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Full Length Research Paper

Diverse Staple Crop Use Knowledge by Traditional Farmers Maintain its Genetic Diversity in Gozamin District, Amahara Region, Ethiopia: Implication for Farmer's Landrace Conservation

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Abstract

The study was aimed at documenting indigenous use knowledge of staple crops in their farming complex to improve livelihood and maintenance of local crop genetic resource. Six peasant associations (PAs) were selected based on altitude range in between 1500-3200 meter above sea level at which many crops can grow. Sixty household heads (10 females &50 males) were systematically selected from 120 household heads having well established home garden and farm fields. Ten key informants from the 60 household heads were involved in the interview to collect in depth information. The data were collected using semi- structured interviews, direct field observation, group discussion market survey, preference ranking and use value. Simple descriptive statistics were used to analyze the information collected from informants. A total of 21 different staple crops distributed in to 4 different families (Poaceae 11 (52%); Fabaceae 7(33.33%); Asteraceae 2(9.52%) were found from the identified farming zones. These crops were further classified in to Cereals, pulses, oil crops, vegetables and fruits. Preference ranking on major cereal crops for making 'Injera' and use value of 8 farmer variety of Hordeum vulgare were analyzed. Knowledge based traditional practices like selecting the soil type, improving the fertility of soil, determining time of sowing, obtaining planting materials through different methods, seed storage techniques, weed and pest management, mixed cropping, perception about exotic seed and their effect s were considered to look farmers diversified knowledge in their farming system. All these activity contributes maintenance of crop genetic diversity in the study area.

Key words: *Gozamin district, staple crop, livelihood, landrace.*

Introduction

Ethiopia is one of the world's eight major centers of crop diversity (Vavilove, 1997) and like many developing countries depends up on its rich biodiversity for its socioeconomic development (Yigardu Mulatu, 2005). Ethiopia is the home of amazing system of indigenous knowledge that helped the people survives under adverse environmental conditions, famine and poverty (Amanuel Assefa and Tesfahun Fanta, 2006). Farmers in Ethiopia manage their cropping system with considerable indigenous skill. For millennia, they have been the generators and curators of the rich assemblage of crop biodiversity under their custodian ship (Shewaye Deribe *et al.,* 2002).

Crop cultivation started early in Ethiopian civilization, with the domestication of new and unique crops from the field and forest (Harlan 1969). Some of these are grown nowhere else, among them *Eragrostis tef* dominantly cultivated in the study area. Cultivated or domesticated plants or plant species that have arisen through human action, such as selection or breading and that depend on management for their continued existence (FAO, 1999) also included in this domain.

Farmlands and homegardens were place of cultivated plants in the study area. The collection of useful plants and animals around homes must have gradually led to small scale plant and animal husbandry, whose continued intensification resulted in the emergence of full-scale agriculture in gardens and fields (Zemede Asfaw and Ayele Nigatu, 1995). According to reports made by ethnobiologists (Martin, 1995; Posey, 1999) modernization is dominating the life styles of traditional society resulting in cultural and environmental changes. Consequently, the indigenous knowledge vital to sustainability is being lost at an incredible rate. A decline in the transfer of indigenous botanical knowledge cause not only loss of the knowledge and skill of planting, but also the plant themselves will be irreversibly lost as a result such studies were highly required to devise a solution before the farmers land races were lost

Materials and Methods

Study Area

Gozamin District is one of the 18 Districts in East Gojjam Zone and 151 Districts in Amahara National Regional State. It is located 10^0 36' 18" N and $37^0$55' 02" E with an altitudinal range 1000-3500 meter above sea level. The 10 year data taken from the nearest weather station from 1999-2008 year was indicated that the mean annual maximum and minimum temperature records of the study area were 26°cand 8.6 °c respectively, whereas the mean annual rain fall distribution is 1342 mm. The District has a population size of 133,656, of which 66,875 males and 66,981 female: 2,583 (1.93%) of the population are urban dwellers which is less than the Zonal average of 9.88 % (CSA, 2007), more over with an estimated area of 1,218.07 square kilometer, it has an estimated population density of 109 people per square kilometer which is also less than the Zonal average of 179.96. The ethnicity of the District population is Amhara and Amharic is every body's language. sedentary rain feed agriculture is practiced and the economy of the people primarily based on mixed cereal agriculture with the farmers growing tef, finger millet, sorghum, maize, barley, wheat, as well as pulses, oil crops, vegetables and fruits. Due to high anthropogenic effect in the study area, forests have been lost but remnant plants around holy places, inaccessible areas, and left for shade trees and on grazing lands are observed. Some of the vegetation's are *Juneperus procera, Hagenia abyssinica, Podocarpus falcatus, Acacia abysinica, Cordia africana, Ficus sycomorus, Erythrina brucei, Eucalyptus camaldulensis, Calpurnia aurea, Prunes africana, Carissa spinarum, Rosa abyssinica, Dombeya torrida and Maytenus arbutifolia.*

