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Climate Induced Weather Changes on Conservation of Crop Genetic Resources in Southern Tigray, Ethiopia

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Abstract: The study was conducted in southern Zone of Tigray regional state. The area is heavily hit by climate induced weather changes such as frequent occurrence of drought, seasonal disturbance of rainfall, flood, hailstorm, alien weeds, outbreak of crop insects and diseases. The data was collected from two districts using cross-sectional survey method. A sample size of 200 respondents was randomly selected using random sampling method. Structured and semi-structured questionnaires' were administered. Most of the respondents did not directly perceived occurrence of climate changes but predominantly observed changes in temperature, rainfall and droughts conditions. It was indicated that there was pronounced changes in timing of rainfall and occurrence of drought. It was reported that pre and late main season rainfall received has decreased in amount over last two decades and short intensive rain periods was noticed. The production risk consideration and uncertainty in rainfall distribution were most likely critical factors in choosing crops/varieties to be cultivated in the study area. Farmers in area chose crops suited to prevailed local weather conditions during main cropping season as a strategy of copping to unpredictable weather conditions. The late maturing crop varieties were found most vulnerable to adverse effects of weather variability and climate induced change. Inseparably, on farm conservation practices were severely affected by weather factors (rainfall, temperature, radiation intensity and wind speed), outbreak of new pests and infestation of invasive weeds, agro-ecological factors, operational conditions and farm specific characteristics. It was observed that extreme weather events were recurrent drought, strong wind, high radiation intensity, high temperature, late onset and early offset of main and belg seasons rainfall, erratic distribution of rain, seasonal rain shortage, storm, hail, frost, untimely rain, flood, soil erosion and increasing outbreak of disease and insect pests. Farming households considered importance of changing long season crop varieties by early maturing types which they assumed as a copping strategy for climate change induced risks. Based on obtained result further additional works are required on how to disseminate information and technology to conserve locally crop varieties, enhance farmers' perception on climate change to reduce its impacts and boost the level of adaptation.

Key words: Household Perception · Determinants · Weather Variability · Local Variety

INTRODUCTION

Climate change brought a challenge on ensuring food and nutritional security particularly on less developed countries. The temperature has been rising on average by 0.2°C per decade in Ethiopia and minimum increment was 0.4°C with over countries average more equitably stable rainfall though, the spatial and temporal variation of rainfall is significantly high (Marius, 2009). The Ethiopian meteorological agency projection indicated that climate induced change in rainfall variability, rising in temperature expected to increased occurrence of drought and flood [1] Increasing in radiation intensity, temperature, wind speed and extreme weather events such as flood, drought, storms and frost presents extreme hazards to sector of agriculture, food system and conservation of local varieties [2].

On-farm conservation is right approach in properly conserving of processes/evolution in genotypes of seeds or planting materials [3]. Climate has been and predicted to have significant impact on communities because of their livelihood is depends on agriculture but the impact is specific to locations. Favorable climate conditions for many crops are changed and expected to change mostly

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in dry-land areas. Crop diversity hotspots found in such areas are maintained by small scale farmers. It is eminent that conservation viability of these varieties negatively impacted due to climate induced changes. Conservation of farmer varieties from today onwards is depends on farmers' preference, knowledge, management, practices, social organization and response of varieties to climate induced changes.

Occurrence and experiences of localized droughts in study area due to low seasonal disturbance of rainfall threaten on-farm conservation and causing subsequent crop failure. Literatures indicated that several works has been done to investigate impacts and perception of climate change on crop production in Ethiopia using different approaches. However, it was found that some of the studies focused on climate change impacts on livelihood and food security both at national and local levels. On other hand, perception analysis of respondents on climate induced weather variability impacts on conservation of local varieties may provide a better insight to strengthen future conservation works. As per knowledge of the author, no research has been conducted so far on link between perception of climate change and local variety conservation. The study made a significant contribution to existing body of knowledge regarding climate change induced weather variability impacts on conservation works of local crop varieties. Thus, study area was selected because its endowment with greater crop genetic and species diversity and its vulnerability to recurrent occurrence of drought, seasonal rainfall disturbance and frequent crop failure because of climate induced localized drought. Therefore, objectives of this research were;

- To enlighten perception of respondents on climate change impacts of farmers varieties
- To identify factors that influence respondents perception on climate change impacts and extent of influence on local farmer varieties
- To assess community crop diversity and its vulnerability to climate change

