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Diversity and Resilient Varieties of Enset for Climate Change Adaptation: The Case of Different Agro-Ecological Zones of Hadiya, Southern Ethiopia

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Abstract

The objective of this research was to assess diversity and resilient varieties of enset and its contribution in climate change adaptation. Household survey and biomass measurement were conducted to collect primary data from the field. More than fifty five (55) landraces of enset were found in the different AEZs. Among the identified landraces Ginbo, Gishira, Disho, and Siskella were assessed as resilient varieties. From the ShannonWeiner Diversity Index, the w/dega (3.86) had more diverse enset landraces than dega (3.85) and dry w/dega (2.79). The survey analysis shows that most respondents opted for enset crops to grow at the time of stress period than other annual crops. According to the survey from the household, enset crop was drought resistant and it could survive long time without enough rain and water. The overall output from the research showed that enset has contribution in adaptation to climate change and variability.

Keywords: Adaptation; AEZs; Climate change; Enset; Landraces

Introduction

The IPCC defines climate change adaptation as 'adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities' [1]. In general words, it refers to all those responses to climate change that may be used to reduce vulnerability or susceptibility to harm or damage potential [2].

Traditionally, farmers use biodiversity such as diverse crops, trees and wild plant species, livestock and aquatic species to sustain their livelihood from climate change [3,4]. This use of diverse species and varieties enhances their adaptability and resilience capacity to changing environmental and economic conditions. Genetic diversity is a key element in farmers' livelihood strategies particularly in areas under high ecological, climatic and economic stresses and risks [4].

Ensete venticosum is also a drought resistant crop and is considered as a crop of bad times [5]. It is a monocot perennial crop that belongs to order *Schistaminae*, family *Musaceae* and genus *Enset* [6]. Genus enset has different species, but there is some ambiguity regarding their numbers. However, all authors agree that *Ensete ventricosum* is the only cultivated species in Ethiopia. It looks like a large, thick single stemmed banana like plant [7]. Usually it is larger than banana and 6-12 meters tall. Enset cultivation can be restricted to altitudes ranging from 1600-3100 m.a.s.l [8]. But according to Brandt et al. [9] it grows best at elevation between 2000 and 2750 m.a.s.l with an annual rainfall of 1100 mm to 1500 mm.

Enset (*Ensete ventricosum*) is a sustainable indigenous crop that uses to ensure food security in different parts of Ethiopia. For instance, the northern town of Lalibela was the site where thousands of people died as a result of the mid-1980s famine. Then, they expressed interest in learning to cultivate and process enset for food as a means of increasing food security [9] and coping mechanism. Cultivation of this crop can significantly improve livelihood by maintaining food security in household and national level. This is one of major crop on which Ethiopia depends for food security. It is a major crop for more than 20% of peoples in Ethiopia. It is grown largely for security reasons, if cereal crops fail and eaten in the form of kocho and hamicho [9].

The study area

Hadiya zone is one of the zones of southern nations, nationalities and peoples region. It is situated roughly at the margin of the great Ethiopian Rift Valley at western margin in north western part of SNPPR. It located between 7°07'- 7°92'N and 37°29'- 38°13'E. The zone bordered in East and North East with Alaba Special Wereda and Siliti Zone, respectively. In the North it bordered with *Kembata Tembaro*, in the South East it is bordered with Oromiya region. Currently, the zone has ten Weredas/districts and one Town administration. Hossana is the capital city of the zone and it is 232 km from Addis Ababa.

Based on simplified agro - climatic classification of Ethiopia, Hadiya Zone lies in three agro- climatic zones having total area of 346958.5 ha. The highlands are temperate and cold climate (are locally called *Dega* or *Hanswa* ranges from 2500-3200 m.a.s.l), midland (warm or locally called *Woinadega* or *Hansw kaala*–ranges from 1500 to 2500 m.a.s.l), and lowland are hot and arid (also called *Kola* or *kaala,* ranges from 500 to 1500 m.a.s.l) each comprising 23.7%, 64.7% and 11.6% of the land area, respectively. According to the work of MOA and Alemayehu [10,11] the sampled districts were classified as *dega* and *woina dega* for Misha and Lemo respectively. But the third sampled district was called Shashogo; it can be classified as *dry warm* or *dry woina dega.*

Material and Methods

Household survey

This study was conducted in Hadiya zone. It contains ten districts and one city administration. Of these three districts namely *Misha, Lemo* and *Shashogo* districts were selected using non probability sampling methods, and the rationale behind the selection was their difference in agro- ecological zones, having meteorological station and being area where enset can be cultivated.