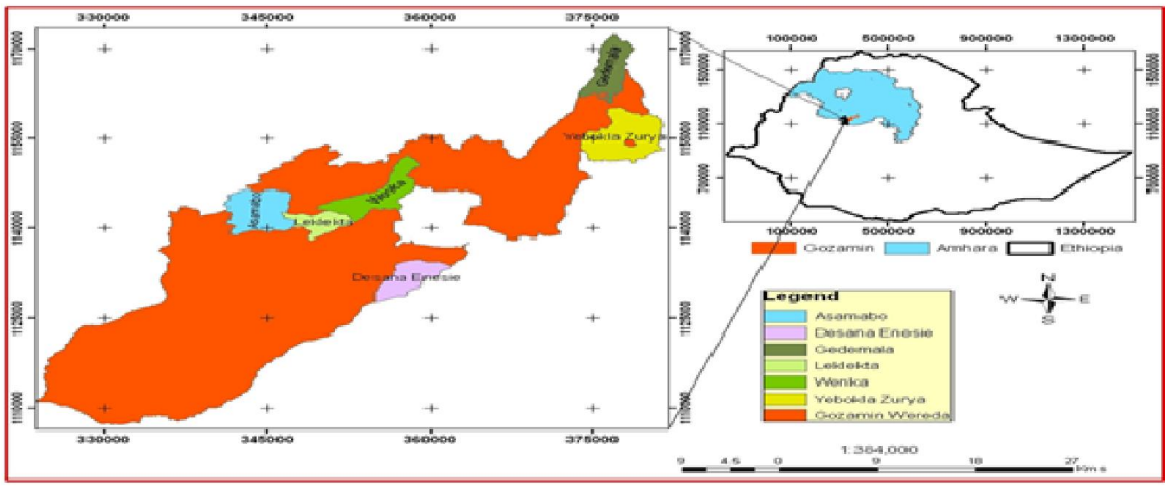

Fig 1: Map of the Study area showing the sampling sites.

Methods

The District was selected purposely due to its diverse altitude range of 1500- 3200 meter above sea level to see different farming activities. Six PAs were selected from 26 PAs after stratified in to agro climatic zone. Two agroclimatic zones were selected and different crops were properly grown at its genetic potential. The elevation ranges from 1500-2300 meter above sea level was considered as Weyna Dega agroecology whereas 2300-3200 meter above sea level was considered as Dega agroecology. The study sites were Dessana Enessie, Leklekita, Assamaboo and Wenkap as that represents the Weyna Dega agroecology and Yeboklazuria and Gedemalla PAs represent the Dega agroecology. Crops grown at two sites of farming zone, i.e., home garden and farm fields were considered in this study.The name of the household leaders having well-established cultivated plants in and around homegarden and representativeness of the main cropping agro ecological zone of the District were alphabetically listed and equal proportion of informants totally 60 house hold leaders were selected systematically. From 60 household heads, 10 key informants or local experts' i.e. local people who possess and share a profound indigenous knowledge of a particular aspect of local culture were selected.

A semi-structured data collection tool was administered containing open and close-ended questions. Different data on crop use knowledge and management of staple crops found in and around home garden as described in Martin (1995), Alexiades (1996) and Cotton (1996) were collected. The techniques were group discussion, semi-structured interviews, field observations, preference ranking and direct matrix ranking. Preference ranking was used to rank cereal crops for making 'Injera'. Market survey was conducted at four major markets in the District. From the market, all types of crops were collected by asking the source where the grains were cultivated from the study district. In general market survey gives a clear image or mind map about the District food crops and other product of plants that have market utility. The plant use value was determined to evaluate the importance of each plant species to the ethnic people and was calculated as the average of the use value of the species. This methodology was used to analyze eight (8) *Hordeumvulgare* varieties collected in the study area.

Results

Emic categorization systems and practices in the study area

The local people of the study area have local categorization techniques that focus on various environmental components including soil, land, vegetation and season.

Local categories of soil and preferred stable crops

Local categories of soil by informants have their own peculiar cropping seasons. The local soil types and their cropping season along with descriptions were presented on [Table 1]. The informants were outline soil preference of individual crop in the study area. This was a natural reality; meaning, the type of soil in one area should be the key factors playing a progressive role in determining the productivity and survival of landraces. The same principle applies in specific soil requirements of crops in Gozamin District .The top crop selected by informants and their soil types are as follows. *Hordium vulgare*gre was successfully in ASHALMA AFER (100%),*Triticum* spp. In BOREBORE AFER (96.66%), *Eragrostis tef* in DEBAY AFER (95%) and WALKA AFER(100%) , *Zea mays* in BOREBORE AFER (100%), *Pisum sativum* in ASHALMA AFER (95 %), *Vicia faba* in ASHALMA AFER (91.66%), *Cicer arietinum* in WALKA AFER (100%) and DEBAY AFER (95%). *Sorghum bicolor* in DALCHA AFER (83.33 %) and ASHALMA AFER (80%).

Table 1: List of soil type, its cropping season and descriptions.

No	Soil type	Harvesting season	Description
1	Walka (Dark black Soil)	September	Highly fragile in texture and high water logging ability during rainy season so that people plough this soil after the rainy season.
2	Borenk (White Soil)	-	Non harvestable soil (poor soil)
3	Debay (Black Soil)	August	The soil fragile in texture and also it is water logging
4	Borebore (Red Soil)	June to July 30	Light soil, easily eroded by wind, rain
5	Ashalma (Brawn soil)	July	Heavy soil, well drained and aerated soil relatively fertile
6	Dalcha(White and Red Soil)	June	Very shallow less fertile soil

Farm land Categories and spatial arrangement of plants

The horizontal arrangement of plants were followed certain pattern. The patterns with reference to the living houses were became as follows. Cattles were penned on the dawn hillside of the house and a channel was cut in the ground to take the urine and droppings out and dumped to the nearest side yard. Zone A, B, C and D in the sampled study sites were considered as Guaro (home garden). The last zonation was considered as Massa (farming fields) mainly cereals, pulses oil crops and trees that constitute the agroforestery system were present. The farming fields (Massa) and home gardens (Guaro) were separated by live fences at which multipurpose plants mainly cultivated.

Staple food crops

Due to wide range of agroecology of the study area i.e., in between 1500- 3200 meter above sea level, many crops were grown. The ethnobotany of staple food crops that have diversified uses were selected by the ordinary informants and presented in [appendix 1].The crops that have largest number of farmer's variety were presented on [Table2]. Among these, *Hordeum vulgare* was further analyzed by using use value analysis and results 'MesnoGebs', 'DinbuloGebs' and 'WeynoGebs' subsequently have the highest use value in the study area. Particularly Mesno Gebs can grow in a wide agroecology and has the highest use value. The use values of other *Hordeum vulgare* farmer's varieties were presented on [Table 3]. In addition, preference ranking of the major cereal crops for making 'Injera' [Table 4] were indicated that, 'Injera' or pancake from *Eragrostis tef* was preferred from the rest. Besides its rank, ordinary respondents were told that adding the flour of Tef to other cereal crops improves the quality of 'Injera'.