MATERIALS AND METHODS

The study was conducted in two purposively selected districts of Raya Alamata and Ofla districts of southern Tigray, Ethiopia. The zone is located 12°14'53.9"-13°06'08"N latitude and 39°10'45.7"-39°53'41.7"E longitude from the equator. The entire area of the zone is estimated to be 499, 616.1ha and the physical landscape is characterized by gorges, valleys, rugged mountainous areas and plain lands suitable for mechanized agriculture. Generally, study area is traditionally classified into *qolla, wainadega* and *dega* based on their topography and other environmental characters. The highlands located in western part whereas low land where located in eastern part of study area. The study area has received bimodal nature of rainfall with main rain season lasts from June to September and short rain season from February to April. The dominant agricultural system is mixed farming which depends on seasonal rainfall distribution and led by small scale subsistence agriculture. The study area experienced localized droughts in each cropping and main rainy season due to abnormally low and untimely rainfall causing failure of cultivated crops and jeopardized local food security [4].

The data was collected based on cross-sectional survey method. Farmers' perception of climate change is first step in recognizing the problem and making decisions to adapt. To understand and identify farmers' level of perception on climate induced weather change, a survey was conducted in six kebelles of study districts. It was done from February to march of 2018. From each district, one hundred (100) respondents were randomly selected using random sampling method to constitute a sample of 200 households. Structured and semi-structured questionnaires' were administered to collect the data.

RESULTS AND DISCUSSION

The perception on climate induced weather impacts on cultivated local crop varieties was present in (Table 1). Based on this survey result, average age of respondents was 46.79 years and 50.31 years in Raya Alamata and in Ofla districts respectively. The found age group was indicated that how respondents were experienced and had long exposure with local climate. From total respondents in each district, 92% and 93% where males whereas 8 and 7% where females both in Raya Alamata and Ofla district respectively. The majority of respondents was males and because females were hesitates to give interview in presence of their household head traditionally.

The family size of respondents was summarized in (Table 1). The family size of respondents were 25, 35 and 40% low, medium and high respectively in Raya Alamata district, whereas 36, 35 and 29% were low, medium and high in Ofla district respectively. Respondents with extended family size had capacity to conduct soil water and crop biodiversity conservation on farm relative to low family size. The extended family size helps to adapt climate

Table 1: Social characteristics of respondents in study districts

	Variables	Sex of respondents		Educational status				Family size		
District	Average age in years	Male	Female	Illiterate	Primary	Secondary	Tertiary	Low (up to 4)	Medium (5 to 6)	High (>6)
Raya Alamata	46.79	92 (92%)	8 (8%)	49 (49%)	48 (48%)	3 (3%)	0	25 (25%)	35 (35%)	40 (40%)
Ofla	50.31	93 (93%)	7 (7%)	57 (57%)	34 (34%)	6 (6%)	3 (3%)	36 (36%)	35 (35%)	29 (29%)

Sources; own survey result of 2018

Table 2: Percentage of respondents' on climate induced weather changes in study areas

	Climatic events			
Climatic variables	Increasing (%)	Decreasing (%)	No change (%)	Don't know (%)
Temperature	91.50	6.50	2.00	0.00
Rainfall	7.00	90.00	2.50	0.50
Occurrence of drought	84.00	14.00	1.50	0.50
Occurrence of flood	71.50	25.50	3.00	0.00
Short summer season	83.50	11.00	5.50	0.00
Long winter season	82.00	15.00	2.00	1.00
Unpredictable rainfall	71.00	18.00	10.00	1.00

Sources; own survey result of 2018

change induced challenges and minimized climate driven weather threats. Educational statuses of respondents were summarized in (Table 1). From total respondents 49, 48 and 3 were illiterate, primary and secondary school education levels in Raya Alamata respectively, whereas 57, 34, 6 and 3 were illiterate, primary, secondary and tertiary level of education in Ofla district respectively. The rate of literacy has an impact on perception of climate change induced weather variability and its likely impacts on local varieties conservation.

Perception of Climate Induced Changes and its Impacts: Climate induced weather changes are manifested in forms of rainfall variability, rising in temperature and sea level and caused intensified natural hazards such as hailstorms, floods, landslides and droughts [5]. Climate change is continues to be major threat to communities founded their livelihood in agriculture [6]. Anthropogenic factors that caused enormous variability in natural climate have increased unusual warm and coolness made to recognize and judge eventual effect. Quantification of local households' perception on local climate induced weather changes and its associated impacts was fundamental to address threats of local varieties conservation, food insecurity, poor strategies and responses.

