Оригинальная статья / Original article

https://doi.org/10.18619/2072-9146-2024-1-26-35
УДК 634:005.59(63)

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Acknowledgments. The authors acknowledge all contributors, as well as the members of the journal's editorial board.

Conflict of interest. The authors certify that there are no potential conflicts of interest.

Authors' Contribution: All authors participated in the analysis of materials, writing the text of the article and forming conclusions.

Declaration of Generative AI and AI assisted technologies in the writing process. The authors declared that AI and AI-assisted technologies were used solely for checking the paper's readability.

For citation: Asmare M.T., Derero A., Deresu Z. Identification of community fruit tree preference and associated problems in South West Ethiopia. *Vegetable crops of Russia.* 2024;(1):26-35. https://doi.org/10.18619/2072-9146-2024-1-26-35

Received: 21.12.2023
Accepted for publication: 09.01.2024
Published: 19.02.2024

Identification of community fruit tree preference and associated problems in South West Ethiopia

ABSTRACT

Globally, preferences for fruit trees have fluctuated over time. However, the most desirable attribute of cultivated fruit tree species has not been consistent across all species and locations. Therefore, the purpose of this study was to determine farmers' preferences for fruit tree species and the associated problems they face in four different study sites, categorized by gender and family size. Equal sampling techniques were used in each selected study site, resulting in a total of 120 household heads participating in structured interviews. The data collected was then analyzed using SPSS version 26 software, utilizing the Mann-Whitney U and Kruskal-Wallis tests. Across the study sites, a total of fourteen fruit tree species from ten families were found to be preferred. The preference for fruit trees based on gender showed no significant difference among respondents between kebeles per woreda. However, the preference for fruit trees based on family size showed a significant difference between kebeles per woreda. The number of species preferred for their subsistence value was twice as large as those preferred for commercial reasons. The proportions of these preferred species and the percentage of observed problems with fruit trees varied significantly across the studied sites. Of all the interviewed household heads, 70% in Fenika, 36.6% in Kite, 66.6% in Shesheka, and 50% in Kometa kebeles encountered severe problems during fruit tree planting. The most common problems identified were disease or pest infestation, lack of expert support, land availability, knowledge, and access to seedlings. In order to address these issues, it is important to utilize indigenous knowledge and scientifically tested research approaches to alleviate the factors that influence farmers' preferences.

KEYWORDS:

Agroforestry, Farmers, Homestead, Preference, Species function

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Благодарности. Авторы выражают признательность всем авторам, а также членам редколлегии журнала.

Конфликт интересов. Авторы подтверждают отсутствие потенциальных конфликтов интересов.

Декларация о генеративном ИИ и технологиях, помогающих ИИ в процессе написания. Авторы заявили, что искусственный интеллект и технологии, основанные на искусственном интеллекте, использовались исключительно для проверки читабельности статьи.

Вклад авторов: Все авторы в равной степени принимали участие в написании статьи.
Для цитирования: Asmare M.T., Derero A., Deresu Z. Identification of community fruit tree preference and associated problems in South West Ethiopia. *Vegetable crops of Russia.* 2024;(1):26-35. https://doi.org/10.18619/2072-9146-2024-1-26-35

Поступила в редакцию: 21.12.2023
Принята к печати: 09.01.2024
Опубликована: 19.02.2024

Выявление предпочтений Сообщества по фруктовым деревьям и связанных с этим проблем на юго-западе Эфиопии

РЕЗЮМЕ

Во всем мире предпочтения фруктовых деревьев со временем менялись. Однако наиболее желательные характеристики культивируемых видов фруктовых деревьев не были одинаковыми для всех видов и мест. Таким образом, целью данного исследования было определить предпочтения фермеров в отношении видов фруктовых деревьев и связанные с этим проблемы, с которыми они сталкиваются на четырех различных участках исследования, сгруппированных по полу и размеру семьи. На каждом выбранном участке исследования использовались методы равной выборки, в результате чего в структурированных интервью приняли участие в общей сложности 120 глав домохозяйств. Собранные данные затем были проанализированы с использованием программного обеспечения SPSS версии 26 с использованием тестов Манна-Уитни U и Крускала-Уоллиса. На всех участках исследования было обнаружено, что в общей сложности предпочтение отдается четырнадцати видам фруктовых деревьев из десяти семейств. Предпочтений фруктовых деревьев по признаку пола не выявило существенных различий среди респондентов между муниципалитетами в округах. Однако предпочтение фруктовых деревьев в зависимости от размера семьи показало значительную разницу между муниципалитетами в округах. Число видов, предпочитаемых из-за их жизненной ценности, было в два раза больше, чем тех, которые предпочитались по коммерческим причинам. Пропорции этих предпочтительных видов и процент наблюдаемых проблем с фруктовыми деревьями значительно различались на исследуемых участках. Из всех опрошенных глав домохозяйств 70% в муниципалитетах Фенике, 36,6% в Ките, 66,6% в Шешеке и 50% в Комета столкнулись с серьезными проблемами во время посадки фруктовых деревьев. Наиболее распространенными выявленными проблемами были болезни или заражение вредителями, отсутствие экспертной поддержки, наличия земли, знаний и доступа к саженцам. Для решения этих проблем важно использовать местные знания и научно проверенные исследовательские подходы, чтобы смягчить факторы, влияющие на предпочтения фермеров.

КЛЮЧЕВЫЕ СЛОВА:

агролесомелиорация, фермеры, усадьба, предпочтение, видовая специфика

Introduction

The expansion of urbanization, climate change, and population growth has a critical impact on achieving food security [1, 2]. Recently, providing stable food to the world's population has become more challenging [1, 2]. People living in humid and sub-humid areas of the tropics have been better able to withstand these challenges by producing plantation and homestead fruit, in addition to engaging in agricultural activities [3]. In these areas, large-scale production of *Mangifera indica, Carica papaya,* and *Persea americana is common. Litchi chinensis, Nephelium lappaceum,* and *Durio zibethinus,* on the other hand, are produced and traded at a regional level in lower volumes compared to other tropical fruits.

Unlike those mentioned above, people living in arid and semi-arid parts of the country, whose livelihoods are based on rain-fed agriculture with short rotation cycles, face difficulties in obtaining stable food [4, 5]. In addition to climate-related factors, lack of knowledge in implementing and managing fruit-based agricultural activities, limited land availability, and delays in introducing cultivated fruit tree species contribute significantly to this situation. For example, in countries like Kenya and other sub-Saharan African countries, cultivated fruit trees were introduced and grown on a small scale after farmers received information on growing trees in their home gardens [6, 7]. During that time, most farmers preferred and grew tree species based on their fruiting ability, use as fuel, fodder, mulch, and suitability as support structures for climbers like pepper, betel vine, and various other climbers. As a result, both the number of trees and the extent of their cultivation increased to some extent in their home gardens [8].

Later on, local markets for fruits and tree products developed through barter trade as a response to subsistence needs. Women played a significant role in directly marketing the fruit yields. Families who took care of their tree stock would buy the tree products they needed and sold surplus products to others to make a profit [6]. In rural development initiatives, such activities by farmers (fruit tree and other tree growing) were considered a means of income diversification and employment opportunities. Although farmers' involvement in these initiatives was good, obtaining stable food from fruit trees became a question, especially in sub-Saharan African countries [9]. This is due to less attention being given to the growers' preferred species and growing practices compared to sustainable farming systems, as well as tenure pressure, market price fluctuations, lack of skills, and seedling bottlenecks [10]. Expanding fruit tree-based agroforestry practices in a participatory approach requires properly identifying the growers' preferences and documenting associated problems, as well as developing local capacity, suitable production methods, and a supportive political environment [7]. However, these aspects have been poorly studied in areas like the southwest region of Ethiopia. Therefore, this study aims to test (i) how gender and family size influence fruit growers' preferences and (ii) which criteria are commonly used by farmers when selecting fruit tree species across the studied sites.

Materials and methods

Site description

The research was conducted in Aman Zuriya woreda, specifically in the Shesheka and Kometa kebeles, as well

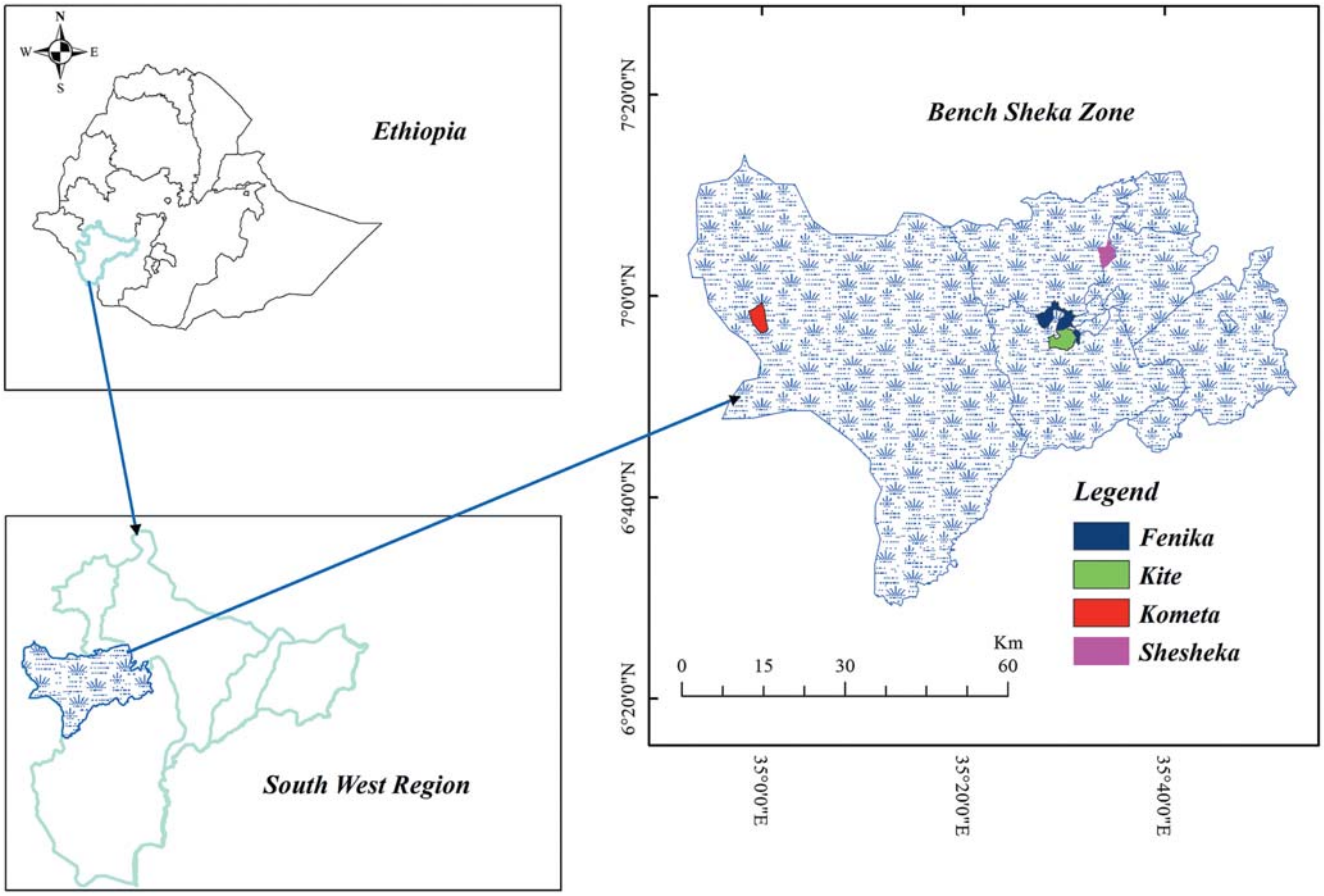

Figure 1. Study area map

as in Debub bench woreda, specifically in the Fenika and Kite kebeles. The Debub bench woreda was associated with a warm and humid agroecology, where both crops and livestock were combined in their farming system. The district had a total of agroecological zones ranging from 980 to 1900 meters above sea level, with 42.2% covered by midland zones and 57.8% covered by lowland zones. The rainfall in the area followed a bimodal pattern, with the major rainy season occurring from June to October and the minor rainy season occurring from March to May. The dry season lasted from November to February. The maximum and minimum temperatures recorded were 27.5 and 17.2 degrees Celsius, respectively, with an annual rainfall of 1800 millimeters [11-13]. Aman Zuriya Woreda is located approximately 570 kilometers from Addis Ababa and about 10 kilometers from Mizan Teferi Town. The topography in Aman is undulating, with elevations ranging from 1350 to 1400 meters. This location had an average annual rainfall of over 2200 mm and a temperature of 24 °C [14]. The soil in the area had a pH level of 5.5-6.5 and was quite deep and brown [15].

The site's dominant fruit tree species description

The fleshy stone fruit mango (*Mangifera indica*) is a member of the Mangifera genus, which is found in the Anacardiaceae family of flowering plants, along with a number of tropical fruiting trees. Mango (*Mangifera indica*) is grown in the majority of tropical and subtropical climates without frost. Currently, mango is grown in more than 85 nations worldwide, with a total of 3.69 million hectares of mango production space. However, the estimated 35 million tons of global mango production in 2009 was low [16]. The main locations for mango cultivation in Ethiopia are the Oromia, SNNPR, Benshangul, and Amhara regions. Despite being known as the king of fruit, mango production has faced challenges such as pest/disease outbreaks, poor management, absence of improved varieties with technology, postharvest loss, and climatic factors [17]. Mango fruit contains nearly every vitamin (A&C) and mineral (calcium, iron, thiamine, and niacin). Ecologically, mango is widely cultivated in warmer regions of the Dry, Moist, and Wet Kola agro-climatic zones. It does well in dry areas but does not tolerate flooding and prefers sandy-loamy soil that is well drained. Rockier subsoil should be avoided because roots penetrate it deeply. Water and nutrients are gathered by the numerous shallow roots in the upper soil layers. It grows best at elevations between 500 and 1,800 m.a.s.l [18].

The Lauraceae family includes *Persea americana*, a crop with a huge economic impact worldwide. Avocado is a famous tropical fruit tree native to tropical America, where it grows in a variety of habitats ranging from montane forests to coastal lowlands [18]. It grows well in Ethiopia's agro-climatic zones of Moist and Wet Weyna Dega (1,500-2,200 m). Despite being relatively new, avocado (*Persea americana*) production in Ethiopia has significantly increased in recent years. Private orchard owners in Hirna, Ethiopia's east, and Wondo Genet, Ethiopia's southwest introduced avocado to the country in 1938. Since then, avocado farming has spread to other regions of the nation. For example, the Jimma Agricultural Research Center (JARC) planted seedlings from Wondo Genet and Bishoftu to establish the nation's first avocado orchard in southwest Ethiopia in 1969. The most common applications for avocados include food (fruit), shade, cosmetics, and oil (fruit). Avocado exports are predicted to rise by 11% to about 2.5 million tons globally in 2021, mainly due to abundant supplies from Mexico and Peru, the top exporting nations. Avocados continue to be in high demand worldwide, and their profitable export prices have driven significant investments in area expansion in both countries. The Mexican government expects the country's avocado production to increase by 2% annually to 2.5 million tons in April 2021, primarily due to a 6% increase in area. Preliminary export data from Mexico indicates that 1.5 million tons will be shipped in 2021, a 7% increase [19].

Bananas are derived from the *Musa acuminate* and *Musa balbisiana* species. *Musa acuminate* is a Malaysian species, while *Musa balbisiana* is native to India. African bananas come in three varieties: East African Highland bananas, which are used for cooking and brewing beer, and African plantain bananas, which are primarily grown in Central and West Africa. Although the research system has made both dessert and cooking types/varieties of banana available, the types of varieties currently being produced in Ethiopia are dessert varieties that have been around since the early 1970s. In major banana-producing regions, farmers cultivate banana varieties that have been previously recommended, including *Poyo, Giant Cavendish, and Dwarf Cavendish* [20]. Bananas make up approximately 59.64% (53,956.16 hectares) of Ethiopia's total fruit area, around 68.00% (478,251.04 tons) of all fruits produced, and roughly 38.30% (2,574,035) of all farmers who grow fruit [21]. However, the Southern Nations Nationalities and Peoples' National Regional State (SNNPRS) is home to about 22.38% (1,504,207) of Ethiopia's banana producers, as well as 68.72% (37,076.85 hectares) of the country's banana-producing land [21]. Among the major banana-producing zones in the SNNPRS are the Bench-Maji, Sheka, and Gamo-Gofa zones, with the Gamo-Gofa zone alone producing more than 70% of the total banana sold in Ethiopia's major market outlets [22].

Methods

The research was conducted in two Woredas (districts): Debub Bench and Aman Zuriya of the Bench Maji zone. The study took place in September and October of 2019. Household heads from Debub Bench and Aman Zuriya Woreda in the southwest region's Bench Sheka zone were purposefully selected for structural questions. Two kebeles (Peasant associations) were purposely chosen in each Woreda based on their experience in producing fruit trees in home gardens. Market and road connectivity were also considered in the selection of households. Equal sampling approaches were used when selecting household heads from each kebele. In each kebele, 30 household heads underwent structured interviews. Before the interviews, the selected household heads and data collectors were given detailed explanations of the study's objectives. All study participants, including participating households, local communities, individual kebele administrations, district-level forestry offices, and agricultural offices, provided informed con-

sent before the survey data was collected. The research was conducted in accordance with research ethics and norms, and the organization's research directorate committee approved the data collection techniques. Discussions were held with randomly selected groups of household heads to identify common characteristics of fruit tree species across the specified kebeles (referred to as species function). Use categories (subsistence and commercial) and species biotic traits (disease resistance capability, drought resistance capacity, and stability of the fruit tree species) were frequently emphasized and used as criteria for species selection during data collection. Additionally, household heads were asked to choose their favorite species without considering the identified criteria. One household head selected one species as their general preference without any specific criterion. In the criteria-based fruit tree species choice, household heads identified all their preferred fruit tree species for each purpose. The most frequently chosen species (in general and for each function) among the interviewed household heads were then identified and rated. Respondents were also asked to describe the type and availability of problems encountered during tree planting. The frequency of the reported difficulties was recorded and appropriately encoded.

Data analysis

The data collected for this study was encoded, organized, and analyzed using Microsoft Excel spreadsheet program and SPSS (VR. 26) software. Before conducting the analysis, the Shapiro-Wilk normality test was applied to the scores assigned to the preferred species, the number of generally preferred species, the number and proportion of preferred species per function among kebeles, the presence of problems, the types of problems observed among kebeles, and the relationship between gender and family size class of the interviewed household heads. The family size classes were determined based on the mean, maximum, and minimum number of total families of the interviewed household heads. Two family classes (high and low) were created for each woreda. Household heads with a family size greater than or equal to 7 were classified as high, while those with a total family size below 7 were classified as low.

Before analyzing the data, the assumptions of the Mann-Whitney (U) and Kruskal-Wallis test (H) were carefully considered[23]. Kebeles, family size class, and gender class were considered as predator variables, while the proportion of general and specifically preferred species, as well as the percentage of problems encountered during fruit tree planting, were the response variables. The proportion of generally and specifically preferred species, as well as the percentage of problems observed among respondents in each woreda of the selected kebeles, were analyzed using the Mann-Whitney U and Kruskal-Wallis test, respectively, to compare the gender and family size classes. To analyze the response variables, the Kebeles category was used as a group (predator) variable in the Kruskal-Wallis test, while keeping the gender and family class factors constant. Stepwise Step-down multiple comparisons were conducted to determine if there were any significant differences among the tested parameters across kebeles.

Results and discussion

The percentage of male (69) household heads interviewed was slightly higher than that of females (51). Out of the total residents (6780) in the surveyed sites, 11.96% of the family members of the interviewed household heads were included in this study (see Table 1).

The preference for fruit tree species varied across woredas and kebeles. In Aman zuriya woreda, the top three preferred species were *Coffea arabica* (17.89%), *Musa acuminata* (16.26%), and *Ensete ventricosum* (13.41%). In Debub bench woreda, the top three preferred species were *Musa acuminata* (19.76%), *Coffea arabica* (14.29%), and *Ensete ventricosum* (14.23%). When considering the woreda classification, the top five preferred species in the study areas overall were *Musa acuminata* (18.03%), *Coffea arabica* (17.03%), *Ensete ventricosum* (13.83%), *Persea americana* (12.22%), and *Citrus sinensis* (11.42%). Although the number of preferred fruit tree species showed no significant difference, out of the four kebeles, only kite kebeles resident farmers preferred 14 fruit tree species (Table 2).

Table 1. Socio-demographic data of the study site

Woreda	Kebeles	Family size of the interviewed household		Gender of interviewed household heads		total population
		Male	Female	Male	Female	
Aman Zuriya	Kometa	155	96	19	11	2221
	Shesheka	101	66	18	12	2454
Debub Bench	Fenika	125	98	17	13	602
	kite	87	83	15	15	1503
	total	468	343	69	51	6780

Table 2. Fruit tree species preferred by farmers per each kebeles and woreda

Family name	Botanical name	Local name of species	Aman Zuriya				Debub Bench				Total score	Over all rank
			Shesheka (n=30)		Kometa (n=30)		Fenika (n=30		Kite (n=30)			
			score	rank	score	rank	score	rank	score	rank		
Annonaceae	*Annona squamosa*	*Gesheta*	10	4	13	6	16	5	2	8	41	6
Rosaceae	*Malus pumila*	*Apple*		np		np	2	9	1	10	3	10
Lauraceae	*Persea americana*	*Avocado*	18	2	14	5	18	4	11	4	61	4
Musaceae	*Musa acuminata*	*Banana*	18	2	22	2	24	1	26	1	90	1
Rubiaceae	*Coffea arabica*	*Coffee*	20	1	24	1	21	2	20	2	85	2
Musaceae	*Ensete ventricosum*	*Enset*	14	3	19	3	24	1	12	3	69	3
Moraceae	*Artocarpus heterophyllus*	*Jack fruit*		np		np		np	1	10	1	14
Anacardiaceae	*Mangifera indica hybrid*	*Hibered mango*		np		np	1	10	1	10	2	12
Rutaceae	*Citrus limon*	*Limon*	2	10		np	1	10		np	3	10
Anacardiaceae	*Mangifera indica*	*Mango*	10	4	6	9	15	6	8	6	39	7
Rutaceae	*Citrus sinensis*	*Orange*	10	4	17	4	20	3	10	5	57	5
Caricaceae	*Carica papaya*	*Papaya*	2	6	12	7	12	7	2	8	28	8
Rutaceae	*Citrus reticulata*	*Mandarin*	3	5	10	8	5	8		np	18	9
Myrtaceae	*Psidium guajava L.*	*Zeytuna*	1	7	1	10		np		np	2	12
Total			108		138		159		94		499	

Farmers were primarily attracted to the subsistence value (58.63%) of fruit tree species in the selected kebeles (Table 3), followed by the commercial value (28.51%). FAyE, Weber [24], and Dimobe, Tondoh [25] both reported that villagers preferred certain tree species for human food. The total weight of fruit tree species in terms of stable yield provision (4.2%), disease resistance (4.2%), and drought resistance (4.4%) was approximately equal. The number of species per function varied. Except for the subsistence and commercial categories, nine species were preferred for each function. The top two consistent yield-producing species were *Citrus sinensis* and *Persea americana*. Farmers selected *Musa acuminata* and *Coffea arabica* as the most drought-resistant species across all sites. *Psidium guajava* L., *Mangifera indica* hybrid, and *Artocarpus heterophyllus* had the lowest relative preference across functions. Variations in species preference among household heads could be attributed to the severity of difficulties encountered during fruit tree plantations.

Table 3. Fruit tree species preferred by farmers due to selected reasons in both woreda

Botanical name	Species local name	Subsistence	Commercial	Disease resistant	Drought resistant	Stable yield provision	Over all score	Rank
Annona squamosa	Gesheta	21	15	1	1	3	41	6
Malus pumila	Apple	3	Np	np	Np	Np	3	10
Persea americana	Avocado	33	15	6	3	4	61	4
Musa acuminata	Banana	59	18	5	5	3	90	1
Coffea arabica	Coffee	47	29	2	4	3	85	2
Ensete ventricosum	Enset	40	21	3	3	2	69	3
Artocarpus heterophyllus	Jack fruit	1	Np	np	np	Np	1	14
Mangifera indica hybrid	Hibered mango	1	1	np	np	Np	2	12
Citrus limon	Limon	1	2	np	np	Np	3	10
Mangifera indica	Mango	22	16	np	1	0	39	7
Citrus sinensis	Orange	30	17	1	4	5	57	5
Carica papaya	Papaya	21	4	1	1	1	28	8
Citrus reticulata	Mandarin	13	3	2	np	Np	18	9
Psidium guajava L.	Zeytuna	1	1	np	np	Np	2	12
Total		293	143	21	22	21	499	

In general 67 out of the 120 respondents' had experienced a lot of problem during fruit tree planting.

Table 4. Observed problem so far in the study sites

Response	Frequency	Percent
Hhs who hadn't exposed to variety of problems	53	44.16
Hhs who had exposed to variety of problems	67	55.83
Total	120	100.0

In the study area, the minimum and maximum numbers of preferred species were ten and fourteen, respectively. A small number of species were preferred based on their attributes of stability, yield provision, and other functions.

Variations in the number of preferred species may be related to the variability of the products and services of the resident peoples in Kebeles (Table 6). Levels of household income, education, age, and other

Table 5. Descriptive statistics on the generally and specifically preferred species across kebeles

Parameters	Mean±SD	Minimum	Maximum
Number of generally preferred species per kebeles	11.5±0.2	10	14
Number of species preferred for subsistence	8.13±0.34	4	10
Number of species preferred for commercial	8.65±0.19	7	10
Number of species preferred on disease resistance	3.71±0.19	2	4
Number of species preferred on drought resistant	3.77±0.23	1	4
Number of species preferred on stability	3.57±0.13	3	4

Note: SD is standard division

Table 6. The Kruskal-Wallis test result of extent of problem, specifically and generally preferred species in the study area

Ranked Parameters	Kebeles	N	Mean Rank	Median	H	DF	P- value
Proportion of preferred spp	Kometa	10	5.5	2.5[a]			
	Shesheka	11	21.5	2.75[b]			
	Fenika	12	38.5	3[c]			
	Kite	11	21.5	2.75[b]			
	Total	44		2.75	43	3	0.000
Proportion of pr.spp for subsistence function	Kometa	10	19.5	2[b]			
	Shesheka	8	4.5	1.6[a]			
	Fenika	12	19.5	2[b]			
	Kite	11	36	2.2[c]			
	Total	41		2	40	3	0.000
Proportion of pr. spp for commercial function	Kometa	8	11.5	1.6[a]			
	Shesheka	10	26.5	2[b]			
	Fenika	12	26.5	2[b]			
	Kite	7	4	1.4[a]			
	Total	37		2	36	3	0.000
Proportion of pr.spp of disease resistant function	Kometa	4	8.5	0.8[b]			
	Shesheka10	2	1.5	0.4[a]			
	Fenika	4	8.5	0.8[b]			
	Kite	4	8.5	0.8[b]			
	Total	14		0.8	13	3	0.005
Proportion of pr. of spp of drought resistant function	Kometa	4	7.5	0.8[b]			
	Shesheka	4	7.5	0.8[b]			
	Fenika	4	7.5	0.8[b]			
	Kite	1	1	0.2[a]			
	Total	13		0.8	12	3	0.007
Proportion of pr.spp of stability function	Kometa	3	2	0.6[a]			
	Shesheka	4	9.5	0.8[b]			
	Fenika	4	9.5	0.8[b]			
	Kite	4	9.5	0.8[b]			
	Total	15		0.8	14	3	0.003
Precent of observed problems	Kometa	10	17.5	12.5[b]			
	Shesheka	11	28	16.6[b]			
	Fenika	12	6.5	7.5[a]			
	Kite	11	39	19.2[c]			
	Total	44		14.6	42.8	3	0.000

Note: H is Kruskal-Wallis test; pr.spp= preferred species; median with the same letter across column had sown insignificant difference (P>0.05).

socio-demographic factors may contribute to the variation among the residents of the study sites. This finding supports the results of Okullo, Omujal [26], Omotayo and Aremu [27], Bigirimana, Omujal [28], and Leakey and Akinnifesi [29], who reported that the preference for indigenous fruit tree species differed across districts due to variations in socio-cultural background. Although Dimobe, Tondoh [25]and FAyE, Weber [24] did not specifically study fruit tree species, they also reported variations in tree or shrub species preferences among households across villages and regions. The proportion of preferred species and the percentage of observed problems across kebeles showed statistically significant differences in all tested parameters. This may be related to variations in the ability to withstand encountered problems and the level of awareness about managing these species. Household heads who are better able to handle existing problems are likely to have better species preferences and production than others. The Kruskal-Wallis test showed no significant difference ($P > 0.05$) in the proportion of preferred fruit tree species between Shesheka (median = 2.75, N = 11) and Kite (median = 2.75, N = 11) kebeles. On the other hand, the variation in the extent of the observed problem across kebeles may be related to their level of understanding and problem-solving mechanisms.

The types and extent of problems varied in each kebele. Of all the interviewed household heads, 70%, 36.6%, 66.6%, and 50% of them encountered severe problems during fruit tree planting in Fenika, Kite, Shesheka, and Kometa kebele, respectively. The observed problems faced by fruit tree growers had a cause-effect relationship. For example, diseases or pests and mortality were the effects, while the rest of the observed problems were categorized as causes of these effects on fruit tree species. The occurrence of disease or pests (28.36%) on the fruit tree species received the most attention from respondents. Similar problems were reported by the majority of fruit tree growers in other countries [30-35]. This may be due to the absence of disease-resistant varieties, lack of expert support, improper management practices, and insufficient knowledge about disease protection mechanisms. It was important to educate growers on proper pruning techniques for already planted fruit tree species in order to achieve sustainable fruit yields [30]. The presence of such diverse problems could strongly influence farmers' preferences for species selection for each function (Table 3).

The Mann-Whitney U test did not show a significant difference ($p > 0.05$) in all response variables between the genders of each selected woreda. These results un affirmed the findings of Sari, Saputra [36], who reported that the preference for fruit tree species varied significantly between male and female farmers due to differences in management, knowledge, and utilization. A previous study in the southern Philippines [37] also reported that male farmers preferred fruit trees over other crops, while female farmers preferred plantation crops and timber trees over fruit trees. The results showed that the low family class had a significantly greater proportion of preferred species and observed problems compared to the high family class ($U = 110$, $P < 0.001$, Table 8). This could be related to differences in awareness about the use of preferred species. The proportion of species' preference for subsistence in the high family class (median = 2, N = 10) had a statistically higher impact than the low family class (median = 1.6, N = 10) ($U = 0.00$, $P < 0.001$, Table 8). The highest (median = 2, N = 18) and lowest (median = 0.8, N = 7) values of the proportion of preferred species were observed in commercial and stability values, respectively, in relation to the overall five criteria between family classes (Table 8). This could also be attributed to variations in income sources or means of livelihood among communities.

Table 7. Types of problem encountered so far in planting fruit tree species in their homegarden

Woreda	Kebeles	Lack of polytube	Disease/ pest	Scarcity of support	Lack of knowledge	Lack of land	Seedling scarcity	Market prob.	Mgt.	Mortality	Wind damage
Debub Bench	Fenika	1	4	0	2	3	5	1	2	2	1
	Kite	0	3	0	2	2	1	0	1	2	0
Aman Zuriya	Shesheka	0	7	6	2	1	3	1	0	0	0
	Kometa	1	5	2	2	4	1	0	0	0	0
Total		2	19	8	8	10	10	2	3	4	1

Note: mgt. is management problem; market prob. is market problem.

Table 8. The Aman Zuriya woreda fruit tree species preference and precent of problem encounter of respondents' per family class

Rank	Family class	N	Mean Rank	Sum of Ranks	median	P-value	Mann-Whitney
proportion of preferred species per kebeles	High	10	6	60	5		
	low	11	15.5	171	5.5		
	Total	21			5.25	0.000	110.00
proportion of pr.spp for subsistence functions	High	10	15.5	155	2		
	low	10	5.5	55	1.6		
	Total	20			1.8	0.000	0.00
proportion of pr.spp for commercial functions	High	8	4.5	36	1.6		
	low	10	13.5	135	2		
	Total	18			2	0.000	80.00
proportion of pr.spp of disease resistant function	High	4	4.5	18	0 .8		
	low	2	1.5	3	0.4		
	Total	6			0.8	0.095	0.00
Proportion of pr. spp of drought resistant function	High	4	4.5	18	0.8		
	low	4	4.5	18	0.8		
	Total	8			0.8	1.000	8.00
Proportion of pr. spp of stability function	High	3	2	6	0.6		
	low	4	5.5	22	0.8		
	Total	7			0.8	0.570	12.00
precent of observed problem	High	10	6	60	12.5		
	low	11	15.5	171	16.6		
	Total	21			14.5	0.000	110.00

Note: High if member of family is 7 and low if not. pr.spp =preferred species.

Table 9. The Debub bench woreda fruit tree species preference and precent of problem encounter of respondents' per family class

Ranks	Family class	N	Mean Rank	Sum of Ranks	median	P value	Mann-Whitney U
Proportion of preferred species per kebeles	High	12	17.5	210	6		
	low	11	6	66	5.5		
	Total	23			6	0.000	132.00
Proportion of pr. spp for subsistence functions	High	12	14.5	174	2		
	low	8	4.5	36	1.6		
	Total	20			2	0.000	96.00
Proportion of pr. spp for commercial functions	High	12	13.5	162	2		
	low	7	4	28	1.4		
	Total	19			2	0.000	84.00
Proportion of pr. spp of disease resistance function	High	4	4.5	18	0.8		
	low	4	4.5	18	0.8		
	Total	8			0.8	1.000	8.00
Proportion of pr. spp of drought resistance function	High	4	3.5	14	0.8		
	low	1	1	1	0.2		
	Total	5			0.8	0.400	4.00
Proportion of pr. spp of stability function	High	4	5.5	22	0.8		
	low	3	2	6	0.6		
	Total	7			0.8	0.057	12.00
Precent of observed problem	High	12	6.5	78	7.5		
	low	11	18	198	19.16		
	Total	23			7.5	0.000	0.00

Note: High if member of family is 7 and low if not; pr.spp =preferred species.

Unlike the Aman Zuriya woreda, the results here showed that the low family class had a significantly lower proportion of preferred species (U=132, P<0.001) and observed problems (U=0.00, P<0.001) compared to the high family class (Table 9). As the number of species increased, respondents were more likely to be exposed to intensive land use, export support, and management work. The proportion of species preferred for subsistence function was statistically higher in the high family class (median = 2, N = 12) compared to the low family class (median = 1.6, N = 8; U = 0.00, P < 0.001, Table 9). In this site, the highest and lowest proportion of species preference between family classes were recorded for subsistence (N=20) and drought resistance (N=5) functions. The high family class preferred a relatively higher proportion of species for subsistence and commercial functions compared to others. The low family class preferred a relatively higher proportion of species for subsistence and drought resistance functions (Table 9). The heterogeneity among respondents may be attributed to the lack of alternative means of subsistence and the availability of skilled manpower. In contrast to the overall five functions, the subsistence and drought resistance functions had the highest (median = 2, N = 20) and lowest (median = 0.8, N = 5) values of the proportion of the number of preferred species (Table 9). This could also be related to differences in the source of income or means of subsistence among communities.

Generally, there was a statistically significant difference in the impact of family size on the proportion of general and specifically preferred fruit tree species between the kebeles of Aman Zuriya and Debub Bench Woreda. This impact can be divided into two aspects. The first aspect is the number of educated family members in the household, while the second aspect is the number of uneducated family members. In Aman Zuriya Woreda, the preference for fruit tree species increased as the family size decreased. However, the opposite was observed in Debub Bench Woreda. The variation in awareness about fruit trees among household members could play a significant role in this difference. In both woredas, the proportion of species based on subsistence function was higher compared to others. In Debub Bench Woreda, the percentage of problems observed during fruit tree species planting increased as the family size increased. This suggests that households may prioritize the product rather than the management of the preferred species. It also indicates that there is a lack of measures in place to address problems on the site. In both Debub Bench and Aman Zuriya Woreda, high-class households had (median = 2) a higher preference for fruit tree species for subsistence function compared to lower-class households. The proportion of species preference based on yield supply capacity, disease resistance capacity, and drought resistance capacity showed no significant difference between high and low family classes (median = 1.6) in each woreda. This indicates that respondents were more focused on the food and sale functions, regardless of the attributes of the fruit trees.

Conclusions

Planting fruit tree species has numerous benefits for the community. Among the farmers in the study sites, the most common functions of fruit trees were subsistence, commercial value, and stable yield provision. However, farmers' preferences for fruit tree species varied from place to place, with some favoring specific functions over general ones. Interestingly, family size had a significant impact on species preference and the identification of associated problems, unlike gender. In the study, out of all the household heads interviewed, 90 preferred Musa acuminata, 85 preferred Coffea arabica, and 69 preferred Enset ventricosum as their top three fruit tree species. Only one respondent preferred Artocarpus heterophyllus, while two preferred Psidium guajava L. The most commonly observed problems associated with fruit tree planting were disease and pests, scarcity of seedlings, lack of land, knowledge, and expert support. Therefore, there is a need for research on proper management techniques and disease or pest protection mechanisms for fruit tree species.

● Литература / References

1. Ristaino J.B., et al., The persistent threat of emerging plant disease pandemics to global food security. *Proceedings of the National Academy of Sciences.* 2021;118(23):e2022239118. DOI:10.1073/pnas.2022239118.
2. Lange K.W., Nakamura Y. Edible insects as future food: chances and challenges. *Journal of future foods.* 2021;1(1):38-46. DOI:10.1016/j.jfutfo.2021.10.001.
3. Dagar J.C., Singh A.K., Arunachalam A. Agroforestry systems in India: livelihood security & ecosystem services. Vol. 10. 2013. Springer.
4. Kakota T., et al. Determinants of Household Vulnerability to Food Insecurity: A Case Study of Semi-Arid Districts in Malawi. *Journal of International Development.* 2015;27(1):73-84. DOI:10.1002/jid.2958.
5. Aworh O.C. Food safety issues in fresh produce supply chain with particular reference to sub-Saharan Africa. *Food Control.* 2021;(123):107737. DOI:10.1016/j.foodcont.2020.107737.
6. Arnold J., Dewees P.A. Trees in managed landscapes: factors in farmer decision making. *Agriculture in Sustainable Agricultural Systems.* 1999: p. 277-294.
7. Nair P.R., Rao M., Buck L. New Vistas in Agroforestry: A Compendium for 1st World Congress of Agroforestry. 2004. Vol. 1. 2004: Springer Science & Business Media.
8. Nair C. Socio-economic Factors Influencing Farm Forestry: A Case Study of Tree Cropping in the Homesteads in Keralla, India. Community forestry: socio-economic aspects, 1984.
9. Jamnadass R.H., et al. Improving livelihoods and nutrition in sub-Saharan Africa through the promotion of indigenous and exotic fruit production in smallholders' agroforestry systems: a review. *International forestry review.* 2011;13(3):338-354. DOI:10.1505/146554811798293836
10. Pattanayak S.K., et al. Taking stock of agroforestry adoption studies. *Agroforestry systems.* 2003;57:173-186. DOI:10.1023/A:1024809108210.
11. Tulu D., Urge B. Prevalence and Associated Risk Factors of Ectoparasite of Sheep and Goat in Yeki district in Southwestern Ethiopia. *Journal of Veterinary Medicine and Research.* 2018;5(7):1147.
12. Gebisa G., et al. Prevalence of Bovine Trypanosomosis and Its Associated Risk Factors in Nano and Gudeya Bila Districts of Oromia Regional State, Ethiopia. 2020;10(15):1-8. DOI:10.7176/JBAH/10-15-05.
13. Melese M., Bezabih A. Prevalence of Bovine Trypanosomosis in Selected District of Benchi Maji, South Ethiopia. 2020;8:14.
14. Mihret M., Performance of Pinus taeda Progenies at Aman and Bonga. 2004.
15. Murphy H.F. A report on the fertility status and other data on some soils of Ethiopia. 1968.
16. Hussen S., Yimer Z. Assessment of production potentials and constraints of mango (*Mangifera indica*) at Bati, Oromia zone, Ethiopia. *International Journal of Sciences: Basic and Applied Research.* 2013;11(1):1-9.
17. Bezu T., Woldetsadik K., Tana T. Production scenarios of mango (*Mangifera indica* L.) in harari regional state, Eastern Ethiopia. *Science, Technology and Arts Research Journal.* 2015;3(4):59-63. DOI:10.4314/star.v3i4.8.
18. Bekele-Tesemma A., Birnie A., Tengnas B. Useful trees and shrubs for Ethiopia. Regional Soil Conservation Unit (RSCU), Swedish International Development Authority (SIDA), 1993.
19. FAO, Banana Market Review–Preliminary Results 2020. Food and Agriculture Organization of the United Nations (FAO), 2021.
20. Woldu Z., et al. Assessment of banana production and marketing in Ethiopia. *International Journal of Sciences: Basic and Applied Research.* 2015;24(3):283-307.
21. Macro O. Central Statistical Agency Addis Ababa, Ethiopia. Central Statistical Agency Addis Ababa, Ethiopia, 2006.
22. Alemu M.M. Banana as a cash crop and its food security and socioeconomic contribution: The case of Southern Ethiopia, Arba Minch. *Journal of Environmental Protection.* 2017;8(3):319-329. DOI:10.4236/jep.2017.83024.
23. Sheskin D. Handbook of parametric and nonparametric statistical procedures. CRC Press. Boca Raton, FL., 2003. https://doi.org/10.1201/9781420036268.
24. Faye M.D., et al. Farmers' preferences for tree functions and species in the West African Sahel. Forests, Trees and Livelihoods. 2011;20(2-3):113-136. DOI:10.1080/14728028.2011.9756702.
25. Dimobe K., et al. Farmers' preferred tree species and their potential carbon stocks in southern Burkina Faso: Implications for biocarbon initiatives. *PloS One.* 2018;13(12):e0199488. DOI:10.1371/journal.pone.0199488.
26. Okullo J.B., et al. Farmers' Use of Indigenous Fruit Trees to Cope With Climate Variability in the Lake Victoria Basin Districts of Uganda. 2022.
27. Omotayo A.O., Aremu A.O. Underutilized African indigenous fruit trees and food–nutrition security: Opportunities, challenges, and prospects. *Food and Energy Security.* 2020;9(3):e220. DOI:10.1002/fes3.220.
28. Bigirimana C., et al. Utilisation of indigenous fruit tree species within the Lake Victoria Basin, Rwanda. *Agricultural Science International Journal.* 2016;1:1-3.
29. Leakey R., Akinnifesi F. Towards a domestication strategy for indigenous fruit trees in the tropics, in Indigenous fruit trees in the tropics: domestication, utilization and commercialization. 2008, CABI Wallingford UK. p. 28-49.
30. Lauri P., Laurens F. Architectural types in apple (*Malus X domestica* Borkh.). Crops: growth, quality and biotechnology. 2005: p. 1300-1314.
31. Lock K., et al. The global burden of disease attributable to low consumption of fruit and vegetables: implications for the global strategy on diet. *Bulletin of the World health Organization.* 2005;83:100-108.
32. Rahman G., et al. Fruit tree based agroforestry practices in char land farming system. *J. Agrofor. Environ.* 2014;8(1):1-6.
33. Rahman M.R., Hossain M., Alam M. Prospects and problems of fruittree cultivation in Khagrachari Sadar Upazila. *Int J Usuf Mngt.* 2017;18(2):13-24.
34. Licciardello C., et al. Functional genomics in fruit trees: from 'Omics to sustainable biotechnologies. 2021, Frontiers Media SA. p. 729714.
35. Ihli H., et al., Preferences for tree fruit market attributes among smallholder farmers in Eastern Rwanda. *Agricultural Economics.* 2022;53(1):5-21. https://doi.org/10.1111/agec.12673.
36. Sari R.R., et al. Gendered species preferences link tree diversity and carbon stocks in cacao agroforest in Southeast Sulawesi, Indonesia. *Land.* 2020;9(4):108. DOI:10.3390/land9040108.
37. Ureta J., et al. Exploring gender preferences in farming system and tree species selection: Perspectives of smallholder farmers in Southern Philippines. *Journal of Environmental Science and Management.* 2016;(1):56-73. DOI:10.47125/jesam/2016_sp1/05.

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