



Tropentag 2016, Vienna, Austria

September 18-21, 2016

Conference on International Research on Food Security, Natural Resource Management and Rural Development
organised by the University of Natural Resources and Life Sciences (BOKU Vienna), Austria

Horticultural Crops Diversity and Cropping Systems in the Smallholder Home Gardens in the Transitional Area of Yayu Coffee Forest Biosphere Reserve, Ethiopia

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Abstract

Yayu Biosphere Reserve (YBR) is part of the Eastern Afromontane Biodiversity hotspot located in Illu-ababor, Oromia, Ethiopia. This reserve is a centre of coffee genetic resources and the origin of many other indigenous horticultural crops. The YBR has three parts with the Central Core, followed by Buffer and the external Transitional area. The Transitional area covering 70.5% of the reserve is dominated by smallholder homegarden with different land-use systems. These smallholders grow horticultural crops, cereal and legume crops together. Survey was conducted in homegarden of these smallholders to identify diversity and crop combinations of horticultural crops, collect information and to identify potentials and intervention areas. Multistage sampling was used, first selection of two districts, followed by selection of two villages in each district to arrive at a total of 40 sample homegardens. A detailed data on the crops diversity, combinations and cropping systems and other qualitative data were collected. The survey results also showed that many horticultural crops grow in all homegardens and a total of economically more than 25 fruit, 19 vegetable, 11 root and tuber crops, nearly 14 spices, herbs and many cereals, oil crops, stimulants and African indigenous fruits, vegetables, root and tuber, spices and herbs; more than 90 important cultivated crops were recorded with diversities of landraces in the sample homegardens. This clearly showed that food source diversification and smallholder income generation are an untapped potential that could substantially contribute to nutrition security including low livelihood status of all smallholders in the area. Diversity of cropping systems such as double cropping, inter cropping, multistory cropping and others observed in most homegarden. However, all farmers replied that there are no improved technologies for horticultural crop production. Almost all farmers use local land races with unimproved management practices obtaining very low yields and quality. Thus research should give attention on adding value to potential crops and the home garden cropping system in the area should also be further investigated with the identification of smallholder development interventions so that social development in parallel with resource conservation could be achieved.

Keywords: Biosphere, crop diversity, homegardens, smallholder farmers

1. Introduction

Ethiopia has three UNESCO registered Biosphere Reserves, namely Kefa, Shaka and YBR. The Yayu forest is also part of the Eastern Afromontane Biodiversity Hotspot. This region occurs across Africa from the north in Sudan to the south in the Cape region of South Africa, from east in Djibouti to the west in Cameroon and over 50% of the Afromontane region with elevations above 1500 m occurs in Ethiopia (Tadesse *et al.*, 1993). This YBR is one of the 34 hotspot areas in the world, identified by Conservation International (Mittermeier *et al.*, 2005). The YBR is part of the Eastern Afromontane Biodiversity hotspot located in Illu-ababor, Oromia, Ethiopia. This bio-diversity hot-spot reserve is the coffee genetic resources and center of origin for many other indigenous horticultural crops reported by many explorers and scientists. Core area is extremely protected and Buffer zone is also less protected and no crops cultivation is allowed inside area. The Transition area occupies 117,736 ha and contains crop-land, grazing-land, grassland, wetlands as well as urban and rural settlement areas (Tadesse *et al.*, 1993). The agricultural land

of Yayu settlement consists of only smallholder household farms with diverse and complex crops production systems and most crops are traditional landraces including Arabica coffee (Tadesse *et al.*, 2009; Tadesse *et al.*, 2008; Tadesse 2003; Tesfaye *et al.*, 2009). The agricultural landscape of smallholder surrounding the forest area is also important for the conservation of cultivated many horticultural crops landraces. The smallholder farmers in the this zone grow cereals, legumes, coffee, vegetables, fruits, root and tubers, spices and herbs and other crops together either as sole crop or in a combinations others in the homegardens with the shade trees. Thus, the objective of this paper is to identify diversity and crop combinations of horticultural crops cultivation in the Transitional Zone of YBR and to collect information on horticultural crops production in particular in the area of indigenous wild fruits and vegetables and to identify potentials and intervention areas for filling the gaps in the smallholders farming systems.

