Asian Journal of Agricultural and Horticultural Research

Volume 11, Issue 4, Page 27-36, 2024; Article no.AJAHR.120144
ISSN: 2581-4478

Opportunities and Constraints of Promoting Coffee Plantation in Southern Tigray, Ethiopia

Abrhaley Shelema [a*], Hagos Kidane [b++], Yibrah Gebremedhin [c#] and Harnet Abraha [d]

[a] Department of Horticulture, Tigray Agricultural Research Institute, Alamata Agricultural Research Center, P.O.Box56 Alamata, Ethiopia.
[b] Tigray Agricultural Research Institute, Mekelle, Ethiopia.
[c] Netherlands Development Organization (SNV), Mekelle, Ethiopia.
[d] National Agricultural Research Council, Adis Ababa, Ethiopia.

Authors' contributions

This work was carried out in collaboration among all authors. Author AS gathered and evaluated the data, and drafted the manuscript. Author HK formulated and planned the study, gathered and evaluated the data. Author YG assisted with data interpretation, and conducted a thorough review of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ajahr/2024/v11i4337

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/120144

Original Research Article

Received: 28/05/2024
Accepted: 30/07/2024
Published: 17/09/2024

ABSTRACT

In Ethiopia, coffee is a significant crop, but in the Tigray region, particularly southern Tigray, it receives less emphasis despite its national importance. This study investigates the status of coffee production in southern Tigray, Ethiopia, using a multistage sampling technique to gather data from

---

[++] Socioeconomics and Research Extension Directorate Deputy Director, Agricultural Extension Researcher;
[#] Senior Horticulture Expert;
**Corresponding author: Email: shelemaab@gmail.com;*

Cite as: *Shelema, Abrhaley, Hagos Kidane, Yibrah Gebremedhin, and Harnet Abraha. 2024. "Opportunities and Constraints of Promoting Coffee Plantation in Southern Tigray, Ethiopia". Asian Journal of Agricultural and Horticultural Research 11 (4):27-36. https://doi.org/10.9734/ajahr/2024/v11i4337.*

113 respondents during 2015. The goal is to identify opportunities and constraints in coffee production in the region. Data were collected using individual interviews and Focus Group Discussions, and analyzed using SPSS software and a ranking index. The study found that favorable agro ecology, fertile soils, accessibility to water, and existence of tolerant coffee varieties are the opportunities in southern Tigray, Ethiopia. However, constraints include irrigation competition, lack of training, limited input use, and shifting to khat (Catha edulis) cultivation. Additionally, most farmers do not practice pruning and rejuvenation due to lack of technical knowledge. This result in the coffee plants stand; more erect, less branched and unmanageably tall which rendering difficult to harvest berries. Hence, the study suggested that an integrated coffee production intervention is important to boost coffee production and local policy instrument is prerequisite that restrict the shifting of coffee to khat production in the study districts.

Keywords: Coffee; focus group discussions; ranking index; coffee plantation; coffee production.

1. INTRODUCTION

Coffee (*Coffea arabica* L.), is the second most traded commodity in the world market after oil, which have an estimated export worth of 36.3 billion USD in 2021 [1]. Coffee is one of the sources of foreign currency and the production was reached up to 441,000 metric ton during 2017, which accounts for more than 4% of the national GDP, 10% of agricultural production, and more than 37% of total export earnings of Ethiopia [2], the mean values of coffee exported between the years 1980 and 2017 was about 4,167.57 in millions of Birr. In the long run, coffee exports have significant positive impact on economic growth of the country [3].

Arabica coffea is believed to have originated in Ethiopia's humid high rain forests in the south and southwest. Ethiopia is renowned for producing high-quality coffee beans, known for its distinct aroma and flavor characteristics. Coffee varieties such as Sidamo, Yirga-chafe, Harar, Gimbi, Jimma, and Limmu are particularly acclaimed for their unique characteristics [4]. Flavor is the most crucial component of coffee quality standards, as it has a significant and direct impact. It can be used for indirect selection to enhance the overall organoleptic quality of coffee [5]. Ethiopia is a significant source of genetic resources for *Coffea arabica*, which is cultivated in most parts of the tropics and accounts for 80% of the world coffee market. Coffee production plays a vital role in generation of income and employment in developing countries like Africa, Asia, and Latin America [6].

