

Livelihood benefits, ecosystem services, and food security trade-offs of khat cultivation in eastern Ethiopia

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Abstract

Khat (*Catha edulis*) cultivation and consumption are deeply embedded in the socio-economic and cultural systems of Habro Woreda, Ethiopia, shaping livelihood strategies and land-use decisions. This study examined the socio-economic significance, cultural drivers, environmental perceptions, and health-related attitudes associated with khat using a mixed-methods approach involving household surveys of 111 respondents, key informant interviews, focus group discussions, and field observations. Khat chewing was highly prevalent (96.9%), with age significantly associated with chewing behavior ($\chi^2 = 9.683$, $p = 0.046$), whereas sex showed no significant association ($\chi^2 = 0.020$, $p = 0.886$). More than half of respondents recognized potential cardiovascular risks, although education level was not significantly associated with health-risk perception ($\chi^2 = 11.048$, $p = 0.354$). Most farmers (81.1%) perceived khat as beneficial for soil and water conservation, and this perception significantly varied with cultivation intensity ($\chi^2 = 7.907$, $p = 0.019$). Economically, khat was identified as the dominant livelihood activity, with 96.9% of respondents reporting it as a reliable income source. Qualitative findings revealed extensive indigenous knowledge systems, including moisture-conserving practices such as basin construction around khat plants, alongside concerns regarding declining food-crop areas, market dependency, and excessive youth consumption. Overall, the findings highlight the dual role of khat as a livelihood asset and perceived land-management strategy while emphasizing trade-offs related to food security, agricultural diversification, and long-term sustainability. The study underscores the need for integrated land-use policies that balance rural income generation with ecosystem resilience and sustainable agricultural development.

1. Introduction

Khat (*Catha edulis*) is a perennial evergreen shrub native to Eastern Africa and southern Arabia, widely cultivated and consumed in Ethiopia, Somalia, Kenya, and Yemen [1]. The young leaves and shoots are valued for their stimulant effects, primarily attributed to Cathinone, an amphetamine-like psychoactive compound, along with other related alkaloids such as Cathine and Norephedrine, which contribute to the overall stimulant activity [1]. Harvesting commonly takes place early in the morning, followed by rapid distribution to preserve freshness in regions where chewing is deeply embedded in social and cultural practices.

Beyond its stimulant properties, khat has become an economically, socially, and culturally significant crop across the Horn of Africa and the Middle East [1, 2]. Historical accounts, including those by Richard Burton, document its early trade around Zeyla and Berbera and suggest that khat was introduced to Yemen from Ethiopia by Sheikh Ibrahim Abu Zaharbui [3]. In Ethiopia, khat production and consumption have expanded rapidly over the last few decades, transforming it from a regionally confined stimulant into one of the nation's most important commercial commodities. Recent data indicate that khat contributes approximately 10–15% of Ethiopia's total export earnings, making it the second-largest export crop after coffee, which accounts for roughly 25–30% of export revenues [4, 5].

The plant thrives in mid-altitude environments between 1,500 and 2,100 m a.s.l. and performs well under conditions of moderate rainfall, making it more resilient than many food crops to environmental stressors such as drought and land degradation [1]. Because khat can be harvested multiple times per year, it provides a stable and continuous source of income for farmers, a characteristic that has contributed to its rapid expansion in Ethiopia's highlands [6, 7]. The crop's cultural significance is evident in its widespread use during ceremonies, celebrations, business negotiations, and political gatherings across Ethiopia, Yemen, Somalia, and Djibouti [1]. In recent years, khat has spread along migration routes and is now available in diaspora communities in Europe and North America [8].

Despite its growing importance, khat production and consumption remain subjects of debate. Many users attribute positive effects, including improved alertness, concentration, and social interaction, to khat chewing [2, 3]. However, various studies also highlight associated negative social, economic, and health impacts, including cardiovascular risks, dependency, and reduced household expenditures on food and essential needs [1, 9, 10]. While several studies have examined the socio-economic role of khat production and its effects on household food security [6, 7, 11], relatively limited research has explored the agronomic and ecological dimensions of khat-based farming. In particular, its potential contributions to soil and water conservation, its interactions with local farming systems, and the indigenous knowledge systems underpinning its management remain understudied.