2. Materials and Methods

2.1. Description of the Yayu Humid Tropical Biosphere Reserve: The annual rainfall pattern in the area is long mono-modal with monthly high rain fall from March to mid of October with the peak rainfall from July to August and the least rain fall months are fall in the months of November, Dec. and January (Figure 1). This area receives high rainfall with more than 2000 mm per annum. Many fresh perennial streams and rivers originate and drain from within the region and flow into the River Nile.

2.2. Study Site Description and Sample Sites Selection: Yayu Biosphere Reserve is located in South West Oromia region of Hurumu, Yayu, Chora, Nopha, Alge Sachi and Doreni Woredas of Illu Abba Bora Zone. The biosphere is located within 8° 0' 42" to 8° 44' 23"N and 35° 20' 31" to 35° 18' 20"E. The YBR has three parts with the central Core area, followed by Buffer and the external Transitional area (Anon).

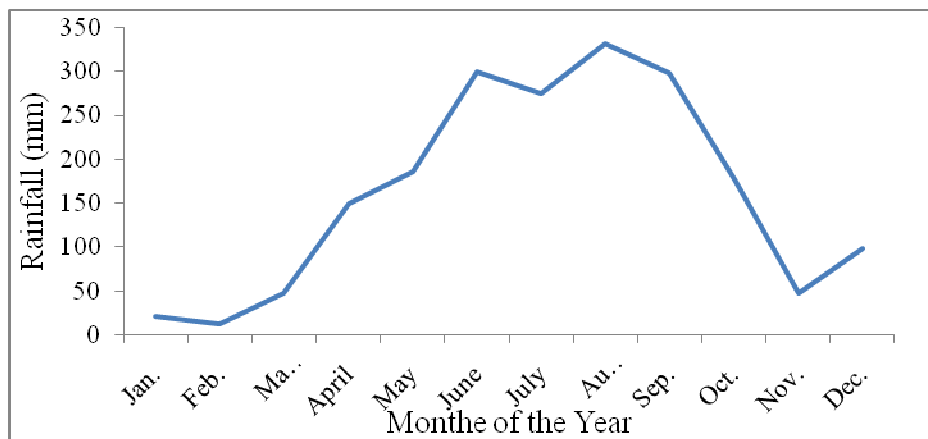


Figure 1. Mean monthly rain fall of Metu weather station (1999-2000) bordering the Yayu Biosphere Reserve

The study focused in the Transitional area of the Biosphere covering 70.5% of the Biosphere with smallholder household farmers farming with different land-use systems (Table 1).

Table 1. Yayu Biosphere Reserve partitions with size of each zones/ area

| Zone/ Area | Area (ha) | Percentage |
|-----------------|----------------|------------|
| Core area | 27,733 | 16.6 |
| Buffer Zone | 21,552 | 12.9 |
| Transition Area | 117,736 | 70.5 |
| Total | 167,021 | 100 |

Source; Tadesse *et al.*, (1993)

Multistage sampling was used, first by selection of two representative districts (Weredas¹) purposely selected in the biosphere: Yayu and Hurumu among the six Weredas residing in the Biosphere; 10 female and 10 male household farmers were taken from each Kebele totalizing 40 sample homegardens. Some of the descriptions of household populations of the sample Kebeles² are shown in the Table 2.

¹The Wereda (District) is an administrative unit which consists of a number of Kebeles, comprise about 10-30

²Kebele is the lowest administrative unit in Ethiopia

Table 2. Estimated number of households and population in the four sample Kebeles lying in the Yayu Biosphere

| No. | Woreda | Kebele | Number of HH | | | Total population | | |
|--------------|--------|---------------|--------------|------------|-------|------------------|-------------|-------------|
| | | | Male | Female | Total | Male | Female | Total |
| 1 | Yayu | Waabo | 194 | 36 | 230 | 450 | 548 | 1360 |
| | | Bonda Megelaa | 451 | 85 | 536 | 938 | 1232 | 2948 |
| 2 | Hurumu | Gaaba | 388 | 138 | 526 | 782 | 1025 | 2616 |
| | | Waangegne | 418 | 127 | 545 | 666 | 1033 | 1699 |
| Total | | | 1451 | 386 | | 2836 | 5787 | |