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The households were selected randomly from the selected kebeles depending on population size by applying the formula suggested by Yamane.

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

Where: n- the sample size,

N- The population size, and

e- The level of precision (±7)

According to CSA (Central Statistics Authority) [12] the total household numbers of the eight kebeles were 4668 as reported by Samia. Depending on this data, the researcher calculated the sample size based on Yamane's formula, and got 194 target populations. But only 145s were taken as total sample size, this was due to the absence of enset farm in all registered house hold. Specially, in Shashogo district the number of households with enset farm was very low. The survey was conducted in the local language, Hadyisa.

Key Informant Interview/KII

By using purposive sampling techniques the researcher identified some key informants from different field of experts and farmers. Hence, a good interview and discussion was held by allowing a lot of time, mainly on climate related hazards in different zones of agro-ecology by relating with enset. All the interview and discussion were recorded by tape recorder, in order to minimize the time spent and information loss.

Field observation

Field observation was conducted at all areas of where household survey was held. Part of enset sample and photographs were taken to cross check the variety of enset and to illustrate some of activates in the field. The enset landraces were collected from the household in the form of interview. And it was crosschecked by direct observation and photographs. It was analysed for diversity in each AEZ by using Shannon index (H'). This formula is listed below.

$$H' = -\sum pi \ ln \ pi$$

H' = Shannon index

Ln = natural log (ln) of that number

pi = is the relative abundance of landraces "i" in the AEZ

Results and Discussion

Diversity and resilient varieties of Enset

During the survey, different landraces of enset that collected from the household in each agro-ecological zone were analysed and crosschecked intensively to reduce redundancy. Its numerous landraces differ with respect to morphological characters (leaf, midrib, petiole and pseudostem colour), use value (*kocho*, corm and fibre), quality of products, maturity period, vigour and reaction to bacterial wilt [13,14]. Many studies have used variety names to identify diversity on farm with crop species that farmers can recognize as diversity [15]. These lists are summarized in Table 1 below.

Some varieties of enset shown above are similar with the result indigenous production methods and farmer based biodiversity in major enset-growing regions of southern Ethiopia [13]. As it can be found from the household survey some varieties of enset were resilient and some others were vulnerable to climate change (Table 2). Farmers' strategies in this study area were to select and grow many different varieties like *Ginbo, Gishira, Disho and Siskella* (Table 2).

Discussion

Only those resilient and vulnerable varieties reported by more than 27% and 10% respectively are shown.

At the time of stress, the resilient varieties of enset were preferred by many farmers than the vulnerable varieties in order to cultivate in their farms. This might be because of the drought resistance and productive characteristics of varieties. Additionally, these resilient varieties of enset commonly were grown in the three sampled AEZ.

As indicated in Table 1 the landraces of enset were generally so

No	Vernacular name	Dega	w/dega	dry/w dega
1	Agade	30	35	5
2	Zobira	19	21	6
3	Gishira	25	33	10
4	Qiniwara	29	31	0
5	Orada	25	28	0
6	Tegadada	0	15	0
7	Xorora	33	35	8
8	Separa	30	36	3
9	Hiywona	29	34	5
10	Moche'e	35	29	0
11	Keseta	19	20	1
12	Disho	33	30	7
13	Ginbo	31	37	5
14	Astera	21	26	2
15	Bedade	18	24	0
16	Shirafira	20	0	0
17	Shate	19	5	0
18	Siskella	25	35	6
19	Unjema	24	34	5
20	Ado'o	20	0	0
21	Uskurusa	19	27	0
22	Benja	23	29	2
23	Tabute	27	21	0
24	Gozoda	30	33	0
25	Hinuwa	31	35	1
26	Kombotira	19	29	0
27	Woshameda	21	25	0
28	Oniya	29	22	3
29	Kd. awnoda	21	23	0
30	Ka. awnoda	25	27	0
31	Mekel wesa	15	13	3
32	Qashqeshiya	13	10	0
33	Hinba	10	9	0
34	Geriye	13	17	2
35	Dirbo	11	21	0
36	Lechee	13	21	0
37	Quina	15	19	1
38	Abat merza	17	10	0
39	Bekucho	10	9	1
40	Shatadena	7	17	0
41	Mesmesicho	21	12	0
42	Merza	20	20	0
43	Amonda	10	13	0
44	Sokido	13	17	0
45	Manduluka	10	20	0
46	Menere	11	23	0
47	Kekara	5	7	0
48	Bokessa	7	13	0

49	Bosora	14	19	0
50	Wocereda	18	21	3
51	Mushawessa	5	11	0
52	Lendere	9	13	0
53	Buchame	3	7	0
54	Shetatena	0	5	0
55	Jajer iqee	0	7	0

Table 1: Frequency of enset landraces in different agro-ecological zones of Hadiya zone.

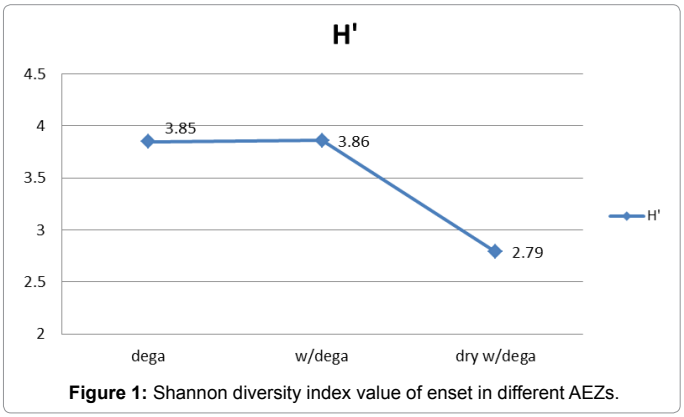

Figure 1: Shannon diversity index value of enset in different AEZs.

No	Resilient varieties	N	% response	Vulnerable varieties	N	% Response
1	Ginbo	30	42.85	Xorora	20	28.56
2	Gishira	20	28.56	Agade	11	15.71
3	Disho	20	28.56	Beneja	8	11.42
4	Siskella	19	27.14	Zobira	7	10

Table 2: Resilient and vulnerable varieties of enset according to local farmers account (N70).

No	AEZs	N	Values
1	Dega	50	0.465 ± 0.29019[a]
2	W/dega	70	0.4064 ± 0.15901[a]
3	Dry w/dega	25	0.0948 ± 0.03212[b]
*Mean values with the same letters across the column are not significantly different at α = 0.0			

Table 3: Mean values (±) SEM of enset farm size in different AEzs.

No	List of parameters related to CRH	AEZ		
		Dega	W/dega	Dry w/dega
1	Frequency of occurrence of CRH per year	1	1	2
2	No. of affected kebeles per year	2	2	6
3	No. of affected HH per year	22	16	138
4	% of relief users per year	28%	27%	45%

Table 4: Frequency of CRH, % of rapid relief users, No. of affected kebeles and household per year in AEZ.

diverse but the diversity was not the same in the sampled AEZs of the study area. Based up on the survey, vulnerable varieties could also grow in the same area but in limited number. Accordingly, the diversity was calculated by Shannon Weiner diversity Index (H'). It showed that 3.85, 3.86 and 2.79 for *dega w/dega* and *dry w/dega* AEZ, respectively (Figure 1).

Based upon this index the *w/dega* (3.86) had more diverse enset landraces than *dega* (3.85) and *dry w/dega* (2.79). This is probably for the reason that *w/dega* had both *dega* and *dry w/dega* agro-ecological characteristics. But highest number of varieties per household was identified in *dega* than the other zones. This shows that the enset growing area has high adaptation capacity than the limited growing area. This result is in agreement with the work of [16]. The use of genetic diversity can help to enhance the resilience of natural system to buffer against possible risk [16].

Diversity is important because it provides source of genes to crops to adapt to change in climate [16]. In the household level, the average enset farm size covered by enset crop was not the same in the sampled AEZs. Table 3 shows that, the mean enset farm size in each household was 0.46 ha and 0.4 ha in *dega* and *w/dega* respectively.

However, their difference was not significant at (P<0.05) level. But the *dry w/dega* was significantly lower than the others AEZ at (P<0.05) level. This might be because of unfavourable condition to all varieties of enset and farmers' low awareness on cultivation and harvesting it.

According to the data collected from the Hadiya zone agricultural office, in the past five year different climate related hazards were recorded. Flood, drought, erratic rainfall/hailstorm and natural fire were some of the hazards that occurred. The frequency and types of hazards were different in each AEZ. The secondary data revealed that in average the hazard could occur two time per year in *dry w/dega* but probably one times per year in other AEZs (Table 4). Yearly, in average 138 households in *dry w/dega* AEZ could be affected due to those hazards. Of the three AEZs of rapid relief users, about 45% could be from the *dry w/dega* AEZ (Table 4). The vulnerability of the AEZs might depend on the enset cultivation. This might implies that no enset growing area has low adaptive capacity than the growing area.

Conclusion and Recommendations

Enset was found to be an option of adaptation to climate change and variability in the study area. It has above 55 local varieties, this diversity is important to enhance the resilience of enset to buffer against possible risk and adaptation to climate change.

From these the varieties *Ginbo, Gishira, Disho* and *Sisqella* were resilient to climate change and variability, but *Xorora, Agade, Beneja* and *Zobira* were assessed as vulnerable to the change. Adaptation capacity of the highly enset growing area could be higher than low enset growing area. Food insecurity can be recognized as one of climate change consequences but people in this enset growing area are coping by using enset and its production.

Enset landraces are so diverse and some of which are resilient to climate change. Therefore, an urgent further study should be conducted on its status, resilience and potential on environmental sustainability; as well as providing institutional and policy support to continue growing landraces and their use in plant breeding.

References

1. IPCC (2007b) Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK.
2. Burton I (1992) Adapt and thrive. Downs view, Ontario: Canadian Climate Centre, Canada.
3. CBD (2008) Climate change and biodiversity. Date accessed: May 2, 2015.
4. Sthapit B, Padulosi S, Mal R (2010) Role of on-farm/in situ conservation and underutilized crops in the wake of climate change. Indian J. Pla Gen. Res.23: 145-156.
5. IIRR (2007) Leaving disaster behind: A guide to disaster risk reduction in Ethiopia. International institute of rural reconstruction, Nairobi and save the children USA, Addis Ababa, Ethiopia.

6. Cheesman E (1947) Classification of the banana. The genus Enset. Horan. Kew Bulletin. 2: 97-106.
7. Admasu T, Struik P (2001) Enset (Ensete ventricosum (Welw.) Cheesman) kocho yield in different crop establishment methods as compared to yield of other carbohydrate rich food crops. The Netherlands J Agri Sci 49: 81-94.
8. Westphal E (1975) Agricultural systems in Ethiopia. Wageningen Agricultural University, The Netherlands.
9. Brandt SA, Spring A, Hiebsch C, Mccabe ST, Endale T, et al. (1997) The 'Tree against hunger'. Enset-based agricultural systems in Ethiopia. American Association for the Advancement of Science, Washington, D.C.
10. MOA (2000) Agro-ecological zonation of Ethiopia. Ministry of Agriculture, Addis Ababa, Ethiopia..
11. Alemayehu M (2006) Country pasture/forage resource profiles of Ethiopia. FAO, Rome.
12. Samia Z (2007) Population and housing census report. Central Statistics Authority, Addis Ababa, Ethiopia.
13. Admasu T, Struik P (2002) Analysis of Enset (*Ensete ventricosum*) indigenous production methods and farmer based biodiversity in major enset-growing regions of southern Ethiopia. Expl Agric.38: 291-315.
14. Jarvis D, Anthony I, Brown D (2008) A global perspective of the richness and evenness of traditional crop genetic diversity maintained by farming communities. Proceedings of the National Academy of Sciences, USA.
15. Hajjara RD, Jarvis I, Gherene B (2008) The utility of crop genetic diversity in maintain ecosystem services. Agriculture ecosystem and environment.
16. Bhandori B (2009) Summer rain fall variability and the use of rice (*Oryza sativa* L.) varietal diversity for adaptation: Farmer perception and response in Nepal. M.sc. thesis. CBM Swedish Biodiversity Centre, Nepal.