Perception of occurrence of climate change has crucial roles for future adaptation and copping of climate driven challenges. According to Getis *et al.* [7] respondents' behavioral response is often shaped based on level of perception of existing climate induced weather related problems and hence analyzing challenges in terms of socioeconomic and conservation is essential. The process of obtaining awareness about weather phenomenon including climate change is called perception. Mengistu [8] was conducted perception survey on farmers of central Tigray, northern Ethiopia and reported that untimely rain and frequent occurrence of drought were most changes recognized by respondents so far.

Respondents perception was analyzed on occurrence of climate induced extreme weather events in their respective locality and their response were summarized below (Table 2). The analysis result indicated that 91.50 percent of respondents were perceived that temperature has got warmed, whereas 6.5 and 2 percent were believed temperature has been decreasing and no change at all respectively over last ten to twenty years. Of total respondents, 90 percent of them revealed that amount of rainfall received in their locality has decline enormously, whereas 7.00, 2.50 and 0.5 percent of respondents were disclosed that rainfall has been increasing, no change and do not have idea respectively. Households were also asked to indicate their perception on occurrence and frequency of drought in their locality and majority (84.00%) of them perceived that existence and occurrence of drought within less than three years interval in their locality, whereas 14.00, 1.50 and 0.5% of them described that drought was decreasing, no change and do not know respectively over last ten to twenty years period.

Respondents were also asked regarding period of summer and winter season and most (83.5 and 82.00%) of them perceived that summer season was got too short and winter season was got too long respectively over last ten to twenty years. The summer season was contracted

significantly from three months of rain period to one month now over past decades. Likewise, 11.00, 15.00, 5.5 and 2.00% of them perceived that short summer and long winter season was decreasing and no change at all respectively in study area. On other hand, respondents were asked to indicate their perception on condition of rainfall distribution in their locality and majority (71.00%) of them revealed that unpredictable nature of rainfall distribution was increasing over last ten to twenty years, whereas 18.00 and 10.00 percentage of them perceived that decreasing and no change on unpredictable nature of rainfall occurrence respectively in study areas.

Most of respondents do not directly perceived existence of climate change but predominantly observed changes in temperature, rainfall and timing of main rain and related droughts. It was indicated that there was pronounced changes in timing of rainfall and occurrence of drought. The rainfall usually comes later than expected in onset and ceased earlier in offset. On other hand, respondents indicated that drought becomes a common event and occurred more frequent than it was before. Historically, drought has been seen within the interval of ten years and concentrated recently to five years but now it has been occurring more frequent than before within intervals of less than three years. According to perception of respondents, one good year harvest is alternated with next year drought which caused complete crop failure and devastation. The result was in agreement with finding of Dejene [1] which indicated that drought was occurring to level of two consecutive years. Respondents perceived that climate induced changes of weather affects right time of sowing, water utilization, moisture deficit at critical growing point, limits availability of animal feed, availability of human food, complete yield loss, causes drying of streams and rivers, morphological damage and tearing of leaves, affects maturity time of crops, affects germination, increases transpiration rate and causes physical damage. It was perceived that major causes/reasons happened for these events were deforestation, cursed of God, unplanned soil water conservation activities, climatic variability, over cultivation, population pressure and expansion of cultivated land.

The national meteorological agency projection indicated that amount of rainfall received in northern part of Ethiopia will dramatically decline whereas increasing in southern part in near future [9]. The prevalence of high temperature with decreasing in amount of rainfall exposed the study area to seasonal prolonged drought. The recurrent occurrence of natural events such as occurrence of frequent drought, strong wind, high radiation intensity, increasing temperature, late onset and early offset of main and *short* rainfall season, seasonal disturbance/erratic distribution, rain shortage, hailstorm, untimely rain, flood, soil erosion, infestation of invasive alien plant species, increasing outbreak of disease and insect pests have significant concerns to households depends on agriculture. Generally, changes in temperature and rainfall were changing land and water regimes in the study area that alters agricultural practices and activities. Thus, climate change induced changes of weather elements affects stability and sustainability of socioeconomic activities, agricultural practices and local crop variety conservation in the study area.