Crop Nutrient management

The preferred soil types were also integrated with traditional soil fertility maintenance. All methods were vitally important for keeping landraces diversities at their home land (on- farm conservation). Lists of widely undertaken soil fertility improvement methods of the study area were as follows. Manuring (100%), Crop rotation (96.66%), Composting especially above ground pile composting (83.33%), repeated deep tillage (65%), Chemical fertilizer (33.33%), Fallowing (3.33%), Cheek dam (16.6%), Terracing (58.33%), Furrowing (33.33%), and Burning of crop residue (23.33%). Soil maintenance methods take the precedence as one of the grassroots practice to run the wheel of plant conservation in the farming system of the study area.

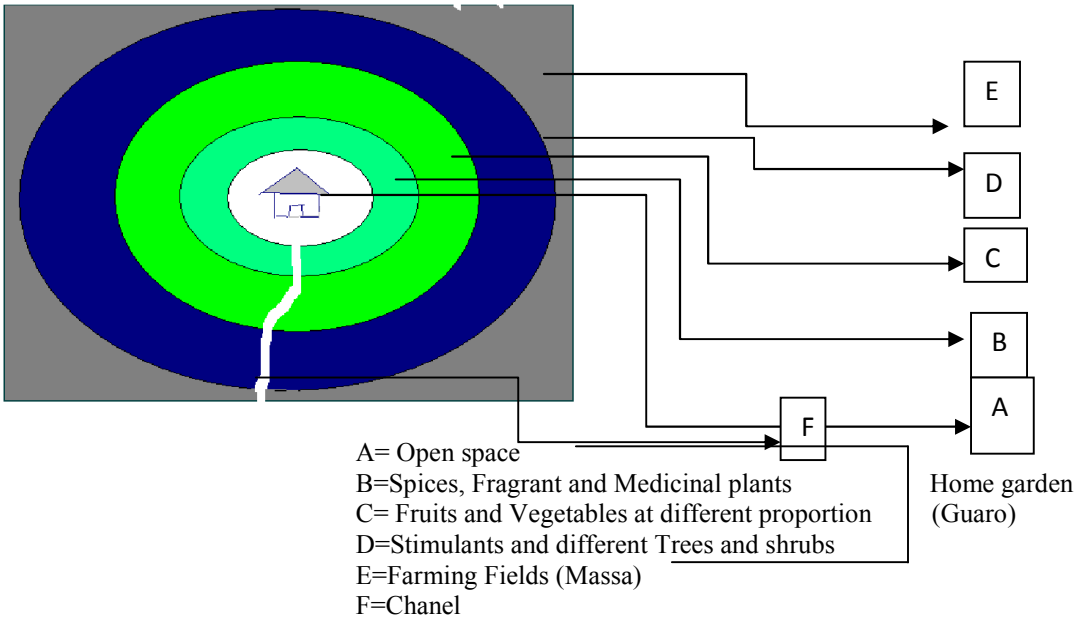

Fig 2: Model showing crop zonation in the farming site of the study area.

Table 2: List of farmers varieties in the study area

No	Name of the species	Farmer varieties	No of respondents	Percentage
1	Hordeumvulgare L.	Mesnogebs	52	86.66
		Weynogebs	35	58.35
		Tkurgebs	48	80
		Temejgebs	50	83.33
		Late gebs	45	75
		Dnbulogebs	37	61.66
		Tkursenefkollogebs	57	95
		Nechgebs	53	88.33
2	*Triticumdurem*Desf.	Aelyassnde	53	88.33
	*Triticumaethiopicum*Jakubz.	Tkursnde	27	45
	Triticumaestivum L.	Mrtesnde	42	70
	Triticumastivum L.	Wasmasnde	36	60
	Triticumaestivum L.	Sidasnde	47	78.33
	Triticumaestivum L.	Bulgasnde	23	38.33
	Triticumturgidum L.	Zenbolelsnde	37	61.66
3	*Eragrostistef* (Zucc.) Trotter	Key tef	60	100
		Bursa tef	60	100
		Nechtef	60	100
4	*Zea mays* L.	Nechbokolo	60	100
		Key bokolo	57	95
		Weynobokollo	30	50

Seed source of staple food crops

Obtaining local quality staple crop seed during each sowing period was mandatory to individual farmers in order to harvest a reasonable amount of production from a plot of land. Irrespective of other environmental, socio economic, political and natural factors, local quality seed by itself determines the quantity and quality of production that is expected to be harvested after the end of every cropping season. Detailed activities are presented below [fig 4].

Table 3: Use value ranking for 8 *hordeumvulgare* L. farmers' varieties

No	Name of farmers varieties	Use of farmers varieties								Total score
		derekot	abshlo	malt	injera	beso	roasted grain	porridge	bread	
1	Mesnogebs	5	3.5	9	7	10	8	10	8	60.5
2	Weynogebs	9	8	6.5	8	6.5	4	6.5	8	56.5
3	Tkurgebs	10	10	8	0	0	3	0	0	31
4	Temejgebs	4	9	10	9	0	0	0	0	32
5	Late or Nechtiegebs	3	5.5	4	5.5	6.5	2.5	5.5	6.5	30
6	Dnbulogebs	6.5	6.5	5.5	9	8	5.5	8	9	58
7	Nechgebs	5.5	4	3	10	9	6.5	9	10	57
8	Tkursenefkollogebs	0	0	0	4	4	10	4	0	22

Note: *Uses were categorized in to three classes, no use, minor use, and major use. The use value scores assigned to these classes were, 0, 0.5, and 1 respectively.*

Table 4: Preference ranking of the top major crops grouped under cereals for making 'Injera'

Name of the crop	Respondents										Total	Rank
	R1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R9	R 10		
Wheat	2	2	1	2	1	4	2	3	3	2	21	5
Barley	5	4	6	5	4	5	4	4	6	5	48	2
Sorghum	3	3	4	4	3	3	3	5	2	4	34	4
Tef	6	6	6	6	6	6	6	6	5	6	59	1
Finger millet	4	5	3	3	5	2	5	3	4	3	41	3
Maize	1	1	2	1	2	1	1	1	1	1	12	6

Fig 3: Number of respondents and traditional staple food seed source in the study area.