Source: Yayu ECFE Office

2.3. Methods of Data Collections: The sequential steps were followed in carrying out the informal survey activity. Focus group discussions (FGD) with household farmers representative and key informant interviews on general horticulture themes were arranged. Sample male headed and female headed household farmers were grouped in to five to six members. Focus group discussions (FGDs) were used as major tool to collect qualitative information and discuss opinions, ideas, constraints and solutions with major fruits and vegetable sectors. The discussions facilitated and arranged by each Kebele Manager and Chairperson at specified time. Focus group discussions were held with many farmers' groups (five to seven groups from each Kebele). Key informant interviews such as Kebele Development Agent (DA), Kebele Manager, elder people who lived long years in the area. Personal observations, by transect walk in the transition area were made along the farm fields, backyard and fences to generate additional information on the overall sources the fruit vegetable crops including wild types. The secondary data were combined with the data from the personal observations are used in the analyses of the current situation of the fruit vegetable crops including the wild grown vegetables in the area. Period of the FGD and key informants interview took place from 14 November 2015 to 6 December 2015 and continued while meeting with both male and female farmers, meeting with the stakeholder officials.

3. Results and Discussion

3.1. Variations among Households and Job Differences Between Female and Male Farmers: The households residing in the Biosphere have many differences, among land holding, size of coffee farm land, livelihood and overall economy, thus different members of a household have different perceptions of problems, opinions and different resources to address the problems. Plowing with oxen, cultivating cereals and coffee in the fields in particular far a way, guarding wild animals from farm fields throughout the crop life cycle is duty of males. The management of cash crops of the household such as coffee and maize, sorghum are usually the man's domain. Whereas home gardening with planting of variety of fruit and vegetable crops are most often considered as a "woman's duty". These homegardens are planted and maintained by members of the household especially by women and their products are intended primarily for household consumption.

3.2. Multistory Structures and Functions of the Homegardens: The household homegarden survey conducted revealed that many crops such as coffee, avocado, mango, banana, Enset, root and tubers, and many other crops grow in the sample homegardens of the households. The main structural arrangements in most home gardens are primarily coffee mixed with trees and shrubs, fruit trees or planted in strips, or planted as a boundary and fence, edges of plots and fields mainly for coffee shades, and live fence. From these trees including fruit trees farmers get food, fodder for their livestock, fuel wood and other wood products and other uses such as a windbreak and shades.

3.3. Coffee, Major Cereal and Legume Grains, and Oil Crops Production: The Yayu Biosphere area is rich in coffee genetic diversity and home of coffee genetic reserve (Tadesse *et al.*, 2008; and Tadesse, 2003; and Tadesse *et al.*, 2002). Many exotic cereal grains crops such as maize, barley, wheat, etc.... are important food crops cultivated by all household farmers including sorghum and Teff which is indigenous to the country among the cereals. Maize is number one food crop in the area followed by sorghum. Almost all household farmers cultivate maize and sorghum for annual household consumption. There are a number of beans and legume crops also planted in the field for consumption. There are more than 15 crop species of cereals, legumes and oil crops are cultivated in the area.

3.4. Horticultural Crops Diversity in the Biosphere Reserve: The survey results showed that many horticultural crops grow in all homegardens with variable structures and functions. This Biosphere reserve is a genetic reserve for many root and tuber crops, spices and many other herbal plants in Ethiopia

(Tadesse, 2003, and Tadesse *et al.*, 2002). Even almost exotic fruits (avocado, papaya, guava, passion fruits, etc...), root and tuber crops (cassava, taro, Tania, etc...) and many vegetables are naturalized and probably created secondary centre of diversity in the area.

3.4.1. Major vegetable crops: There are diversities of vegetable crops grown in the most homegardens in the sample Kebeles and households in area, among the vegetable crops hot and green paper (both chilies and bigger pepper with high variability), garlic, shallot, head cabbage, onion, tomato, varieties of Kales, spinach, lettuce, Lima bean, carrot, beet root, pumpkin, etc... are grown mostly for home consumption in the home garden by almost all farmers in the transitional area ([Annex Table 1](#)). If the vegetable yields are in excess of home consumption, women would take to the local markets for income generation. Planting vegetable for the household consumption is also entirely the job of women.

3.4.2. Major cultivated roots and tuber crops: All exotic root and tuber crops are cultivated in all farmers compound/ home garden in the transitional reserve area. There is no household without varieties of root and tuber crops indicating that most FGD replied that these crops are hunger alleviating in particular during the food shortage period July to August. Many of the root and tuber crops are indigenous to Ethiopia: among Anchote (*Coccinia abyssinica*), Enset, Aerial yam, etc... are endemic to Ethiopia with high genetic variability and diversity. Many other exotic root crops such as taro, Tania, cassava, sweet potato and root yam, etc... are grown and even naturalized in the area ([Annex Table 2](#)).

3.4.3. Fruits: Fruit crops grown sporadically in every homestead of the farmers. Some of the fruits are economically important (Zakarias, 2010). There is diversity of fruits in the area but coffee is the dominant one. Some of the fruits observed in the area are listed in the ([Annex Table 3](#)) with their scientific and common names. Among the fruits, avocado (with high variability), banana, papaya, orange, lime, lemon, *Anona*, casamiroa, peach, etc... are grown sporadically. Among the fruits: avocado, banana and mango seem the dominant and their favorite fruit crops planted by all households that grow in their homestead.

3.4.4. Spices, herbs, stimulants and oil bearing plants: The transition part of Biosphere Reserve has a lot of spices and herbs flora; among Korarima (*Aframomum korarima*) spice ranks first and other spices such as chilies, ginger, turmeric, coriander, etc... are grown widely ([Annex Table 4](#)). Many herbal and medicinal plant sp. are grown in the farmer's homesteads under fence and along the fence. Further study is required to explore the diversity of these species in the Biosphere area. Many exotic spices crops such as black pepper, cinnamon, cardamom, vanilla, etc... grow in the south western part of the country with similar agro-ecology with Yaya and most of them fit with coffee production system i.e., multi-storied cropping systems. There are stimulants crops planted by most household farmer and many other African indigenous fruits, vegetables, root and tuber, spices and herbs, etc... crops were recorded in the sample home gardens during the FGD and transect walks around the home gardens ([Annex Table 5](#)).

3.4.5. Minor African indigenous fruits, root and tuber and vegetable crops: Based on the group discussions, all household farmers identified lists of less important wild fruits, vegetables, spices and herbal crops growing in the forest, in the farm field and in the pasture as weeds ([Annex Table 7](#)). If anyone further explores more home gardens he/ she surely gets additional species that utilized by farmers.

3.5. Main Home Garden Cropping Systems and Practices: The home garden cropping refer to intimate association of horticultural crops production, multipurpose trees and shrubs with annual and perennial crops and, invariably livestock within the compounds of individual houses, with the whole crop-tree-animal unit being managed by family labor (Fernandes and Nair, 1986).

3.5.1. Mixed and intercropping cropping: Every explorers find intercropping of many and diverse crops from herbaceous to fruits and big Acacia coffee shade trees in the homegarden. Even there is almost no sole maize field, but maize is intercropped with climbing beans and sometimes with Ethiopian Kale.

3.5.2. Double cropping: Since Yaya area receives long periods of rainfall farmers plant twice per year, in particular short maturing crops including Feba and Teff. Farmers identified compatible crops in the double cropping. Some of them plant short maturing Teff variety, then after Teff harvesting they plant Feba bean or vice versa. Some farmers plant long cycle maze and sorghum.

3.5.3. Crop rotations: Most FGD household farmers have responded confidently that they have traditional skill that they rotate cultivation of cereal-legume crop species and they do not plant same crop species on same plot land continuously.

3.6. Major constraints of Homegardens Horticultural Crops Productions in the Area

3.6.1. Wild Animals: All FGD members stressed that crops damage due to wild animal is number one problem in the area. All farmers guard their farm fields and homegardens 24 hours a day from planting up to harvesting each crops from diversities of mammals, birds and other animals affecting the crops.