Rainfall Variability, Seasonal Disturbance and Cropping Season: The study area receives nearly bimodal nature of rainfall usually short *belg* rainfall happens from February to March and main season occurs from June to September. The prevailed semi-arid environment of Tigray receives not only low average rainfall but also experienced inter annual considerable variability. The increase in year to year variability, recurrent droughts and occurrence of short period intensive rainfall affects agricultural activity and food security situations in the study area. The major agricultural activities affected with seasonal disturbance in rainfall were ploughing, sowing, flowering and grain filling period of main crops. The late onset and early offset of main season rainfall with elongated dry spells impairs sowing time, flowering and grain filling period. It affects cultivation of high yielding long cycle crops, threatened diversity and resulted significant genetic erosion. The occurrence of inter seasonal and annual drought reduced soil productivity, availability of animal feed, loss of livestock, exacerbates food insecurity.

Respondents indicated that pre and late main season rainfall amount received has decreased over last two decades and very intensive short rainfall was noticed with decreasing trend in the study areas. The recurrent interruption of *belg* and seasonal rainfall affects cultivation and sustainable conservation of farmers' varieties. The production risk consideration and uncertainty in rainfall distribution are most likely critical factors in selecting of crops for cultivation. The interest of farmers to grow and manage late matured local varieties were gradually degraded due to frequent failure of crops without any economic yield as a result of seasonal disturbance, untimely onset and offset rainfall during critical growing periods. The respondents during the assessment indicated that they were given more attention

now days to grown early matured and drought tolerant varieties only. They further claimed that though productivity of early matured varieties was relatively low, they prefer to grow and harvest some yield than losing entire crop. Therefore, it was understood that number of rain days were shrink significantly and started to affect cropping season negatively. Thus, economically, traditionally and scientifically important local farmer varieties have been seriously affected and eroded their genetic diversity irreversibly.

Climate Change and Crop Preference: There is growing consensus among scientists, policy makers and political leaders' that climate change induced weather changes has brought adverse effect on livelihood of rural community, crop preference to be growing and overall performance of agriculture. The traditional approach to reversing risks, restoring soil fertility and maximized returns under uncertain conditions were mainly focused on crop diversification, rotation, intercropping, natural regeneration and soil water conservation activities. However, crop diversification has its own limitations resulted from population pressure and landholding size. Diversification seems impractical and unrealistic to conduct at small scale subsistence farming level with average landholding size of less than one hectare. Determining household level of perception and crop selection can generate important information about conservation impact of local varieties and how farmers avert risky using multiple cropping.

The observation indicated that there were fluctuations in rainfall during onset, cessation dates and length of growing periods. Farmers in southern Tigray select crops suited to prevailed local weather conditions during main cropping season as strategy of copping to unpredictable weather conditions. When seasonal rainfall is not onset on time, uneven in distribution and low in amount, households predominately select stress tolerant crops like tef, chickpea and early matured sorghum varieties. As a result significant number of late matured local crop varieties were abandon from cultivation and threaten to lost. According to respondents in the study area, substantial number of sorghum and tef varieties used to be grown were abandon and some of them were also threated to lost. Out of eighteen varieties of wheat used to be grown in the study areas, only five of them were found under cultivation whereas twelve barley varieties were identified grown in the area but only three of them were growing now. Nine sorghum varieties were used to be grown but now only five of them were found under cultivation as a result of climate induced changes. Similarly, among eight, three and two tef, maize and chickpea varieties used to be grown four, three and one of these varieties are growing now respectively in the study area (Table 3, 4).

Respondents indicated that sorghum (*Tsemam Degalit* and l*ekua*), tef (*Magna, white, tafhagay*) maize (White and e*mewaysh*), Wheat (*Black, Ares, Zegaybeleo, Tomeyadane, Dekotsa*), Barley (Rea), Chickpea, Faba bean, Field pea (Red), Lentil, *Dekoko* and Linseed crops were used to be grown and growing now in the study area were decline significantly in terms of area covered and total production over last ten to twenty years. The major factors responsible why reduced in production of these crops were due to recurrent occurrence of drought, uneven distribution of rainfall, moisture deficit at critical growing periods, reduction in amount of rainfall received, late onset and early offset of main rainfall, strong wind causes desiccation of water in plant, late maturity nature of growing crops, high temperature, small landholding, soil fertility decline, inherently low yield potential of crops, outbreak of pests, hailstorm, soil erosion during critical sowing and growth stages. On other hand, respondents indicated that types of important crop varieties to be growing in future will be sorghum (*Hodem, Matie, Gorid, Jagrte, lekua*), tef (Improved tef and *Bunign*), improved wheat, *saesea* barley, lentil, *dekoko* and white field pea to cope with climate induced weather changes. The above mentioned crop varieties were resilient to climate induced changes is due to earliness, tolerant to moisture stress, drought escaping, utilizing existing moisture effectively and tolerant to high rainfall variability.