Coffee from certain regions, such as Harar and Yirga-chafe in Eastern and Southern Ethiopia is highly valued due to its fine quality and appropriate processing methods, resulting in premium prices both domestically and internationally [7]. Similarly, in southern Tigray's Raya Azebo district, coffee is sold at a premium price of at least 10-20% additional price over the local price at the local market (district level). Woreda experts and producer farmers in the area believe that their coffee is of high quality, resembling Harar type quality coffee [8].

Despite the significance of coffee in Ethiopia, the average productivity is low, estimated to be 700-800 kg/ha, is considered to be lower compared to other countries, such as Brazil, Vietnam and Colombia [9-11]. Several authors have identified limited adoption of improved technologies and recommended package of practices by most smallholder farmers, widespread prevalence of insect pests, diseases, and weeds are the major reasons for the low yield [12,13].

Similar to the national context, coffee productivity in Tigray is also very low which estimated is that 619 kg/ha, falling below the national average of 683 kg/ha [10]. Despite emphasis from governmental and non-governmental organizations, the production of coffee instead of khat in Tigray, particularly in the lowland areas of southern Tigray, there is lack of integrated interventions at the grassroots level. Additionally, despite efforts by these agencies to promote coffee production, there is limited research on the existing opportunities and constraints of coffee production in the study area. Given the low productivity of coffee in Tigray and the limited information on coffee production opportunities and constraints in this region, the present study was conducted to identify the major factors in this region. The findings of this study can serve as a foundation for further research and development in coffee production, as well as enable the policymakers to understand the gaps in the zone and beyond in the region.

2. MATERIALS AND METHODS

2.1 Area Description of the Study Area

The study was conducted in the major coffee-growing districts of Raya Alamata and Raya Azebo during 2015 in the southern zone of Tigray Regional State. Geographically, Raya Azebo district is situated between 12.32° - 12.95° North latitude and 39.56° - 39.98° East longitude, while Raya Alamata district is located between 12.26° - 12.57° North latitude and 39.24° - 39.76° East longitude (Fig. 1). The total annual rainfall for Raya-Alamata and Raya-Azebo is 650 mm and 600 mm, respectively. Both districts experience bimodal rainfall patterns. Raya-Azebo has light rainfall from February to April and heavy rains between July to September, while heavy rainfall for Raya-Alamata occurs between June and September. The average temperature is 25°C and 24°C for Raya-Alamata and Raya-Azebo, respectively [14].

2.2 Sampling Procedure and Sample Size

The multistage sampling procedure was employed to select sample respondents. Firstly, two districts, via; Raya Alamata and Raya Azebo were selected purposively based on their experience in growing coffee at least farmers who started to harvest coffee. Secondly, six kebeles (four from Raya Azebo and two from Raya Alamata) districts were also selected purposively based on their potential in growing coffee. Thirdly, sample respondents were selected randomly based on their proportion to sample size from list of households who involved on coffee production in the selected six kebeles. Finally, a total of 113 respondents were drawn to accomplish the study (Table 1).

2.3 Data Sources and Data Collection Methods

In this study, both primary and secondary data sources were utilized. Primary data was primarily collected from sampled respondents through individual interviews. Additionally, focused group discussions with district experts from the agricultural office and key informants were employed to supplement the study. Secondary data sources were also used from published journals and unpublished reports and documents.