Cultural practices in relation to staple crop cultivation

Farmers once obtain the seed they can sow on their farmland and cultivate properly by proper weeding (the major weeds are presented in [Table 5]. Besides this, other technical managements were used, for example, using frightening devices like Scare crew (model of a person that were put in a field in order to frighten birds during sowing time and maturing time of barely, wheat, tef, finger millet, maize, sorghum), slingshots (a Y-shaped stick with a piece of elastic material that can stretch, tied to each side used by children for throwing stone to control the effect of monkeys and birds on crops). After the seed mature especially cereals, farmers collect the crops by cutting the part of the plant that contains the seed and collect it in places where it can be virgin land, far away from other crops or some times in the free space around their home in order to thresh the crop by using animals [fig 4] and separate the seed from straw by using wind. This is a unique practice of farmers in the study area and has been transferred from the experiences of past ancestors and it is another side of traditional farmer agrobiodiversity quality maintenance techniques in Gozamin Districts.

Fig 4: Threshing of stable crop by animals in the study area (photo taken by author).

Weed management

Organic pollutants of *plantiago lanceolata* in *Eragrostistef, Lolium temulentum* in *Hordeum vulgare* and in *Triticum* spp. and *Guizotia shimperi*, in *Zea mays* have been reported by respondents as the major cause of yield lose in the study area with the exception of seasonal insect pests. Some of the risk averting technical or cultural mechanisms were purchasing / exchanging pure seed especially *Eragrostis tef* free from *lolium temulentum* seed were the major management activity practiced by more than 75% of respondents. But the best methods of weed management techniques were applying all methods that can be listed on [Table 5]. The respondents also use more than one management methods for increasing the chance of eradicating the weeds from the farmland.

Table 5: The major weeds and management techniques in the study area.

No	Weeds	Traditional management technique	Number of respondents	Percentage (%)
1	*Plantago lanceolata* L.	Purchasing or exchanging pure seed	46	76.66
		Burning the field after collecting the crop	32	53.33
		Ploughing the field many times by giving a chance for the to grow	39	65
		Hand picking from the field during harvesting	33	55
		Sieving	25	41.66
2	*Lolium temulentum* L.	Obtaining pure seed from any source	45	75
		Wind separation before sowing	27	45
		Hand picking from the field	37	61.66
		Sowing the soil before the soil become muddy	31	51.66
		Sieving	16	26.66
3	*Guizotia shimperie*Sch. Bip. ex	Obtaining pure seed from any source	47	78.33
		Hand picking from the field	34	56.66
		Sowing the soil before the soil become muddy	38	63.33

Seed storage techniques

Indigenous knowledge related to seed storage in Gozamin District is another appealing practice. Farmers are alert enough about how to store seed/grains in safe environment in order to protect its deterioration. This valuable traditional skill of seed storage and preservation technique parallel to other pre-harvest operations made them to be called as 'custodians' of genetic diversity. Selecting of quality seeds for the next harvesting season and maintaining it for long period was mainly by women's in the surveyed study sites so that, women are instrumental for seed conservation and take the precedence in strategies of local crop environmental maintenance in the study area.

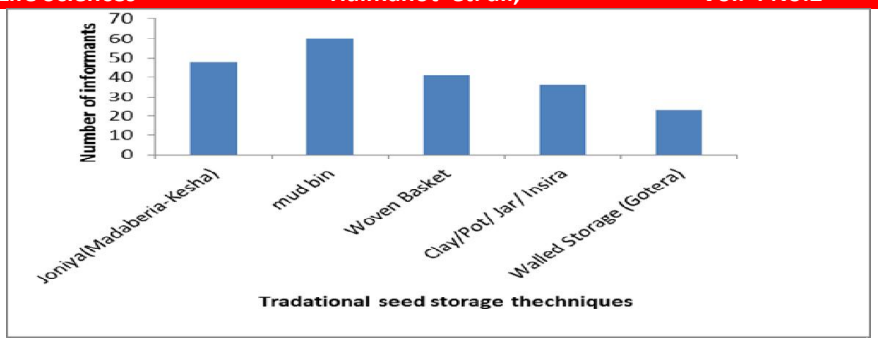

Fig 6: Total number of respondents and traditional seed storage techniques in the study area

Introduction of exotic varieties and loss in diversity of land races

Seed of indigenous crop varieties have the service potential for unlimited number of years unless anthropogenic and natural environmental constraints oblige them to lose this quality. All respondents were confirmed that, yield reduction in local varieties were due to different factors such as deforestation(25%), mismanagement of terracing (50%), low level of fertilizer application (70%), incapability of fallowing (13.33), absence of crop rotation (21.66%), diversion practices (86.66%), impracticality of contour Ploughing (18.33%) and use of already polluted seed varieties (60%). The factors listed by respondents were affected the yield of the existed farmer's landrace. Even though the local people recognize indigenous varieties were magnificently useful as seed for unlimited period of harvesting seasons, the study area farmers were forced to look hybrid seeds for maximum production. Due to this, some of the landraces were in the verge of extinction. In the study area loses of farmers varieties were highly manifested on some crops. The majority of respondents (86.66%) were indicated that, TIKUR SNDE became highly endangered in the area. The rest of the crops that included in the categories were listed on [Figure 5].The hybrid seeds provided by quality seed enterprise to the District farmers were Wheat, maize and tef.