Weather Variability, Local Variety Conservation and Genetic Erosion: IPCC (Intergovernmental Panel on Climate Change) projection indicated that climate change, seasonal rainfall variability and occurrence of extreme weather events affect agricultural production and local variety conservation [10] On farm conservation of local varieties are depends on rainfall distribution and rain rules normal functioning of conservation practices and crop preference to be growing in study areas. Climate induced weather change determines whether enough moisture will obtain and provide suitable conditions for cultivation and conservation practices or works against. Indeed, dependence on erratic and short intensive rainfall has predominantly contributed to crop preference to be growing and farmers were faced challenges in keeping of high yielding late matured local varieties.

Table 3: Identified local crop varieties used to be growing in the study area over the past ten to twenty years?

Wheat	Barley	Sorghum	Tef	Maize	Faba bean	Field pea	Chickpea	Lentil	Grass pea
Dashin	Atona	Jagrte	White magna	America (Red)	Local • Abiy • dekik	White	Black and red	Local	Local
Hidase	Saesea	Tsemam Degalit	Bunign ‣ Red ‣ White	White	Improved	Red	Improved		
Sheye	Atona	Gededom	Tukirweleda	Bunign		Improved			
Tomeyadane	Sheye	Hodem	White	Limo (abiy)					
Zegaybeleo	Barfenchi	Matie	Cross-37	Fetino					
Black	Saesea	Gorid	Red	Emawaysh					
Abetiye	Hagos	Baro	Jawe						
Dekotsa	Rea	Jeru	Tafhagay						
Humera	Black	Chibtie	Taftsidiya						
Ares	Ziwno	Lekua	Sergen						
Gande	Kinchibe	Jamuye							
Lilay	White								
Kerzeze									
Mekelle 1									
Mekelle 2									
Kibebe									
Danfe									
Global									

Sources; own survey result of 2018

Table 4: Local crop varieties found growing presently in the study area

Wheat	Barley	Sorghum	Tef	Maize	Faba bean	Field pea	Chickpea	Lentil	Grass pea
Dashin	Atona	Gededom	Bunign	Red	Local	white	Black and red mixture	Local	
Hidase	Saesea	Jagrte	Cross-37	White	Improved				
Danfe	Ziwno	Matie	Magna	Bunign					
Global		Baro	biset	Fetino					
Kibebe		Gorid	White Bunign	Limo					

Sources; own survey result of 2018

The seasonal and annual average rainfall distribution has been decline significantly while average seasonal temperature over last decades has been increased. The study area was characterized by diverse topographic features and received most erratic rainfall, experienced recurrent natural hazards such as drought, sudden flood and moisture stress that exacerbated genetic erosion.

In response to different degree of weather variability, households adjust composition of productive and nonproductive assets to minimize production risks. Respondents were forced to select type of crops growing in the field and abandons varied crop varieties used to be grown in area due to climate induced weather changes. Selecting of crops used to be growing in area during main season was an important indication to understanding crops responsiveness to seasonal and annual rainfall variability. Thus, genetic erosion has been seen mainly on late mature crop varieties due to main season rain was concentrated into solid one month. It threatens strategic reservoirs of crop genetic resources which assisted to release needed varieties that adapt future challenges of production. In addition, future crop improvement for high yielding and abiotic tolerant will be in question unless drastic measures will not take to reverse it. Refining steps taken to ensure adequate conservation and proper use of crop genetic resources for food and agriculture is not the job left to be done for tomorrow.

Extreme Weather Events and Local Livelihood Impacts: The impact of climate change induced extreme weather changes is manifested in all countries of the globe but developing countries are more vulnerable to these extreme events and disasters as they own inadequate resources to adapt [11]. Climate induced weather changes indicated it

Table 5: Trends of crop production over the last ten to twenty years in the study area

	Average yield in quintal		
Crop type	Past 10-20 years	Currently 2017/2018	Percentage of yield reduction
Wheat	25.04	18.59	34.70
Barely	26.15	18.28	43.05
Tef	23.32	11.00	112.00
Sorghum	55.05	31.98	72.14
Maize	38.30	20.35	88.21
Faba bean	23.36	15.7171	48.63
Field pea	19.28	13.17	46.39
Lentil	11.69	7.54	55.04
Chickpea	25.00	14.25	75.44
Grass pea	20.00	12.00	66.67