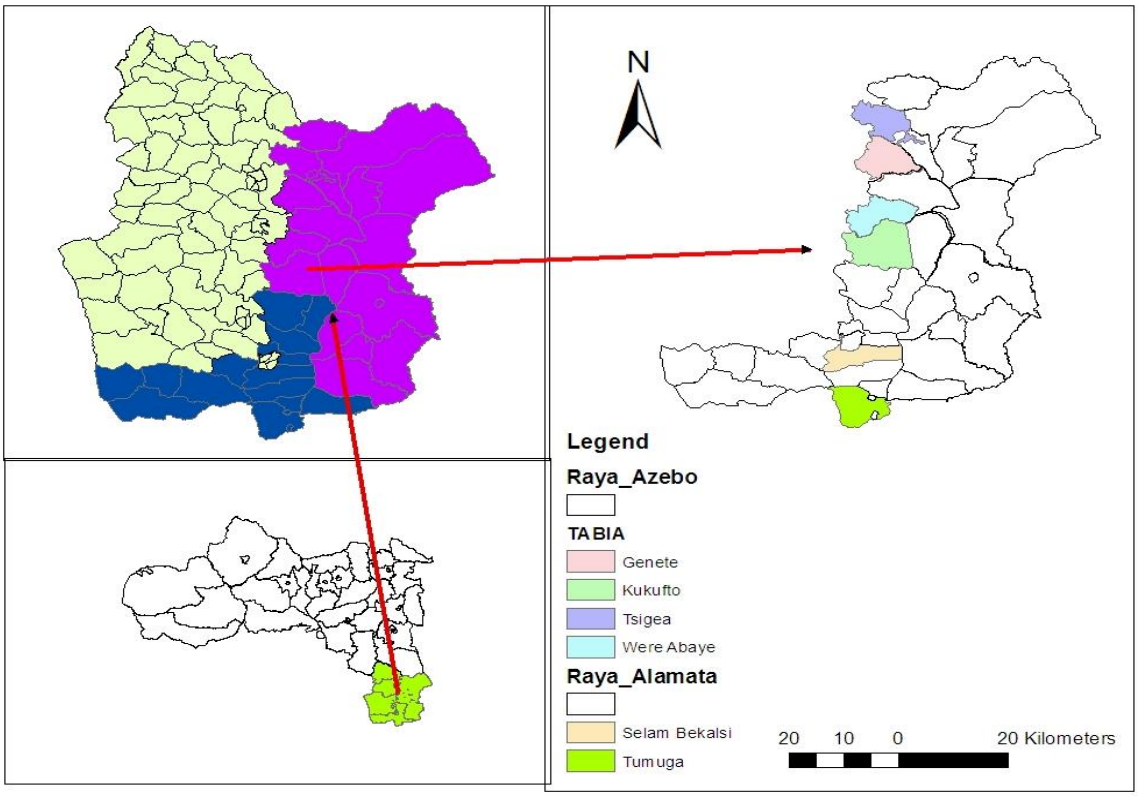

Fig. 1. Map of the study area (Arc Map, 2013)

Table 1. Distribution of sample respondents by Woreda and kebele

Districts	Selected kebeles	Sample taken
Raya Azebo	Hijira werabaye	43 (38.1%)
	Tsigi'a	23 (20.4%)
	Beyru kalian	7 (6.2%)
	Genete	23 (20.4%)
Raya Alamata	Tumuga	7 (6.2%)
	Selambikalsi	10 (8.8%)
Total	6	113 (100%)

Source: Survey data 2015

2.4 Data Analysis Method

The collected data were analyzed using SPSS software and the ranking index method. The ranking analysis was employed to assess the opportunities and constraints of coffee production and the economic importance of horticultural crops using the ranking index method [15]. The ranking index was calculated using the following formula, which has been used by several scholars, including [16], to study the opportunities and constraints of community-based seed production in southern Tigray. The results of the study were presented descriptively. In this study, we used three scales (first, second and third) level on the questionnaire to collect the data on economic importance of the horticultural crops, and to know the major opportunities and constraints of coffee production in Tigray.

*Rank index= Sum (number of farmers the crop rank first*8+ number of farmers the crop rank second*7+ number of farmers the crop rank third*N+…number of farmers the crop ranked last *1) for individual statements economic importance, opportunity or constraint divided by Sum (number of rank first*8+ number of rank second*7+number of rank N*6+…number of ranked last*1) for all statements economic importance, opportunity or constraints.*

Value is assigned according to the ranking order, and the highest value was given for the first rank and lowest value of one for the least rank.

3. RESULTS AND DISCUSSION

3.1 Economic Importance of Coffee Production in Southern Tigray

Farmers in studied districts had grown different types of crops including stimulants like *khat* which have different levels of economic importance on their livelihood. According to ranking index, coffee, khat, and papaya respectively, are the first, second and third in that order based on their economic importance (Table 2). The coffee, khat, and papaya were the top three crops, which have about 40.0%, 33.20%, and 8.10% respectively, an economic importance in the studied districts. Besides, gesho (6.62%), guava (4.30%), orange (4.00%), and mango (2.95%) are among the other economic important crops in the area (Table 2). The present study is consistent with the national context of Ethiopia which states that, farmers are more likely to grow and produce stimulant crops like coffee and khat compared to those of fruits. These crops have a larger area and production, and their holders earn a significant amount of cash as to the report of Central Statistics Agency khat and Coffee shared 2.26% and 5.69% of the area under all crops under small peasant holders in the country and 3,113,999.39 and 5,847,895.69 quintals of produce was obtained from these crops in 2020 production year respectively [17].

3.2 Management Practices Followed by Coffee Producer Farmers in Southern Tigray

According to the recent study using modern production practices can sizably improve the production and productivity of Ethiopian coffee [11]. The most important practices for enhancing coffee productivity and quality include the use of inputs, shade, intercropping, pruning, and rejuvenation. However, the analysis shows that the use of inputs for coffee is very low, with the majority of farmers (84.5%, 98.2%, and 78.6%, respectively) not using fertilizers, pesticides, and improved seeds/seedlings (Fig. 2). Pruning operation in coffee tree is a crucial pre-harvest management practice that reduces disease incidences, modifies air movement within the plantation, reduces leaf drying time, and maintains the framework of plants in a desired

Table 2. The rank of major fruits based on their economic importance (N=113)

Type of fruits	Ranked 1st	Ranked 2nd	Ranked 3rd	Total	Index	Rank
Coffee	37*3	54*2	9*1	228	0.396	1st
khat	52*3	16*2	3*1	191	0.332	2nd
Papaya	11*3	5*2	4*1	47	0.081	3rd
Gesho	7*3	7*2	3*1	38	0.066	4th
Guava	4*3	6*2	1*1	25	0.043	5th
Orange	2*3	2*2	13*1	23	0.040	6th
Mango	0*3	3*2	11*1	17	0.0295	7th
Banana	0*3	1*2	4*1	6	0.0104	8th
N	113	94	48	575	1.00	

Source: Survey data 2015

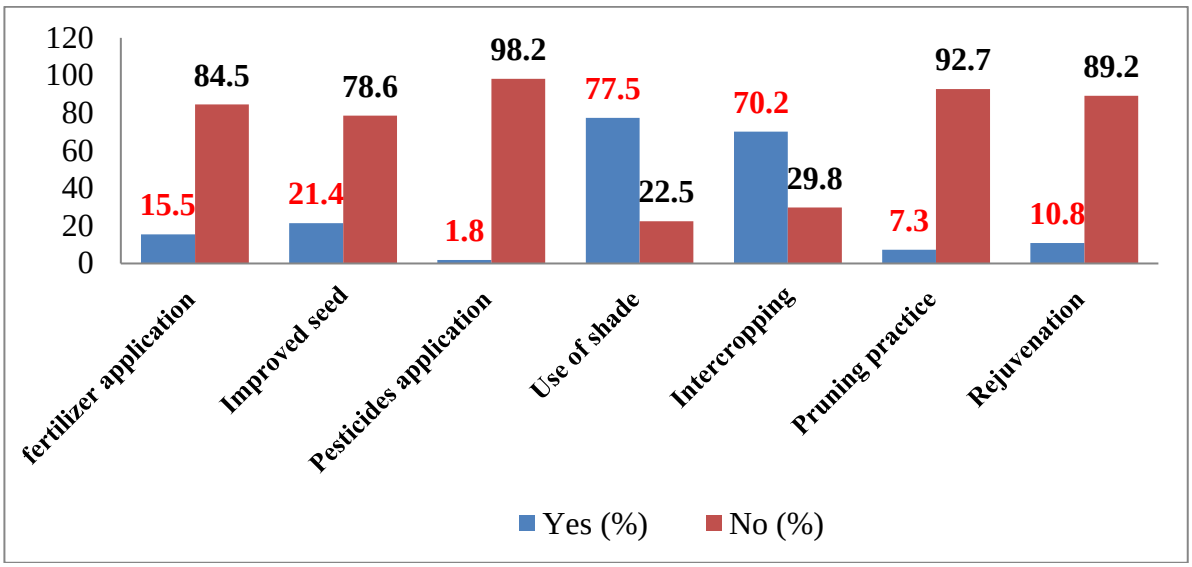

Fig. 2. Percentage of management practices applied by coffee producer farmer
Source: Survey data 2015

shape, ultimately contributing to sustainable higher yields [18,19]. However, the majority of farmers 92.7% and 89.2% respectively didn't practice pruning and rejuvenation (Fig. 2). The result shows that coffee farmers in the study area have low management practices, resulting in old, erect, less branched, and very tall coffee stands that are difficult to harvest and yield low quality due to their vertical growth habits. Contrary to this study, [20] reported that the majority 93.33% of the coffee farmers in Gomma Woreda, Jimma Zone were practicing coffee tree pruning.

The provision of shade is important to protect coffee seedling from morning and afternoon sun injury and enhance its survival rate. As indicated in Fig. 2, more than 70% of respondents used shade and intercropping. Farmers explained that the use of shade could conserve moisture by reducing evaporation and improved yield than under bare land (Fig. 2). The result of this study is consistent with a study by [21], who reported that 87.0% of respondent were using shade for their coffee nursery and plantation in eastern Harargae.

3.3 The trend of Coffee Production and Farmers Merit to Shift from Coffee Production to Khat

Though researcher advice the Ethiopian government to encourage local coffee industries to bring a real transformation in coffee sector as it is the major source of foreign currencies [3]; the current trend of coffee production in the country is decreasing. The status of a coffee plantation in the study area was decreasing from time to time. The result of the study shows that about 60.45% of farmers did not undergo

expansion of coffee plantation in recent time, while only 20.7% of the respondents responded that they increased their land for coffee plantation. The average number of Khat and coffee plantation in the study areas were 625 and 103 respectively, per farmer. In addition, about 65.5% of respondents did not have any plan to increase their coffee plantation in near future (Table 3). This implies that there is a higher Khat population than a coffee per individual farmers in the study districts. This study is consistent with previous study who reported that recently khat is competing for farmland with coffee. Some farmers showed more interest to grow and produce *khat* instead of coffee with the former more yield and lucrative [22].

According to a study by [23], in Sidama region of Ethiopia, as an alternative, many farmers have gradually begun replacing their coffee trees with the more drought-resistance Khat plant. Compared to coffee, khat requires less labor and watering while providing higher financial returns per kilo at farm level. Similarly, market bureaucracy, market access, and income are among the other factors strongly contributed to the shift of coffee farmland into khat farming [23]. In our study, farmers were reported almost similar reasons to shift from coffee production to khat. In terms of irrigation, coffee requires more water consumption than khat, since coffee has different growth stages which require irrigation water at each stage for its optimal growth and development. In terms of ease in production, the chat is easy to propagate, production handling and double harvesting in a year. Additionally, producer farmers in our study reported that khat had higher profits than coffee (Table 4). *Khat* cropping provides immense contributions to generate higher income than coffee. A farmer who produces coffee might get 5000-6000kg/hectare per annum, which generates a maximum of US $171/year. But, if a farmer cultivates khat, he earns an estimated total income of US $571 to $857/quarter with an estimated total income of $US 1714 to 2571 per annum from the half (0.5) hectare of land [23]. This implies that farmers will motivate to shift their coffee farm to khat and /or giving less attention for coffee farming.

3.4 Post Harvesting Management and Marketing Experience of Coffee Growers in Southern Tigray

Pre-harvest and post-harvest practices such as disease prevention, compost application, storage conditions, and storage time have a significant impact on the quality of coffee [20]. Improper harvesting and postharvest processing are adversely affecting the quality of the coffee beans produced [21] coffee quality is poor when harvested during inappropriate time [24]. In southern Tigray, most of the farmers about 99.0% harvested through successive hand picking and they practiced dry processing. Though, almost all farmers in the area harvest their coffee at maturity when the cherries became red (Table 4); but practically some farmers were picking green, immature berries to shorten the interval and the selective labor-intensive harvesting of coffee.

Table 3. Land allocated, future plan and number of tree stand of coffee production (N=113)

The trend of land allocated for coffee as compare to the khat			Do you plan to increase your coffee in the future		Crop	Number of stands per farmers		
						Mini	Max	Mean
Increased	Decreased	Constant	Yes	No	Coffee	14	625	103
23(20.7%)	21(18.9)	67(60.45)	39(34.5%)	74(65.5)	Chat	23	10000	754

Source: Survey data 2015

Table 4. The main reasons for farmers to shift from coffee to khat cultivation

Parameters	Coffee	Khat
Irrigation water consumption	High	Low
Frequency of harvesting	Once/year	2-3/year
Ease of production	Hard	Easy
Biennial bearing	yes	No
Means of propagation	Time consuming	Easy
Profitability	Low	High

Source: Survey data 2015

Table 5. Method of harvesting, processing, and materials used for drying

Methodsof harvesting	N (%)	Stage	N (%)	Time of harvesting	N (%)
Hand picking successively	111(99.1)	Red cherries	113(100%)	soon at maturity	110(98.2%)
Hand-picking all at once	1(0.09)	-	-	Late past maturity	2(1.8%)

Source: Survey data 2015

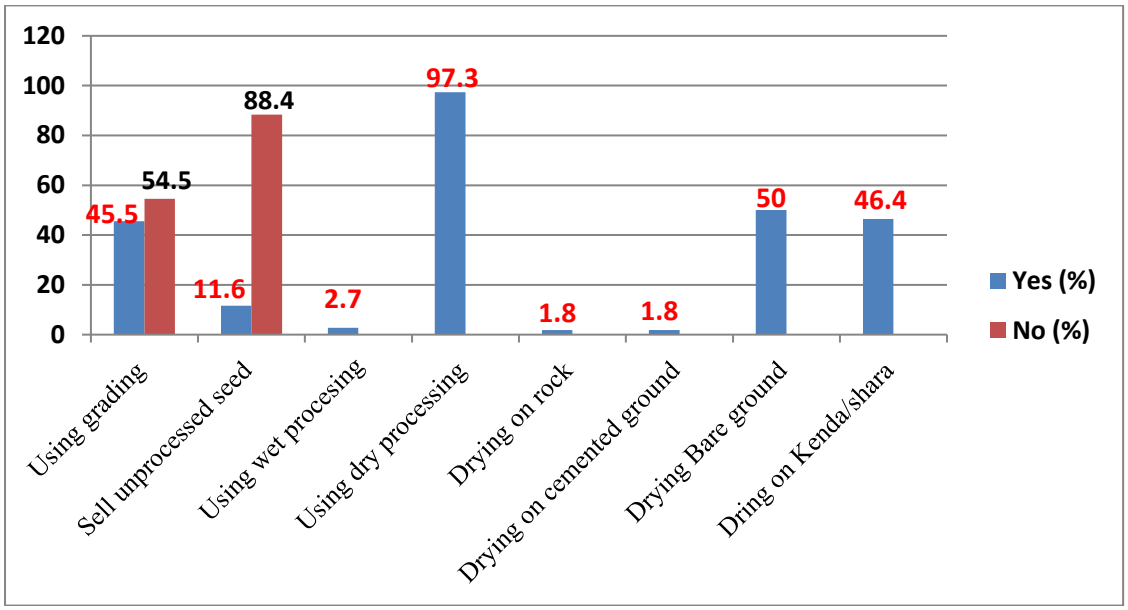

Fig. 3. Methods of drying, grading and processing used by farmers in southern Tigray
Source: Survey data 2015

Table 6. Opportunities of coffee production in southern Tigray

Opportunities	Rank
Availability of suitable agroecology	1
Availability of relatively fertile soils	2
Availability of groundwater and spring water	3
Availability of tolerant landraces coffee varieties	4

Source: Survey data 2015
N.B:1-highest opportunities and 4-lowest opportunity

Table 7. Constraints of coffee production in southern Tigray

Constraints	Rank
Intense irrigation water competition	1
Lack of training and know-how on agronomic practices and use of inputs	2
Shifting of a coffee farm into chat cultivation (crop replacement)	3
Limited access to disease and insect control	4
Lack of access to seedlings and improved varieties	5
Low yield and biennial bearing	6
Difficult to process (time-consuming, labor-intensive, breaking down when pulped grinding, lack of secured drying space)	7
The coffee is aged makes them difficult to harvest	8

Source: Survey data 2015
N.B:1-highest constraint whereas and 8- lowest constraint

Coffee beans require special drying materials and storage to improve sensory quality. Quality deterioration associated with faulty dry processing in the conventional system lowers the quality standards of coffee and is strongly discouraged [25]. The result of the study shows that the majority of respondents used the conventional way of drying, about 50.0% of them used bare ground and 46.4% of them were also using *kenda*/*shara* for drying their coffee (Fig. 3). This result is in agreement with [25], who had also reported that most farmers in Raya Azebo district used bare ground for drying and, drying coffee on the bare ground can expose the product to quality deterioration. Moreover, drying coffee on bare ground highly reduced raw, abnormal color and develops unpleasant odor [21].

The majority of respondents (88.4%) replied that they did not ever sell unprocessed coffee. However, few respondents (11.6%) in Werabaye kebele had the experience of selling unprocessed coffee beans (Fig. 3). In Warabaye kebelle, one investor was staring buying of the red cherries coffee products from farmers to process himself and to sell with a premium price in the local market as well as district market at Mekoni. More than half of the respondents (54.5%) did not adopt grading of coffee beans cherries during processing. This is due to labor-intensive for grading since no extra wage was awarded. However, about 45% of the respondents practiced on-farm grading during processing (Fig. 3).

3.5 Opportunities and Constraints of Coffee Production in Southern Tigray

During the focus group discussion, respondents have realized the opportunities of their environment for coffee production. Some of the existing opportunities were favorable agro ecology, relatively fertile soil and availability of water (ground and spring water) and presence of already established tolerant coffee landraces in their respective order (Table 5). This study is in agreement with [26] and [27], who reported that having suitable agro ecology and soil conditions of coffee production area, existence of coffee genetic diversities to resist different risks (Drought, disease, pest, etc.), internationally well-known brands specialty coffee, unexploited land and water resources with potential to produce more coffee were the main opportunities of coffee production in Ethiopia. The group of the respondents perceived that their coffee is an attractive color for the market, big seed size physically and good aroma and flavor when roasted and tasty when drink as compared to the introduced ones from other regions.

However, intensive irrigation water competition, lack of training and knowhow on agronomic practices and use of inputs as well as crop replacement (shifting of a coffee farm to chat cultivation), limited access and insect control were the main constraints for coffee production in southern Tigray (Table 5). Climate change (scarcity of rainfall, increasing temperature, the occurrence of adverse conditions), low productivity, low outreach of extension services, crop replacement by more profitable cash crops and inadequate services (credit, inputs, seeds, equipment) are also the main constraints for coffee production in Ethiopia [27] in general and Tigray in particular. In addition, [2], reported that the land allocated for coffee in the Arsi zone is being substitutes by khat due to drought, diseases, pest and low price of coffee. Furthermore, a recent study in Sidama revealed that from sixteen coffee producer kebeles in the region three of them are converted by khat, despite the expansion of khat farming brought negative sociocultural and political consequences to the local community [23].

4. CONCLUSION AND RECOMMENDATIONS

The study indicated that coffee is mainly produced in the two lowland districts of southern Tigray and it was ranked as the first economically important crop by the producer farmers. However, coffee management (like the use of inputs and pruning) in the study area is poor. Coffee is being substituted by *khat* due to its disease resistance, drought tolerant as compared to coffee. Some farmers claim the price of the coffee seedling is not fair. Important agronomic practices such as pruning and rejuvenation are not practiced due to a lack of technical know-how. Due to this reason, the coffee stand is very old (60-80 years ago), erect and less branched, very tall and difficult to harvest. This study concludes that the availability of suitable agro ecology, availability of relatively fertile soils, availability of water (ground and spring water), availability of tolerant landraces coffee varieties were the main opportunities to explore for further coffee production, whereas intense irrigation water competition, lack of training and know-how on agronomic practices,

limited use of inputs, limited disease and insect control, shifting from coffee into khat cultivation were the main constraints yet to be resolved for sustainable coffee production. Hence, the study forwarded the following recommendations;

- Research institutes should work to identify higher yielding coffee varieties.
- Provision of training on integrated agricultural practices together with processing techniques.
- Existing irrigation infrastructures should be improved and also constructed in newer potential areas in order to promote efficient water utilization and to optimize the production of coffee.
- Policymakers should give priorities for coffee producers by promoting incentives and subsidies as well as facilitating market linkage for their produce coffee in instead of khat.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

ACKNOWLEDGEMENT

The authors are thankful to Raya Azebo and Raya Alamata districts of southern zone experts and development agents of the selected kebeles. We would like to acknowledge to all individuals participated in group discussion who contributed a lot to conduct the study. Our special thanks also go to the Alamata Agricultural Research Center of TARI (Tigray Agricultural Research Institute) for their support to conduct the study. Finally, we are greatly to thank all individuals who made an effort to materialize this study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Workman D. Coffee exports by country. Diakses dari; 2019.
2. Degaga J. Review on coffee production and marketing in Ethiopia. Journal of Marketing and Consumer Research. 2020 Apr 30;67:7-15.
3. Gizaw N, Abafita J, Merra TM. Impact of coffee exports on economic growth in Ethiopia; An empirical investigation. Cogent Economics & Finance. 2022 Dec 31;10(1):2041260.
4. Anwar A. Assessment of coffee quality and its related problems in Jimma Zone of Oromia Regional State. Sc. Thesis. Ethiopia. 2010:91-110.
5. Abdulfeta Tariku AT, Ali HM, Ashenafi Ayano AA. Correlation and path coefficient analysis of organoleptic quality traits of some coffee (*Coffea arabica* L.) accessions in Ethiopia. International Journal of Agriculture and Bioscience. 2019;8(1):20-24.
6. Behailu W, Abrar S, Nugussie M, Solomon E. Coffee processing and quality research in Ethiopia. Inthe Proceedings of Coffee Diversity and Knowledge Workshop EIAR, Addis Ababa. 2008;345-356.
7. Workafes W, Kassu K. Coffee production systems in Ethiopia. In Proceedings of the workshop on control of coffee berry disease in Ethiopia; 2000.
8. Raya Azebo Woreda Agriculture and Rural Development Office. Mehoni, Ethiopia; 2017.
9. Ayele A, Worku M, Bekele Y. Trend, instability and decomposition analysis of coffee production in Ethiopia (1993–2019). Heliyon. 2021 Sep 1;7(9).
10. CSA (Central Statistical Agency). Report on area and production of major crops (private peasant holdings, meher season). Addis Ababa, Ethiopia. 2021;I, Statistical Bulletin 590.
11. Worku M. Production, productivity, quality and chemical composition of Ethiopian coffee. Cogent Food & Agriculture. 2023 Dec 31;9(1):2196868.
12. Belachew K, Teferi D, Hagos L. Coffee thread blight (*Corticium koleroga*): A coming threat for Ethiopian coffee production. Journal of Plant Pathology & Microbiology. 2015;6(9):303.
13. Shimales T, Kidanu S, Abate B, Teferi D. Paper presented to Crop Research completed activity forum. 9th 14th Oct, 2017 Addis Abeba.
14. OOARD (Office of Agriculture and Rural development), 2017. Summary of annual report. Mokoni, Ethiopia; 2017.
15. Musa LM, Peters KJ, Ahmed MK. On farm characterization of Butana and Kenana cattle breed production systems in Sudan.

Livestock research for rural development. 2006 Apr 27;18(12):1-5.
16. Mezgebo HK. Opportunities and constraints of community based seed production in Northern Ethiopia: The case of seed producing cooperatives in South Tigray. Asian Journal of Agricultural Extension, Economics & Sociology. 2019;29(4):1-0.
17. CSA (Central Statistical Agency). Report on area and production of major crops (private peasant holdings, meher season). Addis Ababa, Ethiopia. 2022;I, Statistical Bulletin 590.
18. Franca AS, Oliveira LS. Coffee processing solid wastes: Current uses and future perspectives. Agricultural wastes. 2009;9:155-89.
19. Tadesse T, Tesfaye B, Abera G. Coffee production constraints and opportunities at major growing districts of southern Ethiopia. Cogent Food & Agriculture. 2020 Jan 1;6(1):1741982.
20. Birhan T, Musema A, Kasahun M. Prevalence of some coffee quality problems in Gomma Woreda, Jimma Zone. World Applied Sciences Journal. 2014;29(2):202-7.
21. Ameyu MA, Mohammed W, Shimber T. Evaluation of harvesting and postharvest processing method on raw quality attributes of green Arabica Coffee beans produced in Hararghe, eastern Ethiopia. International Journal of Plant Breeding and Crop Science. 2017;4(2):187-96.
22. Tolera FG, Gebermedin GA. Opportunities and constraints of coffee production in West Hararghe, Ethiopia. Journal of Agricultural Economics and Rural Development. 2015;2(4):054-9.
23. Garedew Aweke, KiflieWorku and Yodit Abebe Unveiling the shift of smallholders' Cash Crop Farming from Coffee-orchard to Khat in Sidama region, Ethiopia. Ethiopian Journal of Environment and Development. 2023;5(1):1–16.
24. Sualeh A, Mekonnen N. Evaluation of coffee quality of Tigray Regional State, Ethiopia (case study Raya Azebo District). Prudence Journal of Agricultural Research. 2013;1(2):3-6.
25. Tsegaye B, Mohammed A, Shimber T, Getachew Y, Getachew E. The Influence of sun drying methods and layer thickness on the quality of lowland Arabica coffee varieties at Gomma I, Southewesten Ethiopia. Research Journal of Agricultural and Environmental Management. 2014 Nov;3(11):547-54.
26. Duguma T. Value chain analysis of Ethiopian coffee (*Coffea arabica*). Archives of Current Research International. 2017;11(1):1-5.
27. Tsegaye B. Ethiopian coffee sector strategy and future prospects. Addis Ababa, Ethiopia. 2017.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/120144