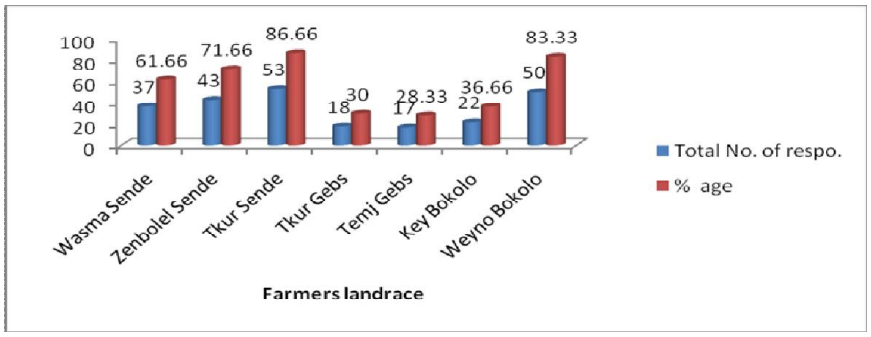

Fig 5: List of Endangered crop varieties and their number of respondents in the study area

Types of introduced (exotic) seed varieties

The high yields of exotic crops were influence the attitude of many traditional farmers especially the young farmer towards cultivation of company hybrid seed varieties. All respondents were said that, the supply and demand of exotic crops in the area can't go side by side. Due to such imbalance and other associated attitudes on exotic seeds, farmers were equipped with diversified cultivation system.

Perception of local farmers towards exotic seed varieties in the study area

The diverse perception [Table 8] were arise towards adaptation, nutritional quality, tolerant to climatic fluctuation, longevity of the seed for storage, considering as a planting material, multipurpose functionality and quantity of yield per plot of cultivated land.

Table 6: Perception of local farmers towards exotic species.

No	Perception towards exotic seed varieties	Number of respondent	Percentage (%)
1	I do not like totally exotic seed verities	13	21.66
2	I like exotic seed varieties and do not care about local varieties	17	28.33
3	I like exotic seed varieties but take care about local varieties	41	68.33
4	The local and exotic seed varieties served the same function if they are equally provided fertilizers.	15	25
5	I accept exotic seed as a seed source if and only if its product is greater than the local variety (Yield dependence)	25	41.66

The impact of introduced seed varieties on indigenous farming practices and welfare of the community

When farmers were tried to saw exotic seeds instead of local varieties, production, multiplying, managing, consuming and conserving practices were ultimately changed. This change brings about a change in culture of farming practices and traditionally experienced food-processing techniques. In the study area farmers recognize changes like poor pest resistance (45%), have no good test during eating (25%), high degree of fertilizer application (81.66%). Other impact of exotic varieties on indigenous farming system can also be presented on [Table 7]

Table 7: Impacts of introduced seeds proposed by respondents in the study area.

No	Peoples attitude towards exotic crops	Number of respondents	Percentage (%)
1	Their longevity is very short	45	75
2	It needs extreme weeding	40	66.66
3	Needs fertilize and selective soil type	49	81.66
4	The seed can't resist effect of pest during storing	27	45
5	Lose of land race	39	65
6	Have no good test during eating	15	25
7	Can't tolerate climatic fluctuations	12	20

Reason of local land race extinction and threatening

Many factors are involved largely in threatening and extinction of several farmer varieties as it was explicitly discussed by the respondents. The factors listed by the respondents were posed a meaning full and an over whelming impacts on the survival and multiplication of the local genetic resource of the study area. According to the respondent's feedback people's preference to exotic varieties (86.66%) and land shortage (81.66%) were the main landrace extinction and threatening factor contribute a significant impact. Others were presented on [Figure 6].

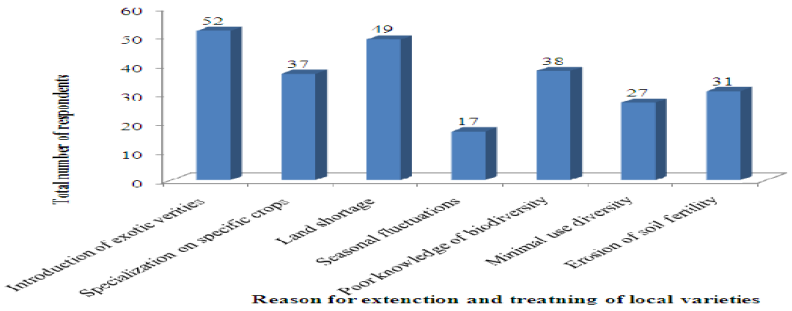

Fig 6: Reasons for extinction and threatening of local varieties with its total number of respondents

Discussion

The Ethiopian highlands are a center of diversity for numerous globally important crops. Heterogeneous landscapes, traditional agricultural practices, and inaccessibility have created and maintained diverse subsistence agro ecosystems (Samberg, L. *et al,*2010). Similarly the study area also contains 21 different stable crops grown at different agro ecology in the given elevation. Studying local people's categorization of natural resources in the study area was at the fore front of the research endeavor. As indicated by Martine (1995), describing the natural resource based on the local people's knowledge was the first to be done in Ethnobotanical study. The

diverse agricultural related knowledge in the study area collected as base line information were landscape classification, soil type, harvesting season and plant type grown in the area. This system, which is a component part of overall traditional environmental knowledge of the local people, passed dawn over generations with its root firmly attached to the remote ancestors. Cultural activities like nutrient management, seed selection weed management, using different storage techniques as indicated by AwegechewTeshome et al. (1999a, 1999b) are responsible in conserving different farmer's variety in the study area. Biodiversity concept visualized in the last zone (Masa) [Fig.2] was intraspecific diversity of crops increases with increasing distance from the dwelling, particularly8 Hordium vulgare L. varieties (MESNO GEBS, WEYNO GEBS, TIKURGEBS, TEMEJ GEBS, LATIEGEBS, DINBULO GEBS, NETCH GEBS and TIKUR SENEF KOLLO). Three *Zea mays* varieties (NECH BOKOLO, KEY BOKOLO and WEYNO BOKOLO); Six Triticum spp. (AELYAS SNDIE, TIKUR SNDIE, WASMA SENDIE, MRTE SENDIE, ZENBOLEL SENDIE and SIDA SENDIE) Were recorded in the survey. Similar research in the Ethiopian highland also confirmed the presence of diverse landraces particularly *Hordium vulgare* (Bedasa, *et al.* 2014; Eticha, *et al.* 2010; Haile-Michael Shewayrga and Peter 2011). Genetic diversity of crop varieties has the potential to increase productivity, regulate nutrient cycling and microclimatic conditions, reduce temporal variability, and maintain resistance and resilience in the face of socioeconomic or environmental change (Altieri 1999; Shennan 2008).

Nowadays due to an increased human population, people particularly the young farmers shifted to hybrid varieties which give a higher product than the local landraces. The presence of exotic species in the study area affects crop genetic diversity including farmer's landrace and diverse cultural knowledge in relation with crop farming. Conventional wisdom suggests that these changes are associated with the loss of crop genetic diversity, a decrease in the number of farmers growing landraces, and the area of landrace cultivation on farms (Bellon 1996; Teklu and Hammer2006). Late alone this, such kind of dependence in the future might affect the landraces which can be harvested over millennia by traditional farmers. The data collected from the study area also confirmed that different crops were at the verge of extinction. Money research reports also addressed the erosion of different farmer's landrace here and there (Samberg *et al.* 2010). Agrobiodiversity lose is one of the most critical issue for environmental problems and food insecurity that strongly linked with lively hood of farmers in the study area. Therefore, it needs due consideration in order to device proper alleviation mechanisms to conserve the endangered crops listed in the study area.

Conclusion

Farmers are probably not well aware of their, often thorough, knowledge of agriculture in general and of their crops and the methods of their cultivation and storage in particular. However, they have built up and transferred this knowledge to the next generations during many millennia. They will adopt new knowledge, new crops and new cultivation and storage methods and new types of old crops or adapt indigenous ones. But, as they do not write about their unique knowledge, it looks as if they do not possess it. Discovered the existence of 'farmers' knowledge' and wished to report on this 'novelty is the researchers interest. This paper presents the farmers knowledge about farming and using the staple crops in the entire life. Farmers were tried to do a lot of activities in conserving the remaining landraces by doing multiple activities. These were selecting appropriate soil types, selection of cultivation seasons, doing integrated nutrient management, seed selection, weed management and using different storage techniques. These knowledge know a day were not sufficient to conserve all land races because of this in the study area the young farmers showed a large interest to hybrid or quality seed by looking its productivity. This attitude was imposing a significant challenge on the conservation of farmer's landrace consequently lead to the presence of endangered farmer landraces in this study area. By turning the landraces with its culture in to commercial crops and changes the present attitude of young farmers towards farmer landraces might protect erosion of these crops in the future. If we do this, the skills and techniques of indigenous and local communities provide valuable information to the global community and can be a useful model for crop genetic diversity maintenance and conservation policies of crops

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Appendix 1: Complete list of plants collected in the study area at different status of cultivation.

Where, F=Food, Fo = Forage/ Fodder, Hc= House contraction, M = Medecine, Hg= homegarden, Fie= Field, , N= Nutracetical

No	Scientific name	Family name	Vernacular name	Crop type	Habit	Parts used	Use	Coll. No.	Altitude	Location	State of cultivation &place	Major use classification
1	*Avena sativum* L.	Poaceae		Cereals	H	Seed	Food				High & Fie	F
2	*Cicer arietinum* L.	Fabaceae	Shimbra	Pulses	H	Seed	Food	HR-066	1856	10014.818'N, 037042.693'E	High & Fie	F
3	*Elusine coracana* (L.) Gaertn.	Poaceae	Dagusa	Cereal	H	Seed	Food	HR-157	2188	110020.073'N, 037035.516'E	High & Fie	F
4	*Eragrostis tef* (Zucc.) Trotter	Poaceae	Bursa tef	Cereal	H	Seed	Food	-	2200	10020.116'N, 037035.381'E	High & Fie	F
	Eragrostis tef (Zucc.) Trotter	Poaceae	Key tef	Cereal	H	Seed	Food	-	2200	10020.116'N, 037035.381'E	High & Fie	F
	Eragrostis tef (Zucc.) Trotter	Poaceae	Nechtef	Cereal	H	Seed	Food	-	1845	10013.908'N, 037041.858'E	High & Fie	F
5	*Guizotia abyssinica* (L. f.) Cass.	Asteraceae	Nug	Oil	H	Fruit	Food		2196	10020.580'N, 037034.362'E	High & Fie	F
6	*Helianthus annus* L.	Asteraceae	Yeferengesuf	Oil	H	Fruit	Food		2188	10020.073'N, 037035.516'E	High &Fie	F
7	*Hordeum vulgare* L.	Poaceae	Dinbulogebs	Cereals	H	Seed	Food	HR-124	3281	10032.418'N, 037052.435'E	High &Fie	F
	Hordeum vulgare L.	Poaceae	Late gebs	Cereals	H	Seed	Food	HR-123	3291	10032.717'N, 037052.580'E	High & Fie	F
	Hordeum vulgare L.	Poaceae	Nechgebs	Cereals	H	Seed	Food	HR-126	3291	10032.717'N, 037052.580'E	High & Fie	F
	Hordeum vulgare L.	Poaceae	Nechmesnogebs	Cereals	H	Seed	Food	HR-120	3079	10030.782'N, 037052.367'E	High &Fie	F
	Hordeum vulgare L.	Poaceae	Temejgebs	Cereals	H	Seed	Food	HR-122	3281	10032.418'N, 037052.435'E	High & Fie	F
	Hordeum vulgare L.	Poaceae	Temejnetelagebs	Cereals	H	Seed	Food	HR-125	3291	10032.717'N, 037052.580'E	High & Fie	F
	Hordeum vulgare	Poaceae	Tkurgebs	Cereals	H	Seed	Food	HR-121	3281	10032.418'N, 037052.435'E	High &Fie	F
	Hordeum vulgare L.	Poaceae	Tkursenefkollo	Cereals	H	Seed	Food	HR-127	3079	10030.782'N, 037052.367'E	High &Fie	F
	Hordeum vulgare L.	Poaceae	Weynogebs	Cereals	H	Seed	Food	HR-118	3291	10032.717'N, 037052.580'E	High & Fie	F
8	*Lathyrus sativus* L.	Fabaceae	Guaya	Pulses	H	Seed	Food		2780	10026.755'N,	High & Fie	F

										037053.689'E		
9	*Linum usitatissimum* L.	Linaceae	Telba	Oil	H	Seed	Food	HR-029	2330	10021.260'N, 037041.150'E	High & Fie	N
10	*Lupinus albus* L.	Fabaceae	Gbto	Pulses	H	Seed	Food	HR-136	2188	10020.073'N, 037035.516'E	High &Fie	N
11	*Phaseolus coccineus* L.	Fabaceae	Key boleke	Pulses	H	Seed	Food		1856	10013.908'N, 037041.858'E	High & Hg, Fie	F
	Phaseolus coccineus L.	Fabaceae	Nechboleke	Pulses	H	Seed	Food		1856	10013.908'N, 037041.858'E	High & Hg	F
12	*Phaseolus lanatus* L.	Fabaceae	Adenguare	Pulses	H	Seed	Food	HR-007	2220	10020.116'N, 037035.381'E	High &Hg	F
13	*Pisum sativum* L.	Fabaceae	Ater	Pulses	H	Seed	Food		2602	10027.006'N, 037052.874'E	High &Fie	F
14	*Sorghum bicolor* (L.) Moench	Poaceae	Mashela	Cereal	H	Seed	Food	HR-001	1845	10013.908'N, 037041.858'E	High & Hg ,Fie	F
15	*Triticum dicocoon*Schrank.	Poaceae	Aja	Cereal	H	Seed	Food		2605	10026.627'N, 037053.381'E	High & Fie	F
16	*Triticum durum*Desf.	poaceae	Alyassnde	Cereals	H	Seed	Food	HR-128	2200	10020.116'N, 037035.381'E	High & Fie	F
17	*Triticum aestivum* L.	Poaceae	Wasmasnde	Cereals	H	Seed	Food	HR-131	2953	10028.599'N, 037052.981'E	High & Fie	F
	Triticum aestivum L.	Poaceae	Bulgasnde	Cereals	H	Seed	Food	HR-133	2852	10028.078'N, 037053.112'E	High & Fie	F
	Triticum aestivum L.	Poaceae	Mrtesnde	Cereals	H	Seed	Food	HR-130	2589	10026.981'N, 037052.756'E	High & Fie	F
	Triticumaestivum L.	Poaceae	Sidasnde	Cereals	H	Seed	Food	HR-132	2953	10028.599'N, 037052.981'E	High & Fie	F
18	*Triticum aethiopicum*Jakubz.	Poaceae	Tkursnde	Cereals	H	Seed	Food	HR-129	2953	10028.599'N, 037052.981'E	High & Fie	F
19	*Triticum turgidum* L.	Poaceae	Zenbolelsnde	Cereals	H	Seed	Food	HR-135	2589	10026.981'N, 037052.756'E	High & Fie	F
20	*Vicia faba* L.	Fabaceae	Bakela	Pulses	H	Seed	Food		2692	10027.006'N, 037052.874'E	High & Hg ,Fie	F
21	*Zea mays* L.	Poaceae	Key bokolo	Cereals	H	Seed	Food		2200	10020.116'N, 037035.381'E	High & Hg, Fie	F
	Zea mays L.	Poaceae	Nechbokolo	Cereals	H	Seed	Food	HR-040	2200	10020116'N, 037035.381'E.	High & Hg, Fie	F
	Zea mays L.	Poaceae	Weynobokolo	Cereals	H	Seed	Food		2200	10020116'N, 037035.381'E.	High & Hg, Fie	F

Appendix 2: List of Food Crops and their method of preparation in the study area

Crops	Local name of food	Plant part and form	Method of preparation
Tef	'Injera'	Whole grain flour	Water being added gradually while stirring. The dough is allowed to stand for 2-4 days to ferment. Some proportion of boiled water must be added to the fermented dough with stirring and allowed to stand 30 minutes –one hour to rise. Liquefied dough is fine dropped to smear evenly on a hot clay plate or 'Mtad' in concentric circle. A tight lid is placed on top of the plate. The lid is removed after 1-2 minutes depending up on the fire supply. 'Injera' is made by mixing flour of tef and other cereals (finger millet, barley, maize, wheat etc.). 'It is eaten with 'Wot'or butter with spiced hot pepper or finely ground grain of *Guizotia abyssinica* (nug) mixed with salt and water was smeared over 'Injera' and served during spiritual ceremony in Ethiopian orthodox church next day of final fasting day of gospel.
	'Kita'	Whole grain flour	Adding water to the flour until the dough becomes soft enough to be baked. After adding proper amount of salt, the dough backed immediately on metal or clay plate by hand smearing and covers it by lid. Remove the lid after 5 minutes. It is eaten with butter and spiced hot pepper or eaten with finely ground grain of *Guizotia abyssinica* (nug) mixed with salt and water smeared over 'Kita'.
	'Genfo'	Whole grain flour	The flour well cooked in water by simultaneous stirring. Add salt and remove from the fire. It is eaten with butter and spiced hot pepper.
Barly	'Injera'	Whole/dehulled grain flour	3-4 kg flour of 'Mesno Gebs' or 'Nech Gebs' or 'Weyno' Gebs and 4-5 litter water with 1-2litter-starter batter (yeast) mixed. The water being added by stirring the flour. The dough is covered and stayed 5 days to ferment. Boiled water was added to the dough if and only if the dough not so much liquefied. Let them for a hour to rise. Adding some fresh water if needed and the liquefied dough is dropped to smear evenly on a hot clay plate and placed tight lid over it. The lid removed after one minute and then 'Injera' taken out.
	'Beso'	Whole/ dehulled grain flour	Flour of roasted grain moistened with boiled or fresh water by the addition of salt and sugar (in slightly solidified bolus form or liquefied form as eat and drink respectively).
	Shameta (nonalcoholic beverage)	Whole/dehulled grain	The flour of barley mixed with small proportion of wheat malt flour with the addition of water, which stays not more than 4 hours.
	Tela (alcoholic beverage)	Malted, roasted and ground grain preparation of 'DEREKOT', 'ABSHLO', 'ENKURO'	The barley grain soaked with water until the germination initiates. Remove the water and put inside bamboo basket by being cover in *Ricinus comunis* and *Enset ventricosum* leaves. After the germination completed the barley become malted and removed from the basket and dried by using sunlight. The finely ground malt, ground stems and leaves of a flavoring plant (*Rhamnus prinoides*) and water mixed with 'ABSHILLO' or 'ENKURO' and 'DEREKOT' in ajar. Cover the jar and stay many days' minimum two days and used it as 'TELLA'. 'ABSHLO' is made when the grain of barley or finger millet or maize or wheat roasted, finely ground and mixed with water that stays 3 days and baked on hot metal or clay plate like 'KITA' but leaves or branches of *Vernonia amygdalina*is placed beneath and above the dough. After backed the KITA further cute in to smaller pieces and mixed to the ingredient of 'TELA'. 'ENKURO' is made when the grain of barley or maize or wheat roasted, finely ground mixed with small amount of water and stay 1-2 days in container. The product is placed on hot clay or metal plate with subsequent mixing of the product by using wooden material. This can be used as ingredient of TELA. DEREKOT is made from maize sometimes BLACK BARLEY. Maize was soaked in water that stays 5-7 days in a pot. Placed the maize on basket made from *Arundinaria alpina* (Bamboo) or *Arundo donax* (Shembeko) to drain the water. If the water is drained, it can be roasted by using hot metal or clay plate until the color become black. The roasted grain can be ground coarsely and serve as ingredients for TELA preparation.
	'Genfo'(Porridge)	Completely dehulled grain flour	Completely dehulled White barley finely ground. Boil the water and add the flour with simultaneously stirring. It is eaten by adding spiced butter and hot pepper
	Eshet (grean roast)	Unripe grain	Spikes of barley at the right stage of ripening are picked and rubbed between the palms or thumped with the hands to

			remove the rachis, glumes and awns.
	Enkuto (partial roasted)	Un ripe partial roasted grain grain	The fragments like rachis, glumes and awns are removed during roasting by holding a hand full of spikes over the flame and then the roasted grain can be eaten.
	Kolo (roastd grain)	Roasted and dehulled grain	Grain from 'Senef Kologebs' can be roasted by using hot clay or metal plate and served alone or in mixture with roasted chick pea, pea, or un roasted saf flower
	Atmit(Soup)	Dehuled grain flour	The white barley completely dehuled by partial roasting and ground in to fine flour. It can be served alone or mixed with flour of *Avena sativa*. Prepared in the same way as wheat flour or tef flour. Dissolved in water or milk, boiled, add sugar and salt with simultaneous stirring. Drink with or without spiced butter.
Maize	Kolo(roasted grain)	Whole grain roasted	Fresh grain roasted by using hot metal or clay plate.
	Tela (Local beverage)	Whole grain	Roasted or malted grain (Especially Key Bokolo) prepared in admixture with barley, Gesho *(Rhamnus prinoides)* and water. The same method of preparation as Tela for barley.
	Nfro (Boiled grain)	Whole grain	Fresh grain is boiled alone or with chickpea, pea, fava bean, cowpea and wheat.
	Dabo (Bread)	Whole grain flour (NetchBokollo)	Dough is made by adding water to the flour. It can be used alone or mixed with barley flour. The dough is allowed to stand four hours until to rise. Mostly yeasts added in to the dough to facilitate the rising. The dough baked on metal or clay plate by hand placing. The plate is covered by another metal plate or tight lid made of bamboo plastered with mud.
Wheat	Kolo(roasted grain)	The whole grain	The grain roasted by using hot clay or metal plate and served alone or in mixture with roasted chickpea, pea, barley or un roasted safe flower.
	Dabo (Bread)	The whole grain flour	Same method of preparation as bread from maize
	Tela (local beverage)	Grain, Malt, 'DEREKOT', 'ABSHLO', 'ENKURO'	The malt,'ENKURO', 'ABSHLO' and DEREKOT are prepared in the same way as barley. Ingredients for local beverage preparation by different females are differently. One group use ingredients like Malt, 'DEREKOT', 'ABSHLO, finely ground 'Gesho' *(Rhamnus prinoides)* leaf or steam and water with good proportion, and others use ingredients like'ENKURO' DEREKOT' Malt, and finely ground 'Gesho' leaf or steam and water.