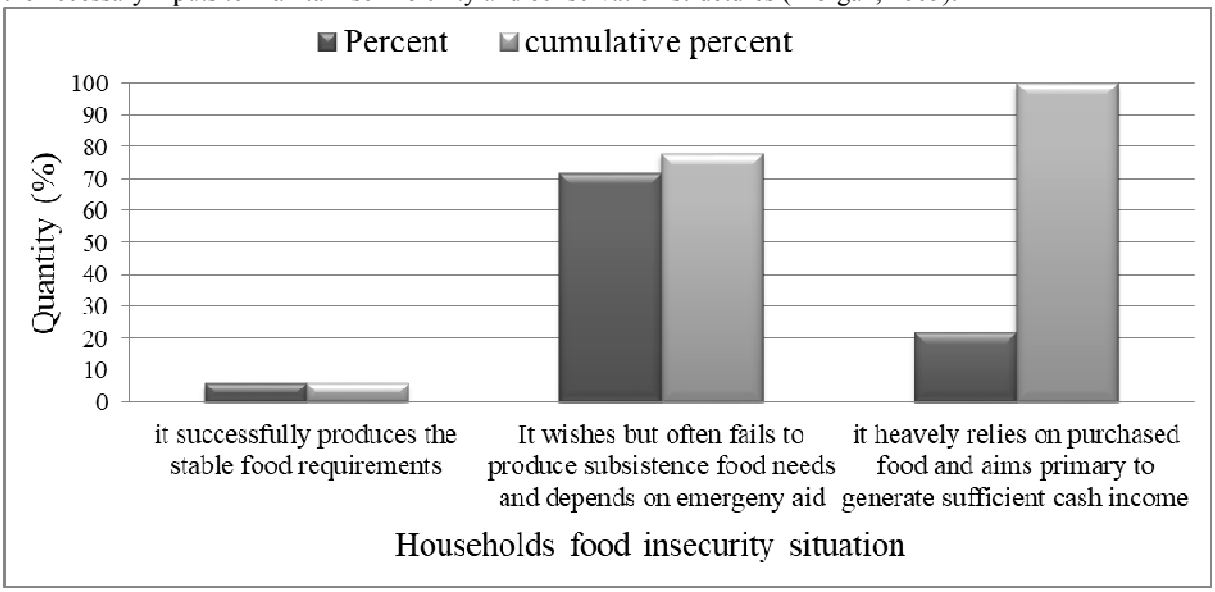


Figure 8. Households' food insecurity situation

Agriculture, hydrology, and socio-economic drought occurs producing associated impacts when drought conditions persist for a period of time. During drought (bad years), not only are inflows to recharge surface and subsurface supplies reduced, but demand for these resources increases dramatically as well (United Nations secretariat of the International Strategy for Disaster Reduction, 2007). For more than two decades drought or bad year prevalence is being persisted and its periodic appearance was identified with basic situations. The smallholder farmers said that we call bad year "if rainfall is absent all the year" followed by "if rainfall is absent during *arfasa/spring* season" (table 3). Within rainy season there are large gaps/dry spells during crop growth stage. Households of the area are familiar in being deal of *atete*/pray if start of rainfall late till May (focus group discussion). *Atete* is a culture based pray to God for search of mercy in rainfall that is practiced by women living

in Shashemene Wereda of West Arsi Zone.

Table 3. Description of bad year in Shashemene Wereda

Category	Percent n=96	Cumulative Percent
Absence of *Arfasa*/spring rainfall	32.6	32.6
low rainfall during *Arfasa*/spring	9.3	41.9
Absence of rainfall during *Ganna*/summer	9.3	51.2
Low rainfall during *Ganna*/summer	7.0	58.1
If it rains too much or too small	7.0	65.1
If rainfall is absent all the year	34.9	100.0

Bad years (lack of rainfall) had been appeared too differently. Farmers of the study area were identified existence of bad years around Shashemene based on fluctuations in onset of rainfall. Accordingly, most of the respondents said that it was occurred every other year (figure 9). In semi-arid areas both onset and duration of rainfall are inherently stochastic and probability of acute dry spells occurrence throughout a growing period is high (Kisanga, 2002). It is expected that by 2025 the per capita availability of water will be deteriorating with raised water scarcity, susceptibility and pressure. Such a situation makes farming in semi-arid areas a risky venture with the likelihood of production failure being so high (Rockstrom, 2000).

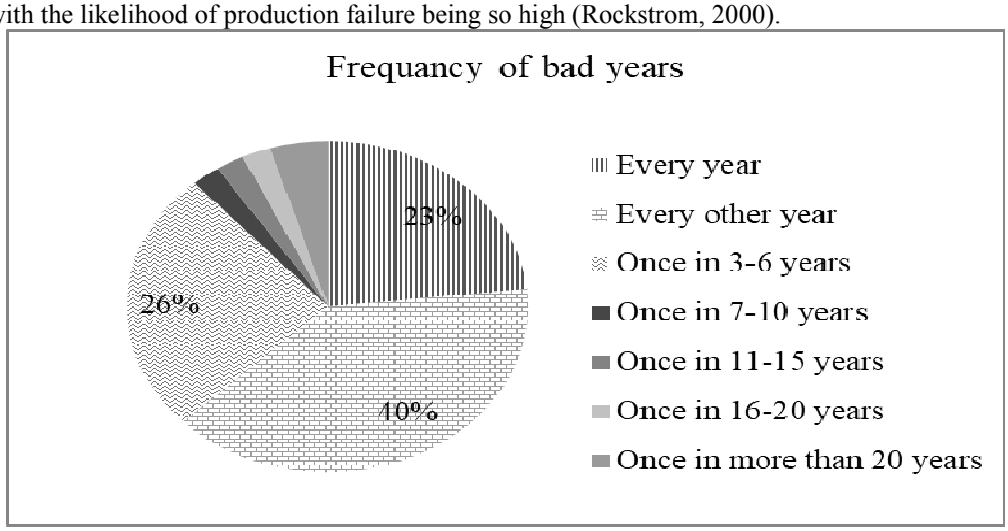


Figure 9. Frequency of bad years in study area

Agricultural crop production supply and demand of subsistence farmers in this research site had large gaps. Most of householder farmers were found under a victim of food crisis during *Ganna*/summer season and some of them are suffered even during *Birra/autumn season* (figure 10). At these time no food were left in home to support life for families having large size. Such situations a aprimary cause of Somany social problems that taking place here and there which ends in loss of human life. Such like problems are very common to Ethiopia but sever in the site as drived by shortage of water availabilty.

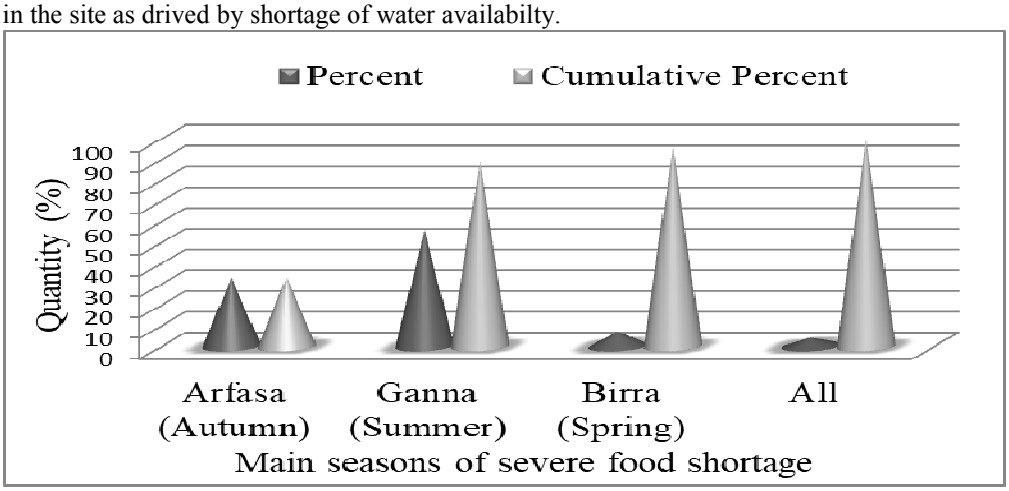


Figure 10. Main seasons of sever food shortage

The households' food production to sustain family had been in challenging condition. Consequently moist

of them was living under poverty. The crop production lags behind by moderate extent to sustain all family members (figure 11). Sub-Saharan Africa countries are susceptible to climate change for a twosome of realities inherent in the region; great natural resource and agricultural reliance; poverty (58.9% living below multi-dimensional poverty (Alkire and Housseini, 2014).

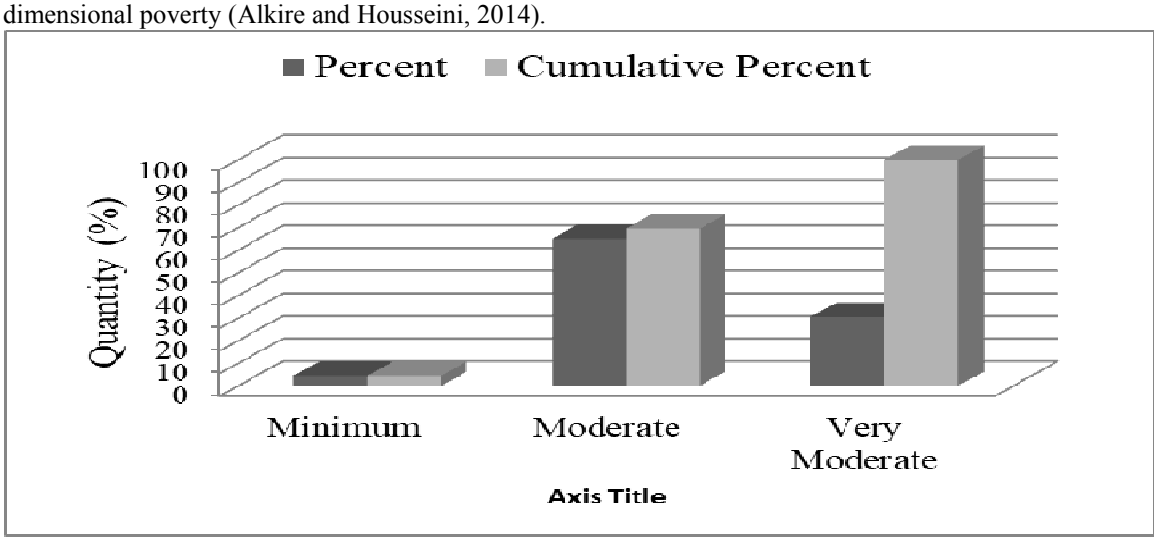


Figure 11. Extent of food to sustain family

The farmers had been isolated the root causes of food shortage in Shashemene Wereda. As to them the most overriding sources of food shortage was family size or population density (figure 12). In addition some of them said that food crisis was caused by family size, arable land shortage, losses of top soil and water scarcity. Having such burning problms practice of traditional rain-fed agricultural crop production never assist smallholder farmers to sustain their family.

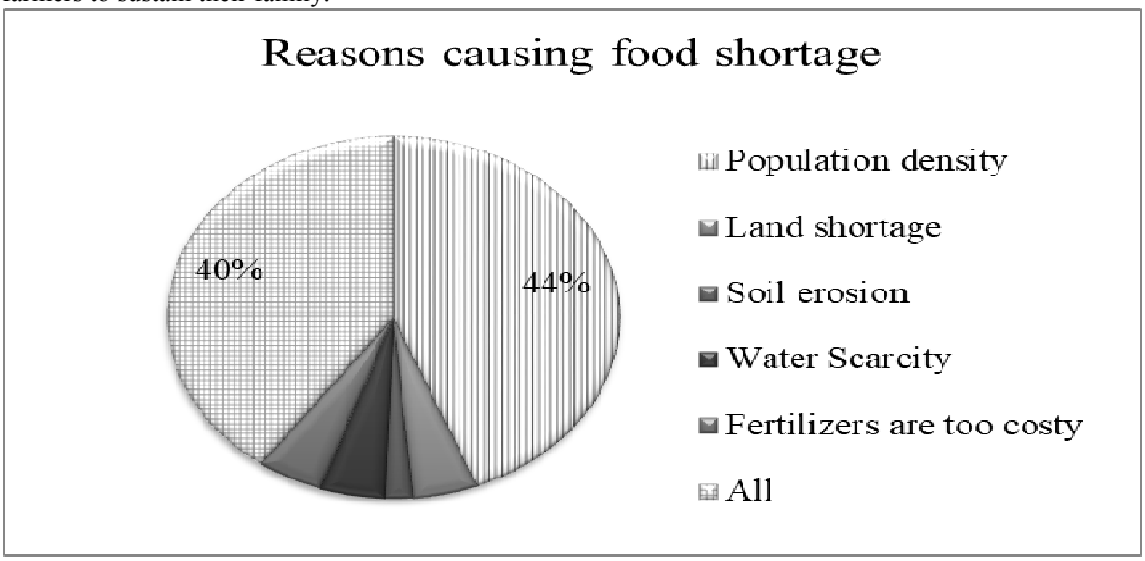


Figure 12. Reasons for food shortage

Drought is one of the major natural hazard threats to people's livelihood and community socio-economic development. Each year, disasters originating from prolonged drought not only affect tens of millions of people, but also contribute to famine and starvation among millions of people, particularly in some African countries. Root causes of drought, drought spells and low rainfall were identified. Accordingly, households of the study area had been isolated deforestation and climate change as a root cause (table 4). In addition drought is hard especially at flowering stage; after a week it reduces a yield and causes death after a month (focus group discussion). Ethiopia is severely affected by recurring droughts and slowly advancing desertification processes. Poor farming practices, population pressure, overgrazing, soil erosion, deforestation, salinity and alkalinity problems in the rural households are the dominant man induced causes of land degradation (drought) in the dry lands of Ethiopia are (World Bank, 1984). More than twenty seven million people live in the dry sub-humid, semi-arid and arid areas, where the ratio of RR/PET is less than 0.65 (UNCCD, 1994). During the 1972/73, 80/81 and 84/85 drought and famine years, the social and the economic development of arid, semi-arid and dry sub-humid areas of the country were seriously affected. The 1984/85 drought claimed the lives of more than two hundred thousand people and millions of livestock. Reasonably the interface of the multiple pressures creates a

higher weakness of the region to climate variability, change and limiting the region's adaptive capacity (Connolly-Boutin and Smit, 2015).

Table 4. Root causes of drought and low rainfall

Causes	Percent n=96	Cumulative Percent
1) Deforestation	16.3	16.3
2) The disgrace from God	4.7	20.9
3) Climate change	11.6	32.6
1 & 3	65.1	97.7
1, 2 & 3	2.3	100.0

The smallholder farmers of the area were familiar in receiving rainfall on specified month a long ago. After decades onset of rainfall had been disturbed following deforestation. Currently everything had changed. Production of valuable crop yield needs on time sowing. Consistency of rainfall occurrence on timely bases might be confirmed for cultivation. As influenced by several drivers onset of precipitation is fluctuating (focus group discussion). Commonly February is the most prevailing month of rainfall commencement (figure 13). Onset of rainfall was previously defined for semi-arid areas either in Ethiopia (Tesfaye and Walker, 2004) or in other semi-arid areas of Africa.

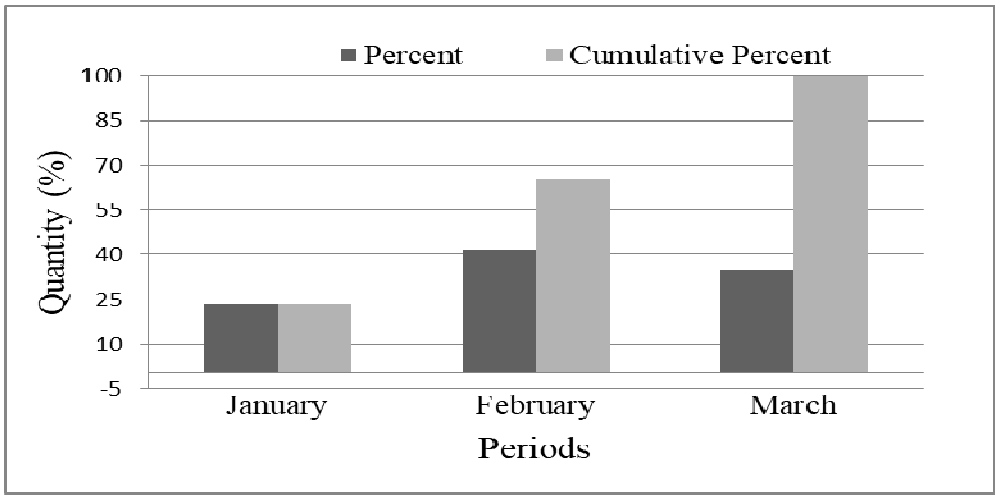


Figure 13. Start of rainfall in good years

It is obvious that local conditions are changing being causing harsh environment. Probability of survive determines by use of existing chances. During bad years farmers of the study area were experienced different options to sow crops especially maize. Likewise, most of respondents sow maize crop through application of minimum tillage to use the minimum and late rainfall. In addition, some of them opt for teff or haricot beans.

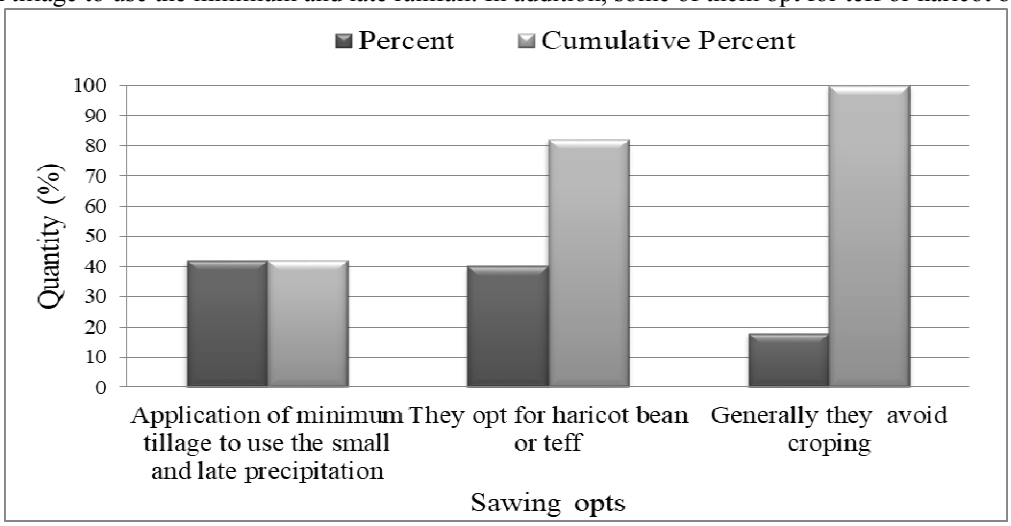


Figure 14. Maize sowing options during bad years

Income sources of households were shown different resistance to bad years. Accordingly, crop production had been the most income source highly affected by bad years (figure 15). In addition *teff* and potato are very

sensitive to drought and they dies after a week (focus group discussion).

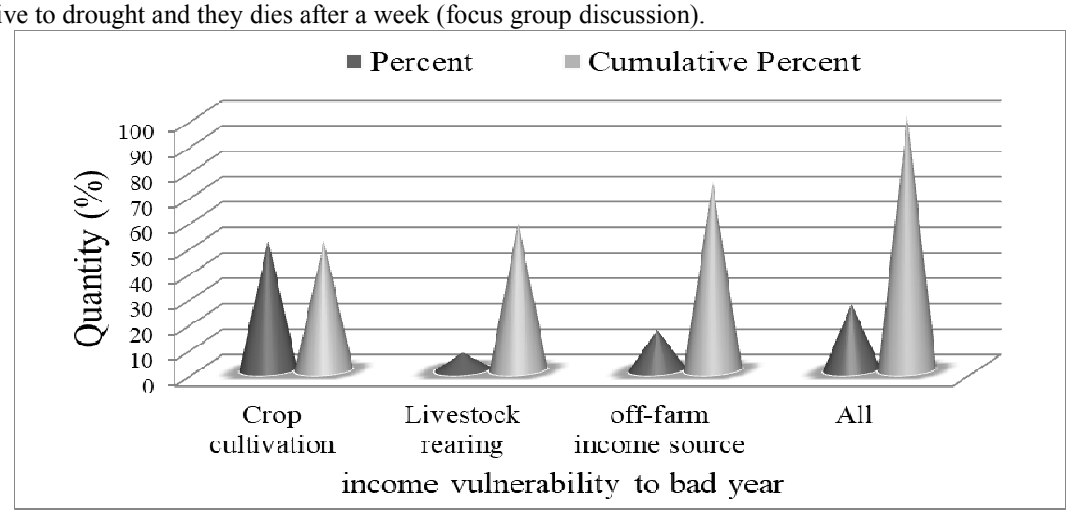


Figure 15. Income sources susceptible to bad years

Farmers need information to adopt/improve agricultural technologies for yield improvement and to withstand in changing local conditions. They were informed or trained from all information sources available locally (figure 16). Theory gives us concepts, provides basic assumptions, directs us to the important questions, and suggests ways for us to make sense of the data (Mikkelsen, 2005).

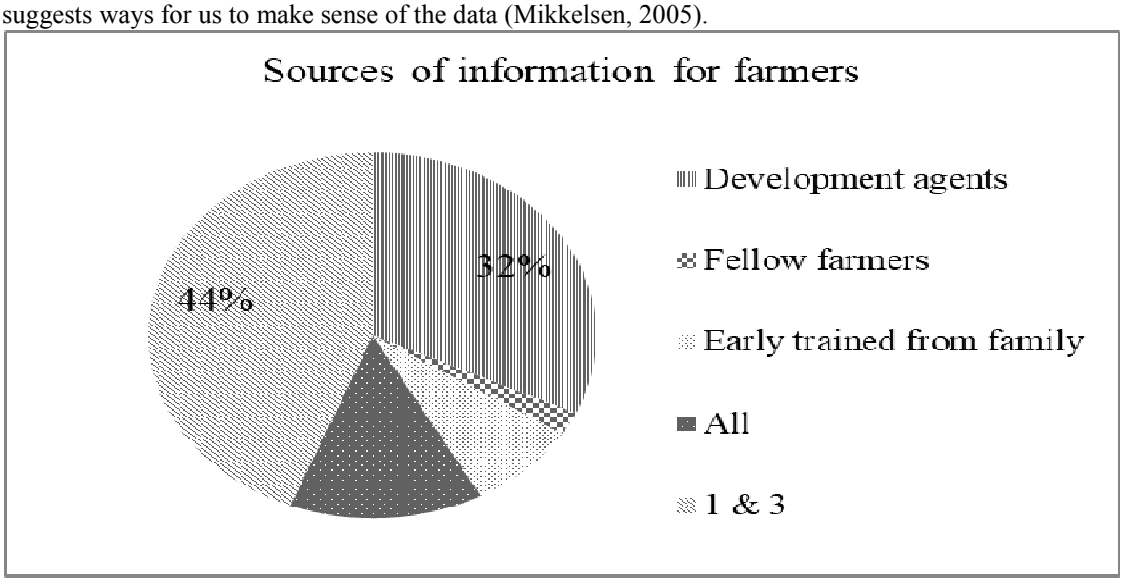


Figure 16. Sources of information for farmers to adopt agricultural technologies

Rainfall patterns of the study area were indicated great variation in its amount, distribution and duration. Almost all of the households said that the rainfall indicated gradual change since long ago and aggravated at the moment (focus group discussion). Drought and socio-economy of the households were strongly linked. Accordingly, drought had been affected economy of these smallholder farmers to full extent. Effect of drought had been perceived too risky state throughout the time figure-17. Likewise, degree/frequency of the problem was increased gradually. They are adapted to specific conditions with effects of climate change like drought, the shortening of the growing season, increased incidence of pests and diseases (Food and Agriculture Organization of the United Nations, 2014).

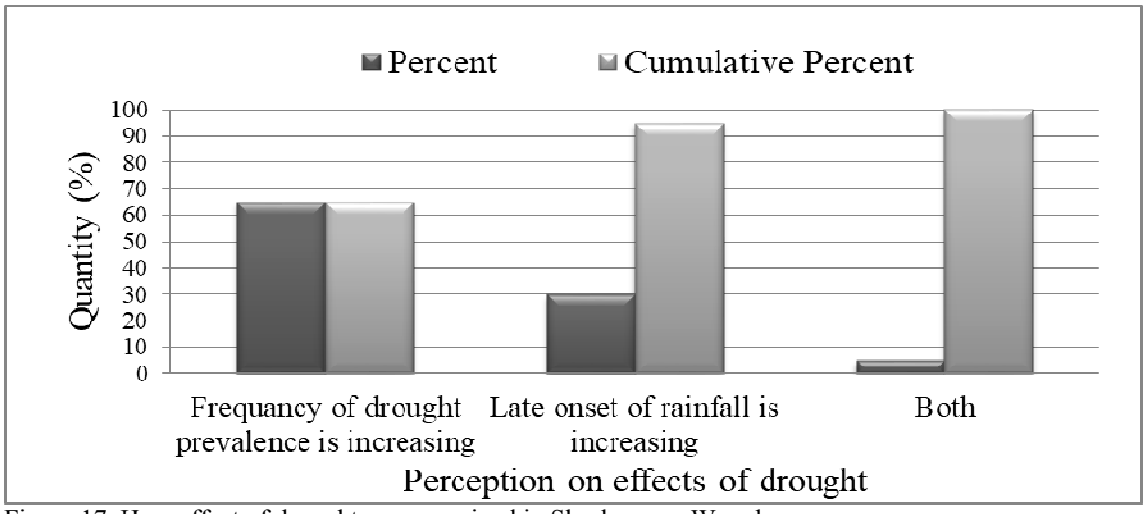


Figure 17. How effect of drought was perceived in Shashemene Wereda

Households of the study area suffer severe food shortage even in good years. Majority of farmers had been affected by this problem during *Ganna*/summer season. This period is known in Ethiopia duly because the harvested yields might be consumed and crops in the field are at late stage (immature) to be used as food. Hunger, famine and relative difficulties are very common in and around rural areas of the country. This implies that many of households live in chronic poverty. Definitions given to local words in table 5 were indicated on website http://www.ethiopiantreasures.co.uk/pages/climate.htm.

Table 5. Seasons of sever food shortage in good years

Category	Percent n=96	Cumulative Percent
1. No problem	7.0	7.0
2. *Birra* (Autumn)	14.0	20.9
3. *Ganna* (summer)	53.5	74.4
4. *Arfaasaa* (spring)	2.3	76.7
5. *Bona* (Winter)	18.6	95.3
2-5	4.7	100.0

Live need coping strategies to pass through challenging bad years. Households around Shashemene were familiar with different coping strategies. Consequently, most of respondents were used livestock/animal selling. And few of them said that we try's to use all the options listed in Figure 18. In SSA smallholder farmers are extremely dependent on self-directed adaptation particularly a farmer's reply in response to a climate change occasion (Calzadilla et al., 2013). Many communities had purposely aimed at reducing overall susceptibility to climate shocks-adaptive strategies and unintended to manage their ex-post impacts-coping strategies towards constructing flexible via inspiring the prevailing ecosystems and accessible natural resource foundations (Munang and Andrews, 2014).

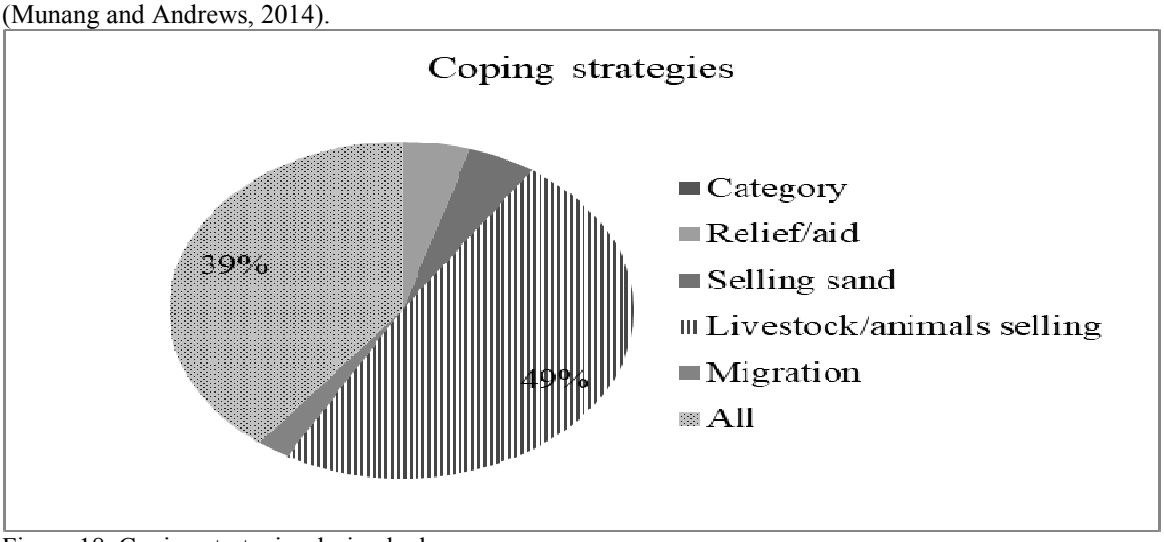


Figure 18. Coping strategies during bad years

As to Ethiopian farmers, income of households of the study area was based on rain-fed crop production.

Basically majority of them produces crops once per year and followed by twice per year.

Table 6. Households' income situation

Category	Percent n=96	Cumulative Percent
Seasonal	7.0	7.0
Twice per year (in June and November)	20.9	27.9
Once per year	72.1	100.0

Soil and Water Conservation Technologies Practiced in Shashemene Wereda

Greatness and negative impacts of soil erosion on agricultural production and natural resources were much known to the society and the government. However here are less motivation and performances to work on risk reduction and improvement of yield per plot which enhances the straggle to minimize chronic hungry condition. Food for life is the very challenging situation in Ethiopia particularly in Shashemene Wereda where over population and land degradation is dominant. Very rare efforts have been done which was limited in time, space and type. Soil and water conservation technologies in use in Ethiopia encompasses soil bunds, stone bunds, grass strips, waterways, trees planted at the edge of farm fields, contours, and irrigation (chiefly water harvesting) and other practices (Edward, et.al., 2011). Different types of SWC practices had been exercised in Shashemene Wereda. Thoroughly, they were practicing *Daagaa hojjechu* (preparation of ditch which trap sediment and runoff coming from upslope); terracing and contour farming. Farmers' attitudes to risk will influence their willingness to invest in SWC. The adoption of SWC practices can be regarded as a risk reduction strategy, whereby the overall resilience of the farming system may be enhanced and the impact of any stress (such as erratic and untimely rainfall) are less dramatic (Hatibu et al., 1995).

Soil is the most important resource on which agriculture is based. Proper management of such useful resource is vital to sustain long-term agricultural productivity. Soil conservation practices are tools the farmer can use to prevent soil degradation and build organic matter. Households had been being benefited from SWC practices too different extent. Some of farmers were satisfied with the practices to moderate extent by declining soil loss. SWC practices have been built to control runoff, thus increasing soil moisture and reducing soil erosion (Edward, et.al. 2011 and Morgan, 2005). Even if community mobilization at particular time and space initiated conservation of portion of watershed, the ultimate goal which is minimization or if possible to avoid risk of soil erosion to tolerable limit not achieved. Since watershed boundary demarcation is not in accordance with watershed management approach; community participation to solve the prevailing problem is full of trouble. The study area is much known by such uttermost problem which was affecting practices of SWC.

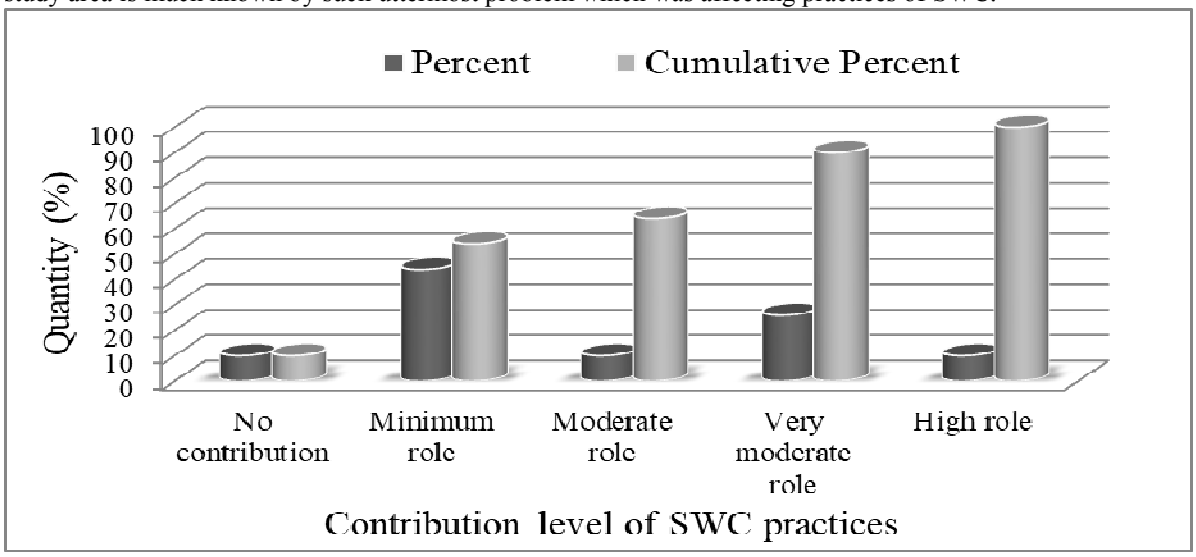


Figure 19. Contributions of SWC practices for communities living in Shashemene Wereda

CONCLUSION

Shashemene woreda is located in central rift valley of Ethiopia. Amount of precipitation had shown serious decline since 1997 (figure 2). Severe temperature (extreme hotness leading to evaporation) and low rainfall is experiencing. Short duration rainfalls of high intensity have caused flooding which results in removal of fertile topsoil per occurrence of precipitation. The study area was vulnerable to drought to moderate risk level (figure 3) indicating prevalence of agricultural water scarcity. The subsistent farming system of smallholder farmers were explored negative impact of soil erosion and drought on their livelihood through its pressure on agricultural

production. Lack of relevant education, prevalence of traditional tillage, topographic position, soil texture (sandy soil), small land holding size, large family size, expensiveness of fertilizers versus reduction of households' purchasing power have intensified poverty that led to food aid. Most of the time shortage of food commences in social instability. As supported by lack of appropriate soil and water conservation severe soil erosion were taking place causing reduced land productivity. Scope of the problem is expanding timely affecting natural resources and the precious human life. The cumulative impact of problems presented in result and discussion part has depressed the overall capacity of smallholder farmers via reducing productive capacity of the farmland. Furthermore livelihoods of the communities dwelling in the research site were extremely affected by soil erosion and drought (shortage of water).

RECOMMENDATION

As investigated by the conducted research communities in Shashemene woreda needs cooperation (developing habit of working together on common problems), relevant training on knowhow of tackling soil erosion, conserving water to minimize drought vulnerability of agricultural crop production that had affecting smallholders livelihood. Further research shall be conducted both on society and the land resources in order to facilitate introduction and adaptation of best Land use planning (inclusive, Productive and sustainable).

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