Sources; authors calculation based on survey result of 2018

Table 6: Trends of average animal holding per-capita over the last ten to twenty years in the study are

	Average number of animals		
Animal kind	Ten to twenty years	Currently (2018)	Percentage of destocking
Ox	2.44	1.75	39.43
Caw	4.11	2.3	78.70
Sheep	7.31	4.99	46.49
Goat	2.84	1.9	49.47
Donkey	0.71	0.63	12.70
Chicken	3.76	4.32	-12.96

Sources; Authors calculation based on the survey result of 2018

will fundamentally alter patterns of crop production across the globe [12]. The projection by IFAD [13] indicated that rain based crop yield will drop by 50% by 2020 and net revenue obtained from crops will also drop by 90% during same period due to adverse climatic impacts. The socioeconomic consequence of climate change resulted adverse changes in income, price, food markets, trade and investment patterns. It reduced farm level output, physical capital, capital to investment and forced farming households to sell productive assets to compromised income shocks.

Respondents were asked to indicate how severe the yield loss was because of changing in weather and their response were summarized below (Table 5). The analysis result indicated that (112.00%) of average higher yield loss was recorded with tef and 88.21% with maize over last ten to twenty years compared to actual production obtained during current year. The third higher yield loss (75.44%) was recorded with chickpea and followed by sorghum by loss of 72.14% of yield obtained over last ten to twenty years. Similarly, 66.67% and 55.04% of yield loss were recorded with grass pea and lentil due to climate change induced weather variability in the study area. The lower yield loss (34.70%) was recorded with wheat where 43.05% with barley compared to other crops growing. The most reduction in yield was obtained with long cycle crops which suffered most with inter-seasonal moisture stress. Severe reduction yield affected socioeconomic situation and food security status of local communities. Thus, it was perceived that climate induced weather change has caused significant damage on their asset and livelihoods.

The study area was known as animal production and was suitable for herd management. However, increasing in deforestation, area closure, introduction of cut carry system, increased in net cropped area and long year leasing of forest areas to investors affect herding quantity. Respondents were asked to indicate number of animals used to be owned over last ten to twenty years and currently available and their response was summarized as below (Table 6). The analysis result indicated that higher destocking (78.70%) was recorded with caw and followed by goat with losing of 49.47% owned per capita. The lower destocking 12.70% was recorded with donkey while only increasing in herd (12.96%) was recorded with chickens. The carrying capacity of existing communal grazing lands was not supporting quantity of herds as per farmer wishes and exacerbated with climate induced droughts that caused feed shortage.

Climate Change and Land Suitability for Farmers Varieties: The dominated cereal and legume production system in the study area was affected by increasing temperature, moisture regime and days to attain physiological maturity. The average increment in daily temperature during main growing season would affect moisture holding and supply power of the soil and hence shorten length of growing period. Respondents also indicated that there was clear negative yield responses of cereals and legume crops due to increased growing season temperature and seasonal disturbance ofrainfall. At large scale, long cycle crop varieties exhibited susceptibility to past warming conditions with less vulnerability to early matured crop varieties. The study area was identified as most vulnerable districts to past climate induced extreme weather events for multiple crop production schemes.

Farming households considered importance of changing long maturing crop variety with early maturing types which they taken as coping mechanisms to climate induced risks. The low land plains of the study area was once known with dense natural forest cover but conversion of natural vegetation and unused lands into farms enhances net cropped area while conversion made to increased cultivated land caused a loss of suitable crop lands. The conversion of natural vegetation cover for farm land purpose has numerous effects on bio-geophysical and biogeochemistry process that directly influenced local climate. It affects condensation process which may have an impact on amount of rainfall received, contributed in increasing surface temperature and enhances desertification process at low land plains of the study area.

CONCLUSION

The study was conducted in two purposively selected districts of Raya Alamata and Ofla districts of Ethiopia. It was understood that number of rain days was shrink significantly and started to affect cropping season negatively. It was further described that how climate induced weather changes affected crops and based on farmers' perception some of induced stresses were interruption of sowing time, land preparation and causes soil erosion, siltation sand on farm, stunted growth, wilting and water deficit at crop critical periods, eventually it matters overall productivity and profitability of crops. Selecting of crops to be growing in the area during main rain season were an important implication emerged from understanding of farmers to crop responsiveness to seasonal and annual rainfall variability. It is required to reverse and halt unsustainable use of natural resources and implementing effective natural resources conservation activities unless it will threat future we want and present life we lead. Therefore, based on obtained result further additional works are required to disseminate information and technology.

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