Habro Woreda, in the West Hararghe Zone of the Oromia National Regional State, is one of Ethiopia's major khat-producing areas [8, 12]. Despite its prominence in local livelihoods, comprehensive studies assessing farmers' knowledge, attitudes, and practices related to khat cultivation, nor examined its contributions to soil and water conservation in this erosion-prone region. From a sustainability perspective, the rapid expansion of perennial cash crops in smallholder systems presents both opportunities and risks. While cash crops may enhance livelihood resilience and reduce short-term economic vulnerability, they can also contribute to reduced crop diversity, increased dependence on external food markets, and long-term ecological pressures when expansion occurs without integrated land-use planning. Understanding these interactions is particularly important in drought-prone regions where livelihood security, ecosystem stability, and agricultural sustainability are closely interconnected. Understanding these socio-ecological relationships is essential for developing sustainable agricultural strategies that balance livelihood benefits with natural resource conservation.

Despite growing research on the socio-economic importance of khat, limited studies have systematically examined the trade-offs between cash crop expansion, ecosystem services, and food security within smallholder farming systems. In particular, the simultaneous interactions between livelihood benefits, environmental functions, and agricultural sustainability remain poorly understood. Addressing these interlinked dimensions is critical for informing balanced land-use strategies in regions experiencing rapid khat expansion. Therefore, this study aims to examine the trade-offs between cash crop expansion, ecosystem services, and household food security in khat-based farming systems by (i) assessing local knowledge, attitudes, and practices related to khat cultivation; (ii) evaluating its contribution to household income and livelihood resilience; and (iii) analyzing its perceived role in soil and water

conservation and its implications for sustainable land use in selected kebeles of Habro Woreda. Through a mixed-methods approach integrating quantitative and qualitative data, the study provides evidence to inform policy, natural resource management, and rural livelihood interventions in major khat-producing zones of Ethiopia.

2. Materials and Methods

2.1. Study Area

The study was conducted in Habro Woreda, one of the major khat-producing districts in the West Hararghe Zone of the Oromia National Regional State in Ethiopia. The district lies between 7°55'–9°33'N and 40°01'–41°39'E, approximately 404 km east of Addis Ababa and 75 km south of Chiro, the zonal capital. It is bordered by Guba Koricha to the west, Boke to the east, Daro Lebu to the south, and Oda Bultum to the north. According to demographic data, Habro has a population of 148,530 with a density of 204.4 persons per km² [13]. The altitude ranges between 1,600 and 2,400 m above sea level. Mean annual maximum and minimum temperatures are 20°C and 16°C, respectively, and the area receives 650–1,000 mm of rainfall annually [13]. The farming system is characterized by mixed crop–livestock production, with major food crops including maize, sorghum, and haricot bean. Coffee and khat constitute the major cash crops, with khat occupying a substantial share of farmland and often intercropped with cereals or coffee.

2.2. Research Design and Approach

A community-based cross-sectional study was conducted from September 2022 to August 2023 to assess knowledge, attitudes, and practices related to khat-based farming and to evaluate its contributions to household income and natural resource conservation. The study employed a mixed-methods design, integrating quantitative data collected through structured household surveys and analyzed using descriptive and inferential statistics with qualitative data obtained from key informant interviews and focus group discussions, which were analyzed thematically to complement and triangulate the findings.

2.3. Sampling Procedure and Study Site Selection

Habro Woreda comprises 32 kebeles. A reconnaissance survey, conducted in collaboration with agricultural experts, elders, and local authorities, was used to identify kebeles with high khat production intensity and representative agro-ecological features. Based on these criteria, three kebeles (Chafe Anani, Defo, and Meda Jalala) were purposively selected. This selection approach is consistent with similar studies conducted in the region [12, 14].

2.4. Sample Size Determination

Sample size determination followed Kothari's formula for populations under 10,000 [15]. A 90% confidence level ($Z = 1.65$) was adopted to balance statistical reliability with field feasibility, while an

estimated population proportion of 0.5 was used in the absence of prior data to ensure a conservative and sufficiently large sample. A margin of error of 0.08 was considered acceptable for the study context. Since the household population in the selected kebeles was less than 10,000, a finite population correction factor was applied to refine the sample size. To enhance representativeness and account for possible non-responses, the final sample size was increased to 111 households.

From a total of 2,218 households across the selected kebeles, 111 respondents (60 males and 51 females) were selected using simple random sampling. In addition, 12 key informants, four from each kebele, were purposively selected based on their local knowledge, experience, and community leadership, following procedures similar to those reported by Tilahun et al. [14].

2.5. Data Collection Methods

Data were collected from both primary and secondary sources using multiple techniques. A structured questionnaire was administered to 111 household heads to gather information on socio-demographic characteristics, indigenous knowledge, khat-based farming practices, soil and water conservation measures, and income-related aspects. The questionnaire was initially developed in English, translated into Afan Oromo, and subsequently back-translated to ensure linguistic accuracy and consistency. To enhance content validity, the instrument was reviewed by subject matter experts in agriculture, environmental studies, and social science research. A pilot test was conducted on a small sample of households outside the study area to assess clarity, relevance, and sequencing of questions, and necessary revisions were made accordingly. In addition, the internal consistency of multi-item perception variables was assessed using Cronbach's alpha reliability analysis. The face and content validity were verified through expert judgment and pretesting feedback. Semi-structured interviews were conducted with 12 key informants, including elders, agricultural extension agents, and kebele leaders. These interviews explored historical changes in khat-based farming, environmental and socio-economic impacts, and emerging challenges within the khat-based farming system. Focus group discussions (FGDs) were also carried out with groups of khat farmers to validate and triangulate information from the household survey and interviews. The FGDs addressed topics such as changes in cropping patterns, perceptions of khat's environmental contributions, income diversification, and community attitudes toward khat consumption. Additionally, direct field observations were made using a structured checklist to document khat management practices, intercropping patterns, soil and water conservation structures, and local market dynamics. The observational data were used to contextualize and corroborate the information obtained through interviews and surveys.

2.6. Data Quality Assurance

Data quality was ensured through several procedures. The questionnaire and observational checklist were pre-tested in a non-study kebele and subsequently refined to enhance clarity, coherence, and reliability. Based on the pretest results, ambiguous items were rephrased, redundant or repetitive questions were removed, and the sequencing of questions was improved to ensure logical flow. In addition, the instruments were aligned with the intended analytical methods to ensure consistency

between data collection and analysis. Field data collectors received training to maintain consistency in data gathering. Completed questionnaires were reviewed daily for accuracy, and inconsistencies were corrected immediately. Triangulation of survey data, key informant interviews, FGDs, and field observations further strengthened the credibility of the findings.

2.7. Data Analysis

Quantitative data were coded, cleaned, and entered into IBM SPSS Statistics for analysis. Descriptive statistics, including frequencies and percentages, were used to summarize respondent socio-demographic characteristics, khat production practices, and perceptions related to khat production and utilization. Qualitative data obtained from interviews, focus group discussions, and field observations were analyzed thematically. The data were transcribed, organized, and coded, then systematically grouped into key themes such as indigenous knowledge systems, socio-economic importance, environmental contributions, and production constraints. Finally, findings from multiple data sources were triangulated to enhance validity, improve reliability, and ensure consistency across the quantitative and qualitative datasets.

3. Results and Discussion

3.1. Socio-economic Characteristics of Respondents

A total of 111 household heads participated in the study, including 60 males (54.1%) and 51 females (45.9%). The majority of respondents were within the productive age range of 31–50 years (69.3%), with relatively small proportions below 20 years (6.3%) and above 50 years (6.3%). Educational attainment varied, with 32.4% having completed secondary school, 23.4% holding a diploma, and 6.3% having no formal education. Household sizes were typically large, with more than half (54.1%) containing 4–6 members and 36.0% containing 7–10 members (Table 1).

Khat chewing was highly prevalent (96.9%). Chi-square test revealed no significant association between sex and khat chewing (χ^2 (1, N = 111) = 0.020, p = 0.886). However, age showed a significant association with khat chewing (χ^2 (4, N = 111) = 9.683, p = 0.046), indicating that chewing patterns varied across age groups.

Table 1
Socio-demographic characteristics of respondents (n = 111)

Variable	Category	Frequency (n)	Percent (%)
Sex	Male	60	54.1%
	Female	51	45.9%
Age group	< 20 years	7	6.3%
	21–30 years	20	18.0%
	31–40 years	38	34.2%
	41–50 years	39	35.1%
	> 50 years	7	6.3%
Educational qualification	Illiterate	7	6.3%
	Primary	19	17.1%
	Secondary	36	32.4%
	Diploma	26	23.4%
	Degree	7	6.3%
	Other	16	14.4%
Household family size	4–6	60	54.1%
	7–10	40	36.0%
	> 11	11	9.9%
Total respondents	—	111	100.0%
Chi-square tests			
• Sex × Khat chewing: $\chi^2(1, N = 111) = 0.020, p = 0.886$			
• Age group × Khat chewing: $\chi^2(4, N = 111) = 9.683, p = 0.046^*$ (<i>Significant</i>)			

3.3. Knowledge, attitudes, and practices regarding khat

Respondents expressed predominantly positive attitudes toward khat. A large majority (95.5%) agreed that khat chewing enhances mental alertness and productivity, and 96.4% agreed that it promotes peaceful social interaction. Awareness of potential adverse health outcomes was moderate: 57.7% agreed that khat poses cardiovascular risks, while 32.4% were undecided and 9.9% disagreed (Table 2).

To explore whether education influences health risk awareness, a chi-square test was applied to the item “Khat is a risk factor for cardiovascular disorders.” The association was not significant ($\chi^2(10, N = 111) = 11.048, p = 0.354$), indicating that health perceptions do not vary systematically by educational level.

Table 2
Knowledge, attitudes, and practices of respondents toward khat (n = 111)

Statement	Disagree n(%)	Undecided n(%)	Agree n(%)	Total (n)
Excessive khat chewing may reduce productive working time	5 (4.5%)	0 (0.0%)	106 (95.5%)	111
Khat is a risk factor for cardiovascular disorders	11 (9.9%)	36 (32.4%)	64 (57.7%)	111
Khat increases peaceful social coexistence	0 (0.0%)	4 (3.6%)	107 (96.4%)	111
Khat promotes productivity and alertness	0 (0.0%)	13 (11.7%)	98 (88.3%)	111
Chi-square test: Education × “Khat is a risk factor for cardiovascular disorders”				
$\chi^2(10, N = 111) = 11.048, p = 0.354$ (Not significant)				

3.4. Indigenous knowledge and conservation perceptions

Farmers demonstrated a strong understanding of khat agronomy and environmental interactions. A majority of respondents (77.5%) believed that altitude and climate in the study area favor khat production. Nearly all (92.8%) agreed that khat lacks a fixed harvesting period, allowing continuous income generation throughout the year. Notably, 81.1% believed that khat contributes to soil and water conservation through shading, reduced erosion, and year-round ground cover (Table 3).

Cultivation intensity significantly influenced perceptions of khat’s conservation benefits: farmers with relatively higher cultivation intensity were more likely to agree that khat improves soil and water conservation ($\chi^2(2, N = 111) = 7.907, p = 0.019$). This indicates that farmers with greater investment in khat production perceive stronger ecological advantages. While farmers perceive khat as beneficial for soil and water conservation, these benefits are primarily based on local observations and may not fully capture long-term ecological trade-offs associated with monocropping.

Table 3
Indigenous knowledge and conservation perceptions (n = 111)

Statement	Disagree n (%)	Undecided n(%)	Agree n (%)	Total (n)
Altitude and climate of the area favor khat	5 (4.5%)	20 (18.0%)	86 (77.5%)	111
Khat has no definite harvest time	0 (0.0%)	8 (7.2%)	103 (92.8%)	111
It is less risky to grow than cereals and coffee	0 (0.0%)	0 (0.0%)	111 (100.0%)	111
Khat contributes to soil & water conservation	3 (2.7%)	18 (16.2%)	90 (81.1%)	111
Chi-square test result: Variable Pair χ^2 (df, N)p-valueSignificance				
Cultivation intensity $\times$ perceived soil & water conservation benefit χ^2 (2, N = 111) = 7.907p = 0.019Significant				

3.5. Contribution of khat to household income

Khat production plays a major role in household economic wellbeing. Almost all respondents (96.9%) reported that khat increases household income, while all respondents indicated that khat related labor activities, such as harvesting, bundling, transporting, and marketing, provide additional income opportunities (Table 4).

The association between cultivation intensity and reported income increase was not significant (χ^2 (1, N = 111) = 0.000, p = 1.000). This suggests that khat is perceived as economically beneficial regardless of the scale of land allocation. Despite its economic advantages, the expansion of khat-based farming may reduce land availability for staple food crops, suggesting a potential trade-off between income generation and household food security.

Table 4
Perceived economic benefits of khat cultivation (n = 111)

Statement	Disagree n (%)	Undecided n (%)	Agree n (%)	Total (n)
Participation in khat cultivation increases household income	4 (3.6%)	4 (3.6%)	103 (92.8%)	111
People involved in harvesting/packing/transport earn income	0 (0.0%)	0 (0.0%)	111 (100.0%)	111
Chi-square test				
Variable Pair χ^2 (df, N)p-valueSignificance				
Cultivation intensity $\times$ reported income increase χ^2 (1, N = 111) = 0.000p = 1.000Not significant				

3.6. Qualitative findings: Local experiences, perceptions, and practices

Key informant interviews, focus group discussions, and open-ended responses provided contextual understanding of khat's role in local livelihoods. Farmers consistently emphasized that khat serves as a reliable income source; especially during drought years when cereal production fails. Many described khat as a financial "lifeline," enabling households to purchase food, cover school expenses, and manage emergencies.

Khat chewing was described as culturally embedded, playing a key role in strengthening social relationships, resolving conflicts, and facilitating community dialogue. Elders highlighted its contribution to peaceful coexistence and cooperation during collective activities.

Environmental benefits were also widely acknowledged. Farmers explained that khat's evergreen canopy shades the soil, reduces erosion, improves infiltration, and provides wind protection. Several respondents noted that steep and erosion-prone areas are increasingly being planted with khat because it "holds the land better" compared to maize or sorghum.

Indigenous management practices including pruning, intercropping, selective harvesting, and seedling selection were commonly reported. Farmers indicated that these practices are largely based on traditional knowledge passed across generations.

Some concerns highlighted emerging trade-offs associated with khat expansion. A few farmers expressed worry that increasing land allocation to khat reduces space for food crops, leading to market dependency for staple grains. Others pointed to emerging pests, market fluctuations, and the risk of overreliance on a single cash crop. Despite these concerns, the overall sentiment toward khat remained strongly positive. These findings collectively indicate a complex balance between economic resilience and potential risks to food security and agricultural diversity.

4. Discussion

This study provides evidence of significant trade-offs within khat-based farming systems, where economic gains from cash crop expansion coexist with concerns related to food security, agricultural diversification, and long-term sustainability. These findings highlight the need to understand khat production as a socio-ecological system rather than a purely economic activity.

This study provides important insights into local knowledge, attitudes, and practices related to khat cultivation, as well as its socio-economic and environmental implications in Habro Woreda. The findings indicate that khat remains central to rural livelihoods, shaping farming systems, household income, and land-use dynamics, while also raising concerns related to food security and long-term sustainability. These findings are consistent with previous studies from Ethiopia and the Horn of Africa.

4.1. Socio-economic characteristics and khat use patterns

The socio-economic profile of respondents, predominantly young to middle-aged farmers with increasing access to secondary education, is consistent with demographic characteristics reported in khat-producing areas of Ethiopia [8, 12]. Similarly, the high prevalence of khat chewing in the study area aligns with findings from other regions of Ethiopia, where khat use is widely practiced and deeply embedded in social norms and lifestyle practices [3, 5, 16].

The absence of a significant association between sex and khat chewing corresponds with more recent studies that report narrowing gender differences in khat use as chewing becomes increasingly normalized [1, 10]. Conversely, the significant association between age group and khat chewing may reflect differences in social responsibilities, cultural expectations, or disposable income across age categories, similar to patterns observed in national surveys [16].

4.2. Knowledge and attitudes toward khat's health and social impacts

Respondents reported overwhelmingly positive perceptions about khat's perceived benefits, including enhanced alertness, work performance, and social cohesion. Such perceptions have been widely documented in prior research, where users commonly report improved concentration and sociability, contributing to khat's continued cultural acceptance [1, 10].

However, awareness of potential adverse health effects, particularly cardiovascular risks, was mixed. Approximately half of the respondents recognized khat as a risk factor for cardiovascular disorders, aligning with biomedical evidence linking khat chewing to elevated blood pressure, arrhythmias, and other cardiovascular complications [1, 9, 23]. The absence of a significant association between education level and cardiovascular-risk perception suggests that health knowledge related to khat may circulate through community networks rather than formal education channels, echoing observations in earlier public health studies [3, 9].

4.3. Indigenous knowledge and environmental perceptions

Farmers in the study area demonstrated extensive indigenous knowledge regarding khat's ecological and agronomic characteristics. The perception that altitude and climate favor khat aligns with ