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Fruit plant species with potential for cultivation and use in Arba Minch, Ethiopia

BACHELOR'S THESIS

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Declaration

I hereby declare that I have done this thesis entitled Edible fruit species of Ethiopia independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague 14.4.2022

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Abstract

The aims of the theses were to find find fruit species, which are suitable for cultivation in Arba Minch region. Table of fruit species of Ethiopia was made with some additional information like mode of their consumption, local name, other plant parts used, other uses except from eating the fruit, ecology in Ethiopia, and grown habit.

The work was done in the form of literature research, on the basis of scientific articles and publications using predetermined keywords.

Whereas Ethiopia is a country with very high malnutrition, there were searched wild fruit species with high nutritious potential for improvement of malnutrition and micronutrient deficiencies that are most common in Ethiopia. Some cultivated species were also emphasized for their significant content of some nutrients.

It was also paid attention at the current status of fruit in Ethiopia both as a part of the diet and its importance in production and export market. The research also noted the major pests and diseases of cultivated fruit species in Ethiopia.

There were found the dominant vegetation types in Arba Minch region, Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket, and Dry Combretum wooded grassland. The species that were found suitable for these vegetation types are *Adansonia digitata, Ziziphus spina-christi, Grewia bicolor, Sclerocarya birrea, Balanites aegyptiaca, Boscia mossambicensis, Tamarindus indica, Diospyros mespiliformis* and *Syzygium guineense.*

Key words: malnutrition, nutrition, vitamin, micronutrient, health, deficiency, market, cultivated, wild, potential

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1. Introduction

Malnutrition is the biggest problem in the public health topic, especially in developing countries. It has many forms including wasting, stunting, underweight, overweight, obesity, subsequent non-communicable diet-related diseases, vitamin deficiencies and mineral deficiencies. There are 1.9 billion adults who suffer from obesity or overweight and 462 million adults who suffer from underweight. There are 45 % of children in the age under five years who die from undernutrition in the world, usually in countries with low or middle income. In the same countries, there is also a rising number of children with the problem of obesity or overweight. In Ethiopia there is a problem of non-diversified dietary composition [1]. There are some species that are commonly represented in the daily dietary intake which causes the same nutrients to be ingested throughout the diet [2].

Ethiopia is one of the countries with the highest malnutrition rate in Sub-Saharan Africa. The biggest problem of malnutrition in Ethiopia is for women and children. The major forms occurring in the country are acute and chronic malnutrition, iron deficiency anaemia (IDA), vitamin A deficiency (VAD), and iodine deficiency disorder (IDD). According to the Demographic Health Survey from 2005, about 47 % of Ethiopian children under five years are stunted and 11 % are wasted. Of the stunted ones, 38 % were underweight and 11 % were severely underweight [3].

Even though malnutrition in Ethiopia has been declining in the last 15 years, the number of deaths caused by malnutrition is very high. Undernutrition causes about 28 per cent of child deaths there. This fact has a significant impact on the development of social and economic sectors in the country. Twenty-six per cent of women from 15 to 49 years is undernutrition and 24 % of them is anaemic. Anaemia is one of the most detected diagnoses. Among children under the age of five years about 57 per cent of them is anaemic. These two diagnoses, i.e., anaemia and malnutrition, are directly connected, so the fact that only 45 % of children are fed at least three times a day is very alarming. The most common deficiencies of micronutrients are lacks of iron, vitamin A, folic acid, iodine and zinc. Consumption of fruits and vegetables is the main source of many micronutrients essential for human growth and health. According to UNICEF (2017) agriculture and livestock husbandry is the livelihood of 85 % of the Ethiopian population. That is why fluctuations in climatic conditions are critical for their lives. According

to UNICEF and GAIN Ethiopian children aged 6-23 months suffer mainly from lack of iron, zinc, iodin, and vitamin A micronutrients [4].

Importance of fruits in human nutrition

In nutrition, the primary importance of fruit is its content of vitamins, minerals, fibre, and other compounds of bioactivity [5]. Consumption of fruits than provide benefits like greater life span, better mental condition, improvement of cardiovascular system, lower risk of some types of cancer, better regulation of body weight and some more. Fruits are an important amount of potassium, which is necessary to reduce the boneloss effect kidney stones [6-11]. Fruit also helps the good brain work by stimulating the memory recalls [5]. Because fruit is an important "supplier" of fibre, its consumption has positive influence on the digestive system [5]. Some of the most common species in Ethiopian diet are *Adansonia digitata* L., *Balanites aegyptiaca* Del., *Ziziphus mauritiana* Lam., and *Boscia senegalensis* (Pers.) Lam. ex Poir. [2].

There is a big deficiency especially in rural parts of Ethiopia of vitamin A which is over 60 % and of iron which is even higher, 86,3 %, and the situation in rural areas still getting worse [12].

Vitamin A deficiency

One of the most serious public health problems of the Ethiopian population is the vitamin A deficiency. It is a common problem in developing countries, especially in the areas where there is a monotonous legume-cereal based diet. Intake of vitamin A below the required level causes many consequences. These usually affect visual system, blindness, and higher predisposition to infectious diseases. According to the studies, improvement of vitamin A intake can lower the mortality among children aged 6 to 71 months by 23 % and by 40 % among pregnancy-related women. Nowadays it is an effort to improvement by vitamin A supplementation [13].

Bitot's spots were indicated among 1,7 % of children aged 6 to 71 months in Ethiopia and 1 % among the whole Ethiopian population. It is twice the cut-off point determined by World Health Organization (WHO), which makes it a problem of public health significance [14]. A high number of Bitot's spots is likely connected with insufficient consumption of fruits and vegetables and the monotonous cereal-legume diet. Another result of vitamin A deficiency is night-blindness for which suffers 0,8 % of children and 1,8 % of mothers in the country [13].

If the only source of vitamin A is a seasonal fruit like mango, the minimum portion of it would have to increase 10 times to fulfil the minimum adequate volume of liver vitamin A. Fruits are an important source of beta-carotene which is the provitamin of vitamin A and is essential for synthetise of vitamin A in the human body. To achieve the required dose of vitamin A, another vitamin A rich food such as livers or cod-liver oil should be included into the diet [15].

Iron deficiency

Iron deficiency is still the most common nutrition deficit and the most common cause of anaemia. It is estimated that it affects 4-6 billion people. The iron deficit is connected with many pathological diseases including anaemia, failure of organs formation or defects in their function [16]. Probably even a moderate deficiency of iron affects the right intellect development of children and the national intelligence quotient [17-21].

If the deficiency of iron is severed, it leads to iron-deficiency anaemia (IDA) which occurs in 1.24 billion men [15]. According to WHO, IDA is one of the most costly diseases globally because of its impacts on health such as the higher risk of serious morbidity, aggravated mental and motor development in children, lower work capacity, poor immunity, and pregnancy results [22].

2. Aims of the thesis

The thesis aimed to identify fruit species suitable for cultivation and use in the Arba Minch region to enrich the local people's diet with sources of essential micronutrients.

A table of fruit species of Ethiopia was made with some additional information like mode of their consumption, local name, other plant parts used, other uses except from eating the fruit, ecology in Ethiopia, and grown habit.

It was also paid attention at the current status of fruit in Ethiopia both as a part of the diet and its importance in production and export market. The research also noted the major pests and diseases of cultivated fruit species in Ethiopia.

There were searched wild fruit species with high nutritious potential for improvement of malnutrition in Ethiopia. Some cultivated species were also emphasized for their significant content of some nutrients.

3. Methods

This research was done by collecting data about edible fruits growing in Ethiopia and the subsequent focus on the selection of those with particular nutritional potential. Initially, the table of fruit species occurring in Ethiopia was made. Additional information about its edibility and other uses was searched as well as its grown habit and location of presence in Ethiopia.

Scientific articles on fruit-bearing plants growing in Ethiopia were collected and reviewed, and an assortment of suitable species was summarized in the table. Later the research directly focused on the Arba Minch area. Mainly fruit species with high nutritional value or species with nutritionally essential elements were sought. Attention was also paid to wild species with potential for domestication in the Arba Minch region. It was also searched for diseases occurring in this area that affect the main fruit species.

Information was searched mainly in the books and at the internet database of scientific literature Web of Science. Only English language literature was used. Combinations of key terms such as "Ethiopia", "Arba Minch", "Nutrition", "Health", "Fruit", “Vitamin”, “Fruit Crops”, “Cultivated”, “Wild”, “Export”, “Market”, “Micronutrient”, “North-East Africa” and so on were used to search adequate lists. The manual search of relevant literature, textbooks and bibliographies focused on plant resources, mainly fruit species of Ethiopia, East Africa, and South-East Asia.

4. Literature review

4.1. Definition of fruit species

In this research, we will define as fruit, some botanical fruit that can be consumed as an appetizer, as a dessert or just raw, by hand. It can be said that edible fresh fruits are succulent structures, and they usually have pleasant aroma and flavour. Usually, these fruits have a low shelf life and are easily spoiled. Their transport is therefore often problematic.

The fruit is also commercially processed. This is done for creation of the new product with some added value, such as juices or jams. Another reason for processing the fruits is to utilize otherwise unusable fruits that either do not meet the requirements such as different shape or different size or there is a risk of their spoilage. Processing methods are: Fermentation – production of wine or vinegar; Pickling of green mature fruit in brine or in vinegar e.g., mango, which can be done with or without bacterial fermentation; Drying or dehydratation, e.g., dried banana slices; Juice extraction, e.g., citrus or apple juices; Glacéing – pickling whole fruit in a syrup made with sugar; Preserving as jams, marmalades or jellies; Canning – fruit canned in a light sirup, e.g., pineapple [23].

4.2. Study area

Ethiopia has been a landlocked country since 1993 when Eritrea became a separate state. The country entirely belongs to the tropical belt so there is also tropical climate. With a population of almost 118 million (United Nations 2021), Ethiopia is the second-largest country in Africa and the largest one in the Horn of Africa where it is also the most populated [24].

The research was focused on Arba Minch Zuria District with an administrative centre in Arba Minch town. Arba Minch town is an administrative centre and also the largest town of Gamo Zone. Gamo Zone is a part of the Southern Nations, Nationalities, and Peoples Region (SNNPR) and Arba Minch is its second largest town. SNNPR is found in southwestern Ethiopia and Arba Minch is in the east of it. The distance of Arba Minch town from the capital of Ethiopia, Addis Ababa, is 550 kilometres. Arba Minch is located at 6°2′N 37°33′E. Arba Minch town is situated at an altitude of 1200-1300 meters above sea level with the average annual temperature 29.7 ° C and with the annual rainfall of 700 mm. The altitude in the whole Arba

Minch Zuria District ranges from 1187 to 2700 meters above sea level. The annual temperature of the district is 23.6 °C and rainfall is 950 mm [25].

4.2.1. Agroclimatic zonation of Ethiopia

Agroecological zonation in Ethiopia has taken several different approaches. Both traditional descriptions of altitude zones and approaches involving vegetation types occurring in a particular zone, or farming systems used by Pichi-Zermolli (1957), Mooney (1961), Huffnagel (1961), Westphal (1975) and Amare Getahun (1978). The most significant zoning according to altitude bands was performed by FAO / UNDP / LUPRD (1984), Constable (1985) and Hurni (1986), Hurni (1982) for the Simen Mountains, and Mesfin Wolde-Mariam (1990) [26].

According to Hurni, other important level in the creation of the zonation of Ethiopia were made by Mengistu Negash, Tesfaye Haile and Tefesse Olchev (1989) who created a map named 'Agro ecological zones of Ethiopia' at a scale of 1: 2,000,000, a map from Tafesse Asrese (1996) mapping southwestern Ethiopia, and a map of Mesfin Wolde-Miriam (1990) for northern Shewa and Wello, and the mapping system currently in use, also made by Hurni (1995) ‘Ethiopia: Agro-ecological Belts’ at the scale of 1:1,000,000. This one uses a combination of zonation by altitude and zonation by rainfall patterns considering the growing periods. So that this classification takes note to the water retention and to the use of soil [26]. The illustrative display of the classification according to Hurni from 1995, figured in Figure 1.

Because at the time of the creation of this agroclimatic system, there was no map of Ethiopia with the correct scale that would have appropriate precision, it has never been applied to a map. That is why we only have a general pattern of zonation in Ethiopia describing the agro-ecological zones of Ethiopia. These are presented in Figure 1.

In the area of Arba Minch there is bimodal region with short spring and more extended summer rainy season. The most common agroclimatic belts in the agroclimatic region Arba Minch are Weyna Dega (18,57 %), Dega (17,95 %), High Dega (8,61 %) and Kolla (3,04 %). The length of the growing period in Arba Minch is less than 120 days per year [27].

4.2.2. Characteristic of agroclimatic zones of Ethiopia

WEINA DEGA

Weina Dega is the most common agroclimatic zone in Arba Minch region. It is characteristic by altitude 2,300 – 1,500 m a.s.l.. The natural vegetation in this zone is dominated by *Accacia* species. It is divided into three categories according to the amount of total precipitation from which the composition of the flora is derived.

Dry Weina Dega (Savannah) has annual rainfall less than 900 mm. Main crops are wheat, *Eragrostis tef* (Zuc.) Trotter, *Guizotia abyssinica* (L.f.) Cass., *Eleusine coracana* Gaertn., and rarely *Zea mays* L.. Widespread terracing is the traditional style of conservation. There are light brown to yellow soils.

Moist Weina Dega has annual rainfall 900 – 1,400 mm. Main crops are *Z. mays*, sorghum, *E. tef*, wheat, *G. abyssinica, E. coracana*, *Hordeum vulgare* L., and rarely *Ensete ventricosum* (Welw.). Traditional terracing is the main style of conservation. There are red-brown soils. The most common trees are apart from *Accacia* species also from *Cordia* and *Ficus* species.

Wet Weina Dega has annual rainfall more than 1,400 mm. Main crops are *Z. mays, E. tef, G. abyssinica, H. vulgare* and *E. ventricosum* in western parts. Widespread drainage is the traditional style of conservation. There are red-clay soils that are deeply weathered with gullies. Most common natural growing plants in Wet Weina Dega are from *Accacia*, *Cordia* and *Ficus* species, and common are also bamboos.

DEGA

Dega is the sencond most common agroclimatic zone in Arba Minch region. It is characteristic by altitude 3,200 – 2,300 m a.s.l.. It is divided into two categories according to the amount of total precipitation.

Moist Dega also called Afro-montane forest-woodland has annual rainfall 900 - 1,400 mm. The main crops include *H. vulgare*, wheat and pulses with the frequency of harvesting one crop per year. Traditional terracing is the leading way of conservation. There are brown clay soils and this part has as the most common natural growing trees generas *Juniperus, Hagenia, Podocarpus.*

Wet Dega also called Afro-montane bamboo forest has annual rainfall more than 1,400 mm. Main crops are *H. vulgare*, wheats, *G. abyssinica,* and pulses with the frequency of harvesting two crops per year. Widespread drainage is the main way of conservation. There are red clay soils which are deeply weathered, with gullies. This part has the most common natural growing trees generas *Juniperus, Hagenia, Podocarpus* and bamboo.

KOLLA

Kola agroclimatic zone makes 3,04 % of Arba Minch region. It is characteristic by 1,500 – 500 m a.s.l.. It is divided into Dry, Moist and Wet Kolla.

Dry Kolla has annual rainfall less than 900 mm. Main crops are *E. tef* and rarely sorghum. Waster-retention terracing is the traditional style of conservation. There are yellow sandy soils. Dry Kolla natural vegetation is composed by shrubs and trees with most abundant *Acacia* spp. Most common natural growing tree is *Acacia.*

Moist Kolla has annual rainfall 900 – 1,400 mm. The main crops include sorghum, *G. abyssinica, E. coracana*, groundnut and rarely *E. tef*. Widespread terracing is the traditional style of conservation. There are yellow salty soils. Most common natural growing trees are generas *Acacia, Erythrina, Cordia and Ficus.*

Wet Kolla has annual rainfall over 1,400 mm. The main crops are mango, taro, sugarcane, *Z. mays*, coffee and oranges. In traditional style of conservation, the ditches are very frequent. There are red clay soils which are oxidized. Most common natural growing trees are *Milicia, Cyathea* and *Albizia grandibracteata* [27].

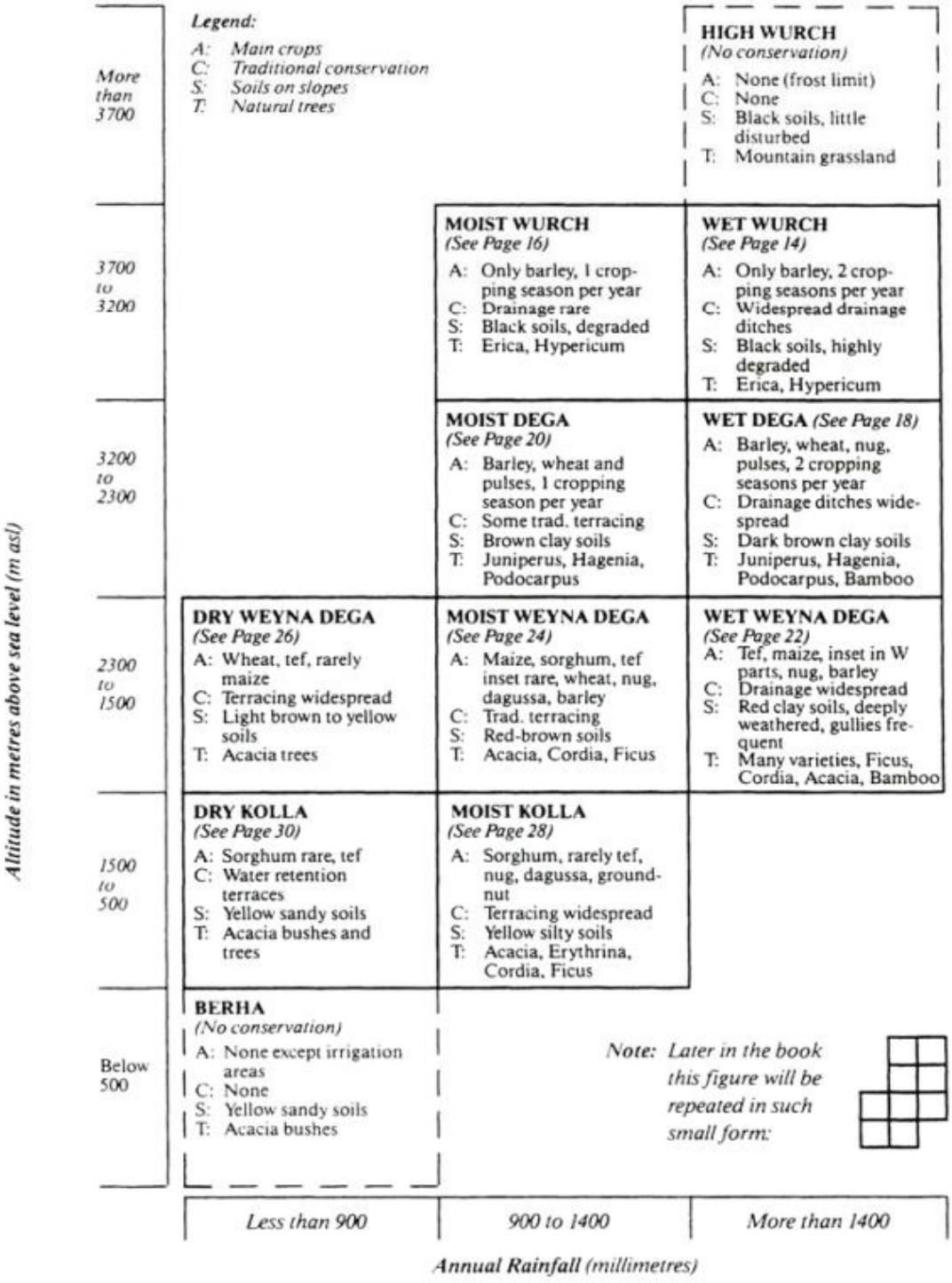
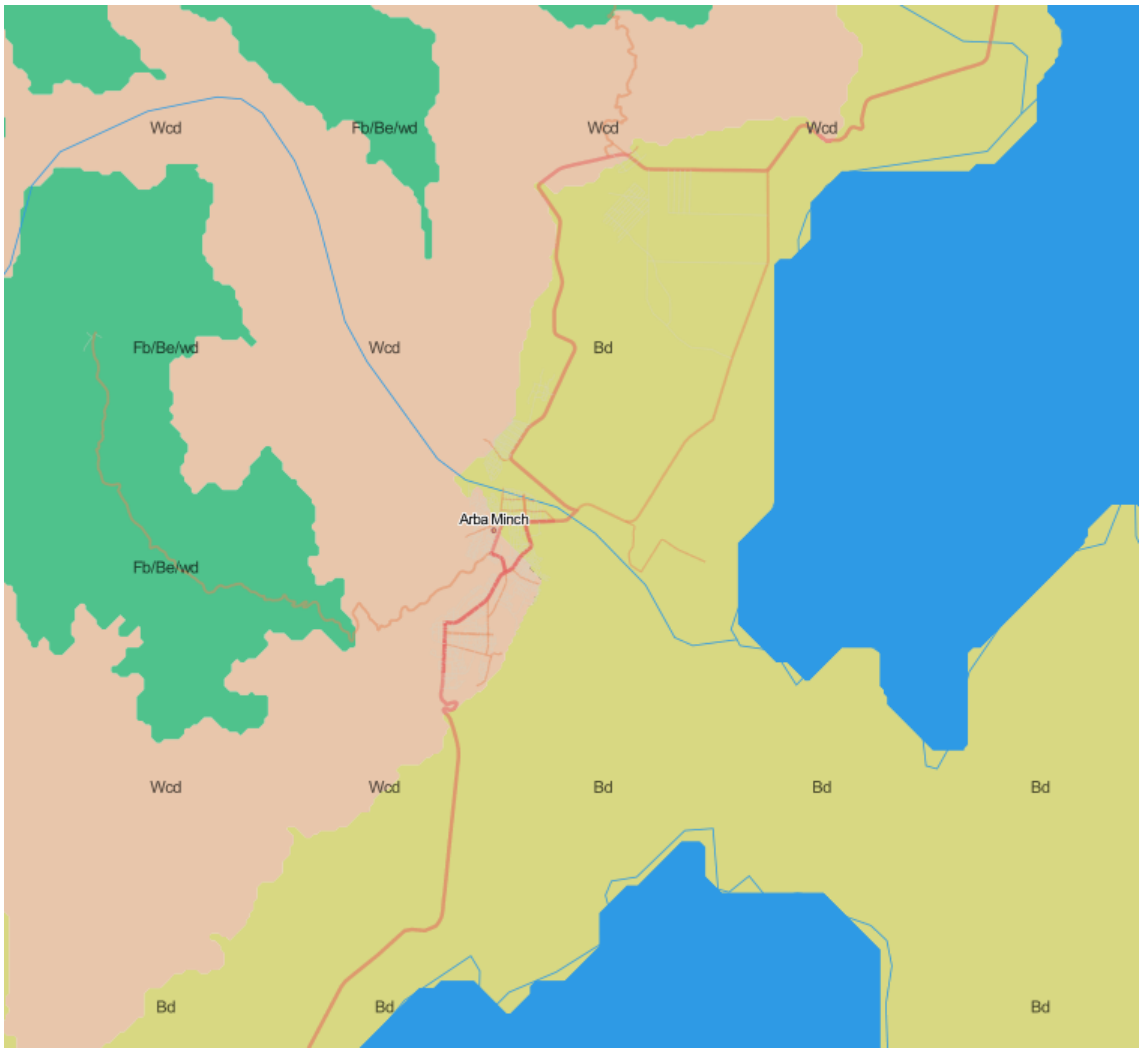


Figure 1. Agroecological zonation system for selecting soil and water conservation (SWC) options in Ethiopia based on field observations (Hurni H, 1986)

4.2.3. Vegetation types in Arba Minch

Vegetation types that surround Arba Minch are Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket, and Dry *Combretum* wooded grassland.



Legend: (Bd) Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket, (Wc) *Combretum* wooded grassland

Figure 2: Vegetation types surrounding Arba Minch

4.2.4. Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket

Characteristic species for this vegetation type are multi-stemmed bushes or small bushy trees, usually with a crown low to the base. Impenetrable thickets are formed locally.

Less frequently, there are also species in this area that have well-defined strains bearing a crown high above the surrounding canopy. These species can be found in areas with higher rainfall amount, especially in areas of rocky hills. Here the trees are closer together and are taller. Usually, however, their height does not exceed 10 m.

Canopy cover is less than 40 percent, so this vegetation is classified as bushland rather than wooded grasslands [28].

Figure 3: Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket (Bd). Gachathi F. 2011.

4.2.5. *Combretum* wooded grassland (Wc)

According to Trapnell and Langdale-Brown (1972) *Combretum* wooded grassland is East Africa's primary wooded grassland vegetation type. Predominant species in this vegetation type are broad-leaved *Comretum* and larger-leaved *Terminalia.* There were recorded two sub-types of *Combretum* wooded grassland, dry and moist *Combretum* wooded grasslands [28].

Figure 4: *Combretum* – Terminalia woodland and wooded grassland on stony soil derived from the basement complex at the foothills in Ethiopia. Friis I, Demissew S. 2008.

Figure 5: *Combretum* – Terminalia woodland and wooded grassland with tall underground of grasses (mainly Hyparrhenia species) on rocky outcrops east of Kurmuk (Ethiopia). Friis I, Demissew S. 1998.

4.3. Cultivated fruits

In Ethiopia, many cropping systems belong to fruit-enriched fallows in shifting cultivation, fruit grown in home gardens, fruit grown in orchards, and fruit grown in corporate plantations. There are approximately 400 species that are mainly used as a source of edible fruits or nuts in South-East Asia, but not even half of them belongs to cultivated species. In South-East Asia the most significant amount of fruit is produced in home gardens. In the case of tree fruit species, they also have the role of shade plants [29].

In Ethiopia, there are 2,658 thousand smallholders of fruit productive farms on 104 thousand hectares which is a 1 per cent share of cultivated area. The country produces 777 thousand tons of fruit production per year [30]. (See in table 1.)

In general, it can be said that in Ethiopia, the most common fruits grown on plantations are bananas, plantains, avocados, mangos, citruses, papayas, strawberries, melons, and guavas [31].

The most common fruit cultivated in Ethiopia is banana and it covers 57,84 % of the fruit crops cultivated area. Next one is avocado with 14,81 % and mango with 14,47 %. Other species include the remainder, in the order of units of per cent. See in table 1. [30]. Also, the increase of banana production is the highest while avocado has the highest increment of growing area [31]. Top of the fruits production of the whole country is made of bananas, mangos, and avocados, providing 67 %, 14%, and 10 % respectively [30]. (See in table 1.)

Ethiopia is an exporter of many fruits. In case of its amount, the most important fruit export commodities are bananas, plantains, oranges, guavas with mangoes and mangosteens, papayas, and lemons with limes, with 6,133; 5,950; 1,576; 1,412; 1,141 and 966 metric tons, respectively. (2017/18). Other significant exported fruits are strawberries, avocados, and watermelons in the amount of 766, 648 and 458 metric tons, respectively. The total quantity of fruit exported fluctuates around 20,000 metric tons per year (2017/18). Exported fruit carries a value of 7,424,000 USD (2017/18). The biggest value share is made by strawberries, bananas, and plantains [30]. (More detailed in Table 2)

Fruit Crops	Area (in '000 Hectares)					Production (in '000 Metric Tons)				
	2013/14	2014/15	2015/16	2016/17	2017/18	2013/14	2014/15	2015/16	2016/17	2017/18
Avocados	11	14	14	18	18	18	54	54	65	81
Bananas	41	54	54	63	59	340	478	440	538	494
Guavas	2	3	2	3	2	1	4	2	4	3
Lemons	1	1	1	1	1	5	8	7	8	8
Mangoes	10	13	15	15	15	72	91	100	105	105
Oranges	3	3	4	3	4	31	31	28	21	31
Papayas	2	2	3	3	3	32	40	48	50	54
Pineapples	0.3	2.2	0.2	1	1	0.5	0.4	0.3	1	1
Total	72	90	92	108	104	499 707	707	680	792	777

Table 1: Area and production of major fruit crops in Ethiopia (CSA Ag Survey, 2017/18)

Products	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Banana, fresh	-	-	4,216	6,854	9,086	7,722	6,133
Plantains	-	-	2,384	3,583	3,691	4,797	5,950
Oranges, fresh or dried	3,298	3,062	3,331	3,008	2,176	2,256	1,576
Guavas, mangoes and mangosteens, fresh or dried	1,705	2,021	2,175	2,339	2,047	2,186	1,412
Lemons (*C. limon, C. limonum*) and Limes (*C. aurantifolia*)	1,072	1,096	980	909	1,149	1,032	996
Papaws (papayas), fresh	464	567	692	841	1,089	970	1,142
Strawberries, fresh	748	579	741	464	602	636	766
Watermelons, fresh	32	40	64	83	84	554	458
Avocados, fresh or dried	9	9	3	7	40	191	648
Sub-Total	7,328	7,372	14,588	18,088	19,964	20,344	19,050
Others	5,503	7,678	4,125	463	340	901	399
Grand Total	12,831	15,050	18,713	18,551	20,304	21,245	19,449

Table 2.: Ethiopia´s exports of edible fruits: volume in metric tons (CSA Ag Survey, 2017/18)

4.3.1. Fruit production areas in Ethiopia

The agroecological conditions in Ethiopia are suitable for the cultivation of fruit species. There is rich and suitable soil for growing different fruit crops. Various ranges of altitude provide conditions for growing different species. There are highland areas favourable for crops like apples, as well as lowlands which are favourable for fruits like dates. Also, the abundant soil has a considerable irrigation potential provided by its huge river basins and thousands of tributaries. These condition properties make the good potential for production of tropical, subtropical and also temperate fruits [31].

Main corridors where fruit crops are harvested are Oromia and Addis Ababa corridors, Bahir Dar, Abay valley and South Gondar, Awash, Dire Dawa, Harar and Somali horticulture corridors, Hawassa and Arba Minch corridor and Mekele-Raya and Kobo Alamata horticulture development corridor [31].

4.3.2. Nutritive value of cultivated fruit species

The importance of consuming cultivated fruit, or fruit in general, lies in the content of the dietary compounds that are mediated by the fruit into the diet. Fruit is a good source of energy, carbohydrates, sugars, dietary fibre, vitamins and minerals. Fruit of some species also contains an amount of protein or fat.

From the most common cultivated fruits in Ethiopia mentioned in the chapter "Cultivated fruits", one of the fruits providing the highest energy is guava (*Psidium guajava* L.) with 68 Kcal per 100 g edible portion. It also has a relatively high and important bulk of protein, 2.6 g, and of vitamin C, 228.3 mg per 100 g of the edible portion of the fruit. The content of vitamin C in guava is significantly high and could have a good impact on the improvement of vitamin C deficiency.

Papaya (*Carica papaya* L.) has excellent potential in the improvement of vitamin A deficiency. Its content of vitamin A is more than five times higher than in guava, about four times higher than in mango and almost seventeen times higher than in orange. Energy

in the 100 g portion of papaya is 39 Kcal which is relatively low. Protein, iron, and vitamin C content are relatively negligible [32].

Mango's energy is 60 kcal in 100 grams. Content of protein, fait and dietary fibre is not highly significant. From vitamins, the highest rate is in vitamin C which is 34.6 mg per 100 grams. A 227-gram portion of mango covers the daily value intake of vitamin C. Out of the minerals, potassium is the best represented even though it is not that high. It is 168 mg/100 g which is still only 4 % of the daily value intake [33-35].

Avocado is thanks to its fat content high also in the provided energy. A 100-gram portion of an avocado provides 160 kcal, 15 grams of fat which covers 19 % of the daily value intake, 2 grams of protein, and 6.7 grams – 24 % of dietary fibre. Unlike other fruits, avocado is poor in carbohydrates. Their content is only 8.5 grams per 100-gram portion. In comparison with other cultivated fruit species, mango is relatively high in magnesium which is 29 mg/100 g, phosphorus 52 mg/100 g, and potassium 52 mg/100 g. Content of zinc in mango is significant and with 0,64 mg/100 g it provides approximately seven times higher amounts of this mineral than other fruits like mango, passion fruit or watermelon [33-35].

Passion fruit is another high source of energy fruit. In 100 grams it provides 97 kcal, with 22.4 grams of carbohydrates, of which 11.2 grams are sugars, 2.2 grams of protein and quite a high amount of dietary fibre – 10.2 grams. Passion fruit is also high in vitamin A and C, and in content of phosphorus and iron. 100 grams of passion fruit covers 8% of vitamin A, 36% of vitamin C, 10% of phosphorus, and 12% of iron daily value intake [33-35].

4.3.3. Fruit species cultivation limits in Ethiopian context

Diseases of fruit crops such as fungi, viruses, bacterias and nematodes are common source of problems in Ethiopian agriculture as well as insect pests, rodents, and birds. Fruit flies *(Ceratitis cosyra, C. fasciventris, C. rosa, C. anonae, and C. capitata, Bactrocera dorsalis, B. invadens),* aphids, thrips, two-spotted spider mites *(Tetranychus urticae),* white mango scale insects *(Aulacaspis tubercularis)* and many others are quite common source of the loss of harvest [36].

The most common insect pests are citrus attacking pests. Those are mainly med fly *(Ceratis capitata)* occurring in Awash valley, red scale *(Aonidiella aurantii)* cosmopolitan and codling moth *(Cryptophlebia leucotreata)* also occuring mainly in Awash valley [36]. Citrus trees' main disease is fruit and leaf spotting which can cause yield loses from 43 to 65 %.

For banana there are reported by research centre from Arba Minch some diseases which cause the reduction of banana production. These are bacterial wilt, Fusarium wilt (Panama disease), banana anthracnose, Sigatoka leaf spot, and banana bunchy topvirus. Fruit fly and banana spotting bug were the most common pests reported [37]. The most common affecting disease for banana is Burrowing nematode. It causes yield losses from 20 to 46 % [38].

The primary disease of enset, (*Ensete ventricosum),* is *Xanthomonas* wilt of enset (*Xanthomonas campestris* pv. *musacearum*) and infestation of enset root mealy bug (*Cataenococcus ensete*). Other not so damaging additional pests are nematodes, mole rat, porcupine and termites, and some other bacteria, fungal and viral diseases. Enset is a resistant plant, so only the first two diseases mentioned are essential [39].

4.3.4. Cultivated fruit species in Arba Minch Zuria

Arba Minch Zuria woreda is one of the zones with the most significant potential for fruit cropping. Major fruit species cultivated in Arba Minch Zuria are banana, mango, avocado, and papaya. There are mainly used the local fruit varieties. As well as in the majority of Ethiopia, the is a lack of knowledge and skills for the fruit plants harvesting [33].

4.4. Wild fruit species

4.4.1. Diversity

Asfaw and Tadesse (2001) established 203 species of wild plants that are consumed. From these, 37 % were herbs, 32 % shrubs, and 31 % were trees. From all of this, 61.6 % had edible fruits, following were leaves which made 27.7 %, stems with 14.4 %, roots with 13.3 %, and seeds with 10.3 %. They say that approximately 15 % of all these species are mainly used during the famine According this study, approximately 28,6 % of wild plants fruits are eaten raw and fresh. Usually, the fruit is eaten right after harvesting, not being processed. In some cases, the fruit is being harvested before they get ripe, and they are stored till the time they mature and ready to eat. This is done also to reduce the risk of being attacked by some pests [40].

4.4.2. Wild fruit species under domestication

In many sub-Saharan African countries, there are often cultivated plants which are also being sold. These have very wide ways of use. In addition to being used as food, they also have the function of a medicine, fodder, live fence, shade tree, etc. That is the reason why these species are often found nearby the human habitations. Among the most abundant species of this type which are found in Ethiopia there belong Carissa plum (*Carissa edulis*), the Abyssinian rose (*Rosa abyssinica*), raspberries (*Rubus* spp.) and the wild kei apple (*Dovyalis abyssinica*) [41].

4.4.3. Distribution of wild fruit species in Ethiopia

The richest distribution of edible species is in forests and in woodlands. Following in the number of species is in grasslands, bushlands, in rocky and dry areas, in cultivated places, in riverbanks and the least of them on the roadsides or in disturbed areas [42].

According to Tadesse and Asfaw research, there was a distribution of their two hundred and three species was such that 81 species were above 2400 m a. s. l., 148 species were at altitude between 1500 and 2400 m a. s. l., and 144 species were below 1500 m a. s. l. [42].

4.4.4. Wild fruit species suitable for Arba Minch region

Species suitable for domestication in the area of Arba Minch with high nutritious potential are *Moringa* spp., *Opuntia ficus-indica* (L.) Mill., *Physalis peruviana* L., *Dovyalis* spp., *Ziziphus spina-christi* (L.) Willd. and species *Rubus*. Fruits of some of these, e.g., *Moringa* spp. or *Opuntia* spp., are already sold in stores but they are still considered as wild or semi-wild [42]. According to another study done in Arba Minch, the conditions in Arba Minch are suitable for species like *Ximenia*, *Maytenus senegalensis* (Lam.) Exell and *Balanites aegyptiaca* Delile [42].

4.4.5. Nutritional potential of wild fruit species

Due to Fentahun and Hager (2009) indigenous people often do not use wild fruit sources with exceptions such as famine. The types of fruit they use are chosen regarding their nutritional importance which they expect from the concrete species [43].

Therefore, in study from Srivastava and Kumar (1998), an analysis was performed comparing the content of protein, fat, and carbohydrates in cultivated and wild representatives of the same species. The four most important species were researched, and their cultivated and wild growing forms were compared with their content of nutrients. Higher protein and fat content have been shown in wild individuals as well as the content of carbohydrates [44].

There was also found that some wild species offers very high amount of some vitamins. For example, the vitamin C content of *Mimusops kummel* Bruce ex A. DC. which is 148.6 mg/100g is almost ten times bigger than in mango which has 16 mg/100 g. Orange has 57 mg/100g of vitamin C and papaya with 12 mg/100 g is even lower in content of vitamin C. On the other hand, guava has with 212 mg/100 g the highest amount out of these. [43].

In the case of the amount of phosphorus, wild *Z. spina-christi* is an extreme. If compared with avocado which is quite known for its content of phosphorus in it, avocado has less than three times lower content of phosphorus in 100 g. In *Z. spina-christi* it is 261.8 mg/100 g while in avocado it is 80 mg/100 g, in papaya it is 40 mg/100 g, in banana it is 36 mg/100 g, in guava 28 mg/100 g and in mango it is 16 mg/100 g.

In the context of this study, therefore, it turns out that wild species can be very beneficial for the nutrition of the local population and can be of great importance to them [43].

The fruit of baobab (*Adansonia digitata* L.) seems to be the one with the highest potential because of its energy and vitamin C content, and also the amount of iron and calcium in the fruit is relatively high. Amount of vitamin C ranges from 126 to 509 mg per 100 g edible portion, iron is 6.2 mg and calcium 610 mg per 100 g of edible fruit portion [32]. Also, the iron content of *D. mespiliformis* is much higher than it is in several cultivated fruits [43].

Content of iron is the highest in Grewia species from founded species in Ethiopia, especially in *Grewia villosa* Willd.. Its amount is in the range of 7.4 to 20.8 mg per 100 g of edible portion. Also the content of calcium in grewia is significantly higher than in other mentioned fruit species. Its content of 610 mg of calcium per 100 g of edible portion is more than two times higher than in *A. digitata* fruit. In comparison with cultivated fruits like guava, mango or papaya, calcium content is approximately 30 times higher [32].

4.4.6. Pests and diseases

To make the fruit agronomy more powerful and to increase the fruit production, bigger managing progresses are necessary. The most important things for prevention of premature decline of the fruit plantations is managing the complexes of diseases and pests, bad quarantine protection and making some control mechanisms. As pest management practices leading to improved fruit production are outdated, cultivation conservation practices need to be updated to improve the situation regarding fruit growing. There is also lack of studies dealing with appropriate pest control practices in the country [31].

5. Conclusion

According to the species selection tool based on the VECEA Map, there were chosen nine species that this study found as significant and beneficial for its dietary content. Selection of these species was focused on the closest area of Arba Minch town.

Vegetation types that are surrounding to Arba Minch are Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket, and Dry *Combretum* wooded grassland. In these types of vegetation, it was searched for the matching species.

For these vegetation types that are the closest to area of Arba Minch were chosen species; *Adansonia digitata, Ziziphus spina-christi, Grewia bicolor, Sclerocarya birrea, Balanites aegyptiaca, Boscia mossambicensis, Tamarindus indica, Diospyros mespiliformis* and *Syzygium guineense.* All of these species would be very beneficial not only eaten fresh but also in the form of nutritional supplements.

Even though *Z. spina-christi* is quite low in calories, its content of phosphorus, 261.8 mg per 100 g of edible portion, is significantly high. In comparison with amount of phosphorus in other fruits, it is several times higher in *Z. spina-christi*. If compared with the same amount of *B. aegyptiaca*, bulk of phosphorus in *Z. spina-christi* is approximately 5 times higher. Another big fruit source of phosphorus is in *S. birrea* which has 104 mg of phosphorus per 100 g of edible portion. Even if it is less than a half of the phosphorus in *Z. spina-christi*, the amount is still many times higher than in other fruit species.

Grewia species was found as a great source of iron. 100 grams of the fruit brings 20 - 29.6 mg of iron [45]. Other good, even few times lower, fruit source of iron is *A. digitata. A. Digitata,* baobab, is mainly a source of vitamin C which ranges up to 509 mg/100 g of edible portion and of calcium with 610 mg. Baobab fruit contains 2,5% of protein [32].

D. mespiliformis has fruits with quite high nutritious value and contains also amount of vitamins B3. Even higher in vitamin B3 is already mentioned *S. birrea* which fruits are in vitamin B3 even three times higher than in fruits of *D. mespiliformis.*

Out of the species founded as suitable for cultivation in Arba Minch, *B. aegyptiaca* is highest in protein. Fruits of this species contain approximately 9% of protein. Due to

the lack of protein intake in the Ethiopian diet, this species should be included in the local diet for improvement.

These fruit species have a great potential for growing in Arba Minch region and were recognized as beneficial to the Ethiopian diet. They should make a significant contribution to the nutrition status of local people, especially for their content of dietary fibre, vitamins, and other micronutrients, which are deficient in the diet. At the same time, supplementation with these vitamins and dietary elements should reduce the incidence of various diseases that are caused by lack of them or alleviate their course.

A table of fruit species present in Ethiopia is displayed in Table 3.

SPECIES	FAMILY	COMMON NAME	GROWTH HABIT	EDIBLE PLANT PART USED	MODE OF CONSUM-PTION	OTHER USES	ECOLOGY	LOCATION IN ETHIOPIA
ADANSONIA DIGITATA	Malvaceae	Bamba (Am), Baobab (Eg)	tree	fruit	Ck/Rw	medicine	Bereha, Dry Kolla	
				shoots	Rw			
				leaf	Ck/Pr/Rw			
ANNONA MURICATA	Annonaceae	Soursop (Eg)	tree	fruit	Rw	medicine, ornamental, fish poison, insecticide	Dry, Moist and Wet Kolla	
ANNONA SENEGALENSIS	Annonaceae	wild custard apple (Eg), Giishta, Yebere lib (Am)	tree	fruit	Rw	medicine	Moist and Wet Kolla	A/G
				flower	Ck			
				leaf	Ck			
BALANITES AEGYPTIACA	Balanitaceae	Desert date (Eg), Bedeno, Jemo, Kudkuda (Am)	tree	fruit	Rw	medicine, oil	Dry, Moist Kolla	B/T/G/O/SN/F
				flower				
				shoots	Ck			
				leaf	Ck			
BALANITES ROTUNDIFOLIA	Zygophyllaceae	Alayaito (Am)	tree	seeds	Ck			SN/F
				fruit	Pr/Rw			
BERCHEMIA DISCOLOR	Rhamnaceae	Wild almond (Eg), Jejeba (Am)	tree	fruit	Rw	medicine	Dry, Moist Kolla	
BORASSUS AETHIOPUM	Arecaceae	African fan palm (Eg), Zembaba (Am)	tree	fruit	Rw	roots, flowers, medicine		G/O/B
				shoots	Rw			
BRIDELIA MICRANTHA	Euphorbiaceae	Yeneber tifer (Am)	tree	fruit	Rw		Moist Kolla, Weyna Dega	
BOSCIA MOSSAMBICENSIS	Capparaceae	Broad-leaved shepherds tree (Eg), Orkori (Am)	shrub/tree	fruit	Ck/Rw			G
CARICA PAPAYA	Caricaceae	Papaya (Eg)	tree	fruit	Ck/Pr/Rw			

SPECIES	FAMILY	COMMON NAME	GROWTH HABIT	EDIBLE PLANT PART USED	MODE OF CONSUM-PTION	OTHER USES	ECOLOGY	LOCATION IN ETHIOPIA
				seeds	Ck			
				flower (male)	Ck			
				leaf (young)	Ck			
CARISSA EDULIS	Apocynaceae	Bush plum (Eg), Agam (Am)	shrub/tree	fruit	Rw	medicine		T/A/B/O/G
CASIMIROA EDULIS	Rutaceae	White sapote, Mexican apple (Eg), Ado'adi (Am)	tree	fruit	Ck/Rw	environmental (shade), medicine		
				seeds	Ck			
CITRUS AURANTIIFOLIA	Rutaceae	Lime (Eg), Lomi (Am)	tree/shrub	fruit	Ck/Pr/Rw	medicine	Dry, Moist Kolla, Weyna Dega	B/G/E/SN
CITRUS MEDICA	Rutaceae	Citron (Eg), Tiringo (Am)	shrub/tree	fruit	Ck/Pr/Rw	medicine	Moist Kolla, Dry, moist and Wett Weyna Dega	
CITRUS RETICULATA	Rutaceae	Mandarin, Tangerine (Eg), Menderin (Am)	tree	fruit	Ck/Pr/Rw	medicine	Dry, Moist, Wet Weyna Dega	
CITRUS SINENSIS	Rutaceae	Sweet orange (Eg), Birtukan (Am)	tree	fruit	Pr/Rw	medicine	Dry, Moist Kolla, Weyna Dega	
				seeds	Rw	cooking oil		
				flower	Ck			
CITRUS × PARADISI	Rutaceae	Grapefruit (Eg)	tree	fruit	Pr/Rw	medicine		
				seeds	Ck/Rw	cooking oil		
CITRUS LIMON	Rutaceae	Lemon (Eg)	shrub/ tree	fruit	Ck/Pr/Rw	medicine		A/SN/O/B/H
				flower	Ck			

SPECIES	FAMILY	COMMON NAME	GROWTH HABIT	EDIBLE PLANT PART USED	MODE OF CONSUM-PTION	OTHER USES	ECOLOGY	LOCATION IN ETHIOPIA
COCCINIA GRANDIS	Cucurbitaceae	Gulo, Kulo, Gungulo, Lacheta, Buta (Am), Ivy gourd, Scarlet-fruited gourd, Tindori (En)	climber	fruit	Ck/Rw			
				leaves	Ck			
COMMIPHORA AFRICANA	Burseraceae	Anqa (Am)	tree	fruit	Rw	fodder, medicine, live fence, gum	Dry and Moist Kolla	
CORDIA AFRICANA	Boraginaceae	Wanza, Awhi (Am)	tree	fruit	ck/Rw	medicine	Dry, Moist and Wet Weyna Dega	B
CORDIA MONOICA	Boraginaceae	Sandpaper saucer-berry, Snot berry (Eg), Laem-mederto (Am)	tree	fruit	Rw	medicine, fuel, materials		T/A
CORDIA SINENSIS	Boraginaceae	Grey-leaved saucer berry, Grey-leaved cordia (Eg), Marer, Mnya mate, Kamasi, Tadana, Midir, Togoz, Chuwacho, Mederto (Am)	tree	fruit	Ck/Rw	medicicne		SN
				bark	Rw	gum		
DIOSPYROS MESPILIFORMIS	Ebenaceae	Kerenso, Jackalberry, African ebony, Jakkalsbessie (Eg), Ayeh (Am)	tree	fruit	Ck/Pr/Rw	medicine, envirnmental, materials	Bereha, Dry, Moist and Wet Kolla and Weyna Dega	B/G
DOBERA GLABRA	Salvadoraceae	Garas (Am)	shrub	fruit	Ck	parfume, materials, firewood	Dry and Moist Kolla	
				seed	Ck			
DOVYALIS ABYSSINICA	Salicaceae	Abyssinian gooseberry (Eg), Koshim (Am)	tree	fruit	Rw	live fence	Moist and Wet Weyna Dega	B
ERIOBOTRYA JAPONICA	Rosaceae	Loquat (Eg), Woshmella (Am)	tree	fruit	Ck/Pr/Rw	ornamental, medicine	Moist and Wet Weyna Dega	

SPECIES	FAMILY	COMMON NAME	GROWTH HABIT	EDIBLE PLANT PART USED	MODE OF CONSUM-PTION	OTHER USES	ECOLOGY	LOCATION IN ETHIOPIA
				seeds	Pr	coffee substitute		
EUCLEA SCHIMPERI	Ebenaceae	Dedeho (Am)	tree	fruit	Rw	firewood, materials	Dry, Moist and Wet Kolla and Weyna Dega	
FICUS CARICA	Moraceae	Adriatic fig, Common fig, Smyrna fig (Eg), Beles (Am)	tree	fruit	Pr/Rw	medicine	Dry, Moist, Wet Kolla and Weyna Dega	
FICUS SUR (F. CAPENSIS)	Moraceae	Cape fig, Broom cluster fig, Sycamore fig, Fig-mulberry, Sycomore (Eg), Shola (Am)	tree	fruit	Pr/Rw		Moist and Wet Weyna Dega	F/T/B/G/O/SN
FICUS SYCOMORUS	Moraceae	Sycamore fig (Eg), Bamba, Shola (Am)	tree	fruit	Ck/Pr/Rw	medicine, soil improvement	Moist and Wet Weyna Dega	F/B/G
				leaf	Ck			
				wood ash	Pr	salt substitute		
FICUS VASTA	Moraceae	Warka (Am)	tree	fruit	Rw			T/F/G
FLACOURTIA INDICA	Salicaceae	Endian plum (Eg)	tree	fruit	Ck/Rw		Dry and Moist Kolla and Weyna Dega	
GREWIA BICOLOR	Tiliaceae	Sefa, Somya, Teye (Am)	shrub/tree	fruit	Rw		Moist and Wet Kolla and Weyna Dega	SN
				leaf	Ck	tea		
				bark	Ck	beer		
GREWIA FERRUGINEA	Tiliaceae	Lenkoata (Am)	shrub/tree	fruit	Rw		Dry and Moist Weyna	B

SPECIES	FAMILY	COMMON NAME	GROWTH HABIT	EDIBLE PLANT PART USED	MODE OF CONSUM-PTION	OTHER USES	ECOLOGY	LOCATION IN ETHIOPIA
							Dega, Moist and Dry Kolla	
				seeds	Ck			
GREWIA VILLOSA	Tiliaceae	Lenquata (Am)	shrub	fruit	Rw		Moist and Wet Kolla and Weyna Dega	T/A
HYPHAENE THEBAICA	Arecaceae	Egyptian doum palm, Gingerbread tree (Eg), Zembaba (Am)	tree	fruit	Ck/Rw	Baskets, mats	Bereha and Dry and Moist Kolla	G
				seeds	Rw			
				apical bud	Ck			
				ash	Pr	salt substitute		
				seedlings	Ck			
MALUS DOMESTICA	Rosaceae	Apple (Eg)	tree	fruit	Ck/Pr/Rw			SN
MANGIFERA INDICA	Anacardiaceae	Mango (Eg), Mango (Am)	tree	fruit	Ck/Pr/Rw		Dry, Moist and Wet Kolla	B/C/A/D
MANILKARA BUTUGI	Sapotaceae	Butigi (Am)	tree	fruit	Rw		Weyna Dega, Dry, Moist and Wet Dega	
MIMUSOPS KUMMEL	Sapotaceae	Ishe, Shiye (Am)	tree	fruit	Rw/ Pr		Moist and Wet Weyna Dega	
MORINGA OLEIFERA	Moringaceae	Moringa, Shiferaw, Halloka (Eg)	tree	leaf	Ck/ Rw		Dry and Moist Kolla	
				shoots	Ck/ Rw			
				flower	Ck/ Rw			
				seed	Ck/ Rw			

SPECIES	FAMILY	COMMON NAME	GROWTH HABIT	EDIBLE PLANT PART USED	MODE OF CONSUM-PTION	OTHER USES	ECOLOGY	LOCATION IN ETHIOPIA
				root	Ck/ Rw			
				fruit	Ck/Pr/Rw			
MORUS ALBA	Moraceae	White mulberry (Eg), Yeferenji injori (Am)	tree	fruit	Pr/Rw		Dry, Moist and Wet Weyna Dega	B
				shoots	Ck (tea)			
				bark	Ck			
MUSA VELUTINA	Musaceae	Banana (Eg)	palm	fruit	Ck			SN
MUSA ACUMINATA	Musaceae	Muziferenji (Am)	palm	fruit	Pr/Rw			
				flower (male)	Ck/Rw			
				shoots	Ck			
MUSA X PARADISIACA	Musaceae	Muzii (Am)	palm	fruit	Ck/Rw			
				flower (male)	Ck/Rw			
				inner stem	Ck/Pr			
				ash		salt substitute		
				shoots	Ck			
NAUCLEA LATIFOLIA SM.	Rubiaceae	African peach (Eg)	shrub	fruit	Rw			G
				flower	Ck			
OLEA EUROPAEA SUBSP. AFRICANA	Oleaceae	The African Wild Olive, Brown olive, Olienhout, Iron tree (Eg)	tree					A
ONCOBA SPINOSA	Salicaceae	The snuff-box tree, Fried egg tree, Fried-egg flower (Eg)	shrub/tree	fruit	Rw			B/G/O
				seeds	Rw/Pr	oil		
OPUNTIA FICUS – INDICA	Cactaceae	Qolqol/Beles (Am)	shrub	fruit	Pr/Rw			A/T/G

SPECIES	FAMILY	COMMON NAME	GROWTH HABIT	EDIBLE PLANT PART USED	MODE OF CONSUM-PTION	OTHER USES	ECOLOGY	LOCATION IN ETHIOPIA
PERSEA AMERICANA	Lauraceae	Avocado (Eg,Am)	tree	fruit	Rw		Moist, Wet Weyna Dega	C
PHOENIX DACTYLIFERA	Arecaceae	Date palm (Eg), Yetemir zaf (Am)	palm	fruit	Ck/Pr/Rw		Bereha, Moist and Wet Kolla	
PHOENIX RECLINATA	Arecaceae	Wild date palm, Senegal date palm (Eg), Selen, Zembaba (Am)	palm	fruit	Ck/Rw	ornamental, wine	Dry and Moist Kolla and Weyna Dega	B
				seed	Ck	coffee substitute		
				sap				
PILIOSTIGMA THONNINGII	Fabaceae	Camel´s foot tree, Monkey bread (EG), Yekolla wanza (Am)	tree	leaves (young)	Ck/Rw	medicine	Moist and Wet Weyna Dega	
				fruit	Ck/Rw			
PITHECELLOBIUM DULCE	Fabaceae	Madras thorn, Manilla tamarind (Eg), Temar (Am)	tree	fruit	Ck/Rw		Dry and Moist Kolla	
				seed	Ck/Rw	oil		
PROSOPIS JULIFLORA	Fabaceae	Algarroba, Mesquite (Eg)	shrub/tree	flower	Rw		Bereha, Dry and Moist Kolla	
				Seedpods	Ck/Rw			
				seeds	Ck			
PRUNUS PERSICA	Rosaceae	Peach (Eg), Kock (Am)	tree	fruit	Rw		Moist and Wet Weyna Dega	
PSIDIUM GUAJAVA	Myrtaceae	Guava (Eg), Zeituna (Am)	shrub/ tree	fruit	Ck/Rw		Moist and Wet Weyna Dega and Kolla	
				seed	Oil			

SPECIES	FAMILY	COMMON NAME	GROWTH HABIT	EDIBLE PLANT PART USED	MODE OF CONSUM-PTION	OTHER USES	ECOLOGY	LOCATION IN ETHIOPIA
PUNICA GRANATUM	Lythraceae	Pomegranate (Eg)	shrub	fruit	Rw			
RHOICISSUS TRIDENTATA	Vitaceae	Bitter grape (Eg), Abab woldu, Wodel asfes (Am)	climber	fruit	Rw	medicine	Moist and Wet Weina Dega	
RHUS NATALENSIS	Anacardiaceae	Chakema, Takuma (Am)	shrub/tree	fruit	Rw	medicine, tea	Moist Weyna Dega	
				root	Ck			
RHUS VULGARIS	Anacardiaceae	Qmmo, Yeregna kolo (Am)	shrub/tree	fruit	Rw		Moist Weyna Dega	
ROSA ABYSSINICA	Rosaceae	Abyssinian rose (Eg), Kega (Am)	shrub/climber	fruit	Rw	medicine	Moist Weyna Dega and Dega	
RUBUS GENUS	Rosaceae	Blackberries (Eg)	herb	fruit	Ck/Rw			
SABA COMORENSIS (BOJ.) PICHON	Apocynaceae	Bungo fruit /mbungo/rubber vine (Eg), Goriza, Geri (Am)	climber	fruit	Rw			
				seeds	Rw			
SALVADORA PERSICA	Salvadoraceae	Toothbrush tree (Eg), Aday, Yeharer-mefaqya (Am)	shrub/tree	fruit	Rw	medicine	Bereha, Dry and Moist Kolla	
				leaves (young)	Ck/Rw			
				shoots (young)	Ck/Rw			
				seeds	Rw			
SCLEROCARYA BIRREA	Anacardiaceae	Marula (Eg)	tree	fruit	Ck/Pr/Rw	medicine		
				bark	Pr			
				root	Pr			
				leaves	Pr			

SPECIES	FAMILY	COMMON NAME	GROWTH HABIT	EDIBLE PLANT PART USED	MODE OF CONSUM-PTION	OTHER USES	ECOLOGY	LOCATION IN ETHIOPIA
SEARSIA NATALENSIS	Anacardiaceae	Dune karee/Natal karee/Northern dune currant/Northern dune currant-rhus (Eg)	shrub/tree	fruit	Rw			T
				root	Ck			
				leaves (young)	Rw			
STRYCHNOS INNOCUA	Loganiaceae	Inguachia/Merenz/Unguaka/Unguak-hebay (Am), Dull-leaved mukwakwa/Dull-leaved strychnos/Monkey orange/Wild orange (Eg)	shrub/tree	fruit	Rw		Moist and Wet Weina Dega	B
STRYCHNOS SPINOSA	Loganiaceae	Kaffir orange/Monkey balls/African orange (Eg)	shrub/tree	fruit	Pr	medicine	Dry, Moist and Wet Kolla	B
SYZYGIUM GUINEENSE	Myrtaceae	Waterberry (Eg), Dokma (Am)	tree	fruit	Ck/Rw	beverages, vinegar	Moist and Wet Kolla and Weyna Dega	B/O
TAMARINDUS INDICA	Fabaceae	Roka/Raku, Humer (Am), Tamarind (Eg)	tree	fruit	Ck/Pr/Rw		Bereha, Dry and Moist Kolla	B/G/O/SN
				flower	Ck/Rw			
				leaves (young)	Ck/Rw			
				seeds	Ck/Pr	coffee substitute, flour		
				seedpod	Rw/Ck			
VITELLARIA PARADOXA	Sapotaceae	Shea, Galam-buttertree, Bambouk-buttertree, Karite-nut (Eg)	tree	fruit	Rw/ Ck			G
				flower	Ck			
				seeds	Ck	shea butter		
VITEX DONIANA	Verbenaceae	Black plum (Eg), Plem (Am)	tree	fruit	Ck/Pr/Rw	wine, jams	Bereha, Dry and Moist and Wet Kolla	B/G
				leaves (young)	Ck	Tea		

SPECIES	FAMILY	COMMON NAME	GROWTH HABIT	EDIBLE PLANT PART USED	MODE OF CONSUM-PTION	OTHER USES	ECOLOGY	LOCATION IN ETHIOPIA
				shoots	Ck			
				seeds	Pr	coffee substitute		
WOODFORDIA UNIFLORA	Lythraceae		shrub	fruit			Moist and Wet Kolla, and Dry, Moist and Wet Weyna Dega	
XIMENIA AMERICANA	Olacaceae	Hog plum, Wild plum (Eg), Tutuqa (Am)	tree	fruit	Pr/Rw	medicine	Dry, Moist and Wet Kolla and Weyna Dega	A/B/G/O/SN
				flower (petals)	Ck			
				seed	Ck	ghee substitute		
				leaves (young)	Ck			
XIMENIA CAFFRA	Olacaceae	Large sourplum (Eg), Moqela/Hinkiketa (Am)	shrub/ tree	fruit	Rw			B/O
ZIZIPHUS MAURITIANA	Rhamnaceae	Jujube (Eg), Kurkura (Am)	tree	seeds	Rw		Dry and Moist Kolla	
				leaves (young)	Ck			
				fruit	Pr/Rw			
ZIZIPHUS MUCRONATA	Rhamnaceae	buffalo thorn (Eg), Geba (Am)	shrub/ tree	fruit	Ck/Pr/Rw		Bereha and Dry, Moist and Wet Kolla and Weyna Dega	SN
				leaves (young)	Ck			

SPECIES	FAMILY	COMMON NAME	GROWTH HABIT	EDIBLE PLANT PART USED	MODE OF CONSUM-PTION	OTHER USES	ECOLOGY	LOCATION IN ETHIOPIA
				seeds	roasted	coffee substitute		
ZIZIPHUS SPINA-CHRISTI	Rhamnaceae	Christ's thorn jujube (Eg), Kurkura (Am)	shrub/ tree	fruit	Ck/Rw/Pr		Bereha, Dry and Moist Kolla	Ethiopia

Table 3: Fruit species in Ethiopia

Legend: Ethiopia - in all regions, (G) Gambella,(D) Dire Dawa, (T) Tigray, (B) Benishangul Gumuz, (A) Amhara, (O) Oromia, (SN) South Nations, Nationalities and Peoples, (H) Harari, (C) Addis Ababa - The capital, (F) Afar, (Rw) raw, (Ck) cooked, (Pr) preserved, (Eg) English, (Am) Afar and Tigrigna, local - amhari

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8. References of figures

Figure 1:

Agroecological zonation system for selecting soil and water conservation (SWC) options in Ethiopia based on field observations (Hurni, 1986)

Figure 2:

Vegetation types surrounding Arba Minch, vegetationmap4africa.org,

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Figure 3:

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Figure 4:

Combretum – Terminalia woodland and wooded grassland on stony soil derived from the basement complex at the foothills in Ethiopia. Friis I, Demissew S. 2008.

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Figure 5:

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