3.6.2. Lack of improved crop varieties and inputs supply: All FGD explained that seeds of all horticultural crops and other agricultural input supply is very weak not available at all from year to year and there is no improvement over time. Farmers plant unimproved crops such as avocado, mango, papaya, banana, etc... fruits, vegetables, root and tuber crops and all other crops.

3.6.3. Poor food consumption behaviors: There are many underutilized horticultural crops (cassava, taro, cocoyam, yams, both banana types, etc...) grow everywhere (along the roads, small rivers and gullies) with minimum care; but the community do not consume including all AIVs, except Kale and Cucurbits fruits. Eating wild plants is a source of shame in the area as expressed by all farmers.

3.6.4. Poor soil fertility with high price of fertilizers: Each member of the FGD stressed that if the farmland is continuously plowed, the soil becomes poor and does not give yield at all. This is because of high rainfall the area the soil is assumed to be acid. There is no improved fertility treatment of this soils.

3.6.5. Weak research attention and extension service for horticultural crops production: All household farmers use land races of all horticultural crops, such as fruits, vegetables root and tubers, spices and herbs, except imported hybrid H. Cabbage seed sourced from few seed shops. Homegarden are very complex systems with a large number of components. These indicate that there is no research and extension system addressing household multiple problems in the area.

4. Conclusions and Recommendations

Survey was conducted in homegardens of YBR smallholder farmers to identify diversity and crop combinations of horticultural crops cultivation and collect information on the African indigenous vegetables and to identify potentials and intervention areas. Multistage sampling method was used, among the six districts, first two districts Yayu and Hurumu were purposely selected. These followed by selection of two Kebeles in each district to arrive at a total of 40 focus group sample smallholders. Qualitative data on the crops diversity, combinations and cropping systems were collected. The FGDs indicated that the main structural arrangements in most home gardens of Yayu Biosphere smallholders are primarily coffee mixed with trees and, fruit trees planted in mixed, or planted as a boundary and fence, edges of plots/ fields mainly for coffee shades, and live fence. From these trees including fruit trees farmers get food, fodder for their livestock, fuel wood and other wood products and other uses such as a windbreak and shades. All the male and female FGDs farmers responded that many horticultural crops grow in all their home gardens and with an approximate 90 economically important crop species. All FGDs members practice various complex cropping systems and practices such as mixed cropping, intercropping, double cropping and crop rotations. The FDG results indicated that all farmers practice are guided, in the absence of a unified set of expert recommendations, by their own perceptions and convictions about species selection, admixture, and management. Home garden horticultural and other crops productions in the area are facing many challenges among the main constraints, crop damage due to wild animals, lack of improved crop varieties and inputs supply, traditional crop management practices, poor information networking, poor food consumption behaviors, poor soil fertility with high price of fertilizers and poor research attention and extension service provided in the area. Thus research should give attention on adding value to potential crops and the home garden cropping system in the area and should also be further investigate with the identification of smallholder development intervention prioritization so that social development in parallel with resources conservation should be emphasized.

5. Acknowledgments

This work was financially supported by the German Federal Ministry of Food and Agriculture (BMEL) based on the decision of the Parliament of the Federal Republic of Germany.

6. References

Barthlott, W, N Biedinger, G Braun, F. Feig and G Kier, 1999. Terminological and methodological aspects of the mapping and analysis of the global biodiversity, *Acta Botanica Fennica*

- Fernandes, E.C.M. and Nair, P.K.R. 1986. An evaluation of the structure and function of tropical homegardens. *Agricultural Systems* 21:279-310
- Fishpool, L. D. C. and Evans, M. I., eds. (2001) Important Bird Areas in Africa and associated Islands: Priority sites for conservation. Newbury and Cambridge, UK: Pisces Publications and BirdLife International (BirdLife Conservation Series No. 11)
- Gebrecherkos Woldegeorgis and Tilaye Wube, 2012. A Survey on Mammals of the Yayu Forest in Southwest Ethiopia. *SINET: Ethiop. J. Sci.*, 35(2):135–138
- EWNHS (Ethiopian Wildlife and Natural History Society, 1996. *Important 99 Bird Areas of Ethiopia: A first inventory*: Addis Ababa: Ethiopian Wildlife and Natural History Society and BirdLife International.
- Mittermeier R. A., Frank Hawkins, Serge Rajaobelina, and Olivier Langrand, 2005. Wilderness Conservation in a Biodiversity Hotspot: *International Journal of Wilderness* 2005: 11 (3)
- Nair, P. K. R. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, in cooperation with International Centre for Research in Agroforestry (ICRAF), pp 489
- Tadesse Woldemariam Gole, Feyera Senbeta, KassahunTefaye, Fite Getaneh, 2009. *Yayu Coffee Forest Biosphere Reserve Nomination Form-September 2009*, Ethiopian Coffee Forest Forum, Addis Ababa. Website: <http://www.ecff.org.et>
- Tadesse Woldemariam Gole, Borsch, T., Denich D. and Demel Teketay, 2008. Floristic composition and environmental factors characterizing coffee forests in southwest Ethiopia. *Forest Ecology and Management* 255: 2138-2150
- Tadesse Woldemariam Gole, 2003. Vegetation Ecology of the Yayu forest in SW Ethiopia: impacts of human use and implications for *in situ* conservation of wild *Coffea arabica* L. populations. *Ecology and Development Series*, No. 10. 162 PP
- Tadesse Woldemariam Gole, Denich, M., Demel Teketay and Vlek, P.L.G, 2002. Human impacts on *Coffea arabica* genetic pool in Ethiopia and the need for its *in situ* conservation. pp. 237-247. (In) *Managing plant genetic diversity* (J. Engels, V. Ramanatha Rao, A. H. D. Brown, and M. Jackson, (Eds). CAB International / IPGRI
- [Tefaye Abebe, K. F. Wiersum, F. Bongers](#), 2009. Spatial and temporal variation in crop diversity in agroforestry home gardens of southern Ethiopia, *Agroforest Syst* 78:309–322
- Zakarias Shumeta, 2010. Avocado production and marketing in the Southwestern Ethiopia, *Trends in Agricultural Economics* 3 (4): 190-206

7. Annex Tables

Annex Table 1. Some of major cultivated vegetable crops in the sample home gardens of YBR, Ethiopia

| No. | Scientific name | Common name | Family |
|-----|--|---------------------------------|----------------|
| 1 | <i>Allium cepa varascalonicum</i> L. | Shallot | Alliceae |
| 2 | <i>Allium cepa</i> L. | Onion | Alliceae |
| 3 | <i>Allium sativum</i> L. | Garlic | Alliceae |
| 4 | <i>Lycopersicon esculentum</i> Mill | Tomato | Solanaceae |
| 5 | <i>Capsicum frutescens</i> L. | Hot pepper | Solanaceae |
| 6 | <i>Capsicum annum</i> | Green pepper | Solanaceae |
| 7 | <i>Brassica oleranceae var.capitata</i> | Cabbage | Crucifereae |
| 8 | <i>Brassica carinata</i> A. Br. | Ethiopian Kale (<i>Gomen</i>) | Crucifereae |
| 9 | <i>Brassica integrifolia</i> (West) O.E. S | | |
| 10 | <i>Brassica oleracea</i> L. | | |
| 11 | <i>Brassica nigra</i> | Ethiopian mustard (?) | 'Senafich' |
| 12 | <i>Beta vulgaris</i> L. | Beet root | Chenopodiaceae |
| 13 | <i>Daucus carota</i> L. | Carrot | Umbelliferae |
| 14 | <i>Lactuca sativa</i> L. | Lettuce | Compositae |
| 15 | <i>Beta vulgaris var. cicla</i> L. | Swiss chard | Chenopodiaceae |
| 16 | <i>Phaseolus Spp.</i> | Lima bean and other beans | Feba ceae |
| 17 | <i>Abelmoschus esculentus</i> | Okra | |
| 18 | <i>Allium porrum</i> L. | Leek | Alliaceae |
| 19 | <i>Moringa stenopetala</i> (Bak. f.) Cufod | Moringa | |

Annex Table 2. Some of cultivated root and tuber crops in the sample home gardens of household farmers YBR

| No. | Scientific name | Common name | Family |
|-----|--|------------------|----------------|
| 1 | <i>Solanum tuberosum</i> L. | Potato | Solanaceae |
| 2 | <i>Ipomoea batatas</i> Lam. | Sweet potato | Convolvulaceae |
| 3 | <i>Ensete ventricosum</i> (Welw.) | Enset | Musaceae |
| 4 | <i>Colocasia esculenta</i> | Cocoyam, Taro | Araceae |
| 5 | <i>Xanthosoma spp.</i> | Tania | Araceae |
| 6 | <i>Coccinia abyssinica</i> (Lam.) Cogn. | Anchote | |
| 7 | <i>Dioscorea abyssinica</i> Hochst. ex Kunth | Aerial yam | Dioscoriaceae |
| | <i>Dioscoria bulbifera</i> L. | | |
| 8 | <i>Dioscoreaal ata</i> L. | Root yam | Dioscoriaceae |
| 9 | <i>Manihot esculenta</i> | Cassava | Euphorbiaceae |
| 10 | <i>Musa sp.</i> | Cooking banana | Musaceae |
| 11 | <i>Plectranthus edulis</i> | Ethiopian Potato | |

Annex Table 3. Some of cultivated useful fruit and nut crops grown in the sample home garden of YBR, Ethiopia

| No. | Scientific name | Common name | Family |
|-----|---|--------------------------|----------------|
| 1 | <i>Psidium guajava</i> L. | Guava | Myrtaceae |
| 2 | <i>Mangifera indica</i> L. | Mango | Anacardiaceae |
| 3 | <i>Musa acuminata</i> L. | Dessert banana | Musaceae |
| 4 | <i>Musa hybrids*</i> | Cooking banana | Musaceae |
| 5 | <i>Carica papaya</i> L. | Papaya | Caricaceae |
| 6 | <i>Citrus sinensis</i> Osbeck | Sweet orange | Rutaceae |
| 7 | <i>Citrus reticulate</i> Blanco | Mandarin | Rutaceae |
| 8 | <i>Citrus limon</i> Burm | Lemon | Rutaceae |
| 9 | <i>Citrus aurantifolia</i> Swigle | Lime | Rutaceae |
| 10 | <i>Citrus aurantium</i> L. | Sour orange | Rutaceae |
| 11 | <i>Citrus medica</i> L. | Citron | Rutaceae |
| 12 | <i>Persea spp</i> Mill | Avocado | Laurceae |
| 13 | <i>Prunus persica</i> L. | Peach | Rosaceae |
| 14 | <i>Psidium guajava</i> L. | Guava | Myrtaceae |
| 15 | <i>Passiflor aedulis</i> Sims | Passion fruit | Passifloraceae |
| 16 | <i>Anona Spp.</i> | Bullok's heart | Annonaceae |
| 17 | <i>Casamiroa edulis</i> La Llave | Casamiroa (White sapota) | Rutaceae |
| 18 | <i>Cucurbit pepo</i> L. | Pumpkin | Cucurbitaceae |
| 19 | <i>Macadamia nut</i> | Macadamia | |
| 20 | <i>Punica granatum</i> L. | Pomegranate | Puniaceae |
| 21 | <i>Ananas comosus</i> (L.) Merr | Pineapple | Bromeliaceae |
| 22 | <i>Opuntia ficus-indica</i> (L.) Miller | Cactus | |
| 23 | <i>Tamarindus indica</i> L. | Ziziphus | |
| 24 | <i>Eriobotrya japonica</i> (Thunb.) | | |
| 25 | <i>Dovyalis abyssinica</i> (A. Rich.) | | |

*= Some banana types in the area are multipurpose such as Du Case Hybrid

Annex Table 4. Some of cultivated spices and herbs in sample home garden YBR, Ethiopia

| No. | Scientific name | Common name | Family |
|-----|---|-----------------|--------------------------------|
| 1 | <i>Iriganellafoenum-graecum</i> L. | Fenugreek | Leguminose |
| 2 | <i>Cuminum cyminum</i> L. | White cumin | Umbelliferae/Parsleey/Apiaceae |
| 3 | <i>Nigella sativa</i> L. | Black cumin | Apiaceae |
| 4 | <i>Lepidium sativum</i> L. | Garden cress | Cruciferare |
| 5 | <i>Rutachalepensis</i> L. | Rue (Tena-Adam) | Rutaceae |
| 6 | <i>Aframomum korarima</i> | Korarima | Zingiberaceae |
| 7 | <i>Zingiber officinale</i> | Ginger | Zingiberaceae |
| 8 | <i>Curcuma domestica</i> | Turmeric | Zingiberaceae |
| 9 | <i>Capsicum frutescens</i> L. | Hot pepper | Solanaceae |
| 10 | <i>Capsicum annuum</i> L. | Chilly | Solanaceae |
| 11 | <i>Rosmarinus officinalis</i> L. | Rosemary | Lamiaceae |
| 12 | <i>Ocimum basilicum</i> L. | Sweet basil | |
| 13 | <i>Nigella sativa</i> L. | Whit cumin | Ranunculaceae |
| 14 | <i>Cymbopogon citratus</i> (DC.) Stapf. | Lemon grass | |

Annex Table 5. Some of stimulant other cash crops grown in the transitional Biosphere area

| No. | Scientific name | Common name | Family |
|-----|--|-----------------------|---------------|
| 1 | <i>Khata edulis</i> (Vahl.) Forssk.exEndl. | Khat (or Chat) | Celastraceae |
| 2 | <i>Hibiscus</i> | Sudan Tea, (Karkad ?) | Hibiscus |
| 3 | <i>Rhamnus piroindes</i> L' Herit | Hop, Rhamnus (Gesho) | Rhamnaceae |
| 4 | <i>Nicotiana tobacum</i> L. | Tobacco | Solanaceae |
| 5 | <i>Saccharum officinarum</i> L. | Sugarcane | Poaceae |
| 6 | <i>Lagenaria siceraria</i> (Mol.) Stardl. | Bottle gourd | Cucurbitaceae |

Annex Table 6. Some of wild spp. of African indigenous fruits, roots and tuber, and vegetables in the YBR, Ethiopia

| No. | Scientific name | Cultivation areas |
|-----|--|--|
| 1 | <i>Aframomum corrorima</i> (C. Pereira) | Grow only in forest and under shades in the forest |
| 2 | <i>Piper umbellatum</i> L. | Grow every where |
| 3 | <i>Coccinia abyssinica</i> (Lam.) Cogn. | Homegarden crops |
| 4 | <i>Physalis peruviana</i> L. | Wild grow in forest |
| 5 | <i>Amaranthus graecizans</i> L. | Sporadically edible, famine food |
| 6 | <i>Brassica carinata</i> | Main vegetable crop with genetic diversity |
| 7 | <i>Brassica nigra</i> | Main vegetable crop with genetic diversity |
| 8 | <i>Capsicum frutescens</i> L. | Main vegetable crop with genetic diversity |
| 9 | <i>Cucurbita maxima</i> | Main vegetable crop with genetic diversity |
| 10 | <i>Cucurbita moschata</i> | Main vegetable crop with genetic diversity |
| 11 | <i>Cucurbita pepo</i> | Main vegetable crop with genetic diversity |
| 12 | <i>Plectranthus edulis</i> (Vatke) Agnew | Homegarden root crop |
| 13 | <i>Dioscorea bulbifera</i> L. | Homegarden root crop |
| 14 | <i>Dioscorea abyssinica</i> Hochst. ex Kunth | Homegarden root crop |
| 15 | <i>Dovyalis abyssinica</i> (A. Rich.) Warb. | Koshim (A, O, T), Edible, used as live fence |
| 16 | <i>Opuntia ficus-indica</i> (L.) Miller | Grow everywhere including the homegarden |
| 17 | <i>Capsicum annuum</i> L. | Homegarden and field crop |
| 18 | <i>Amaranthus sparganiocephalus</i> | Wild |
| 19 | <i>Amaranthus viridis</i> L. | Wild |
| 20 | <i>Tamarindus indica</i> L. | Edible grow every where |
| 21 | <i>Zingiber officinale</i> Roscoe | Garden spice, grow under shade |
| 22 | <i>Corchorus olitorius</i> L. | Wild and grow in forest |
| 23 | <i>Moringa stenopetala</i> (Bak. f.) Cufod. | Grow everywhere including the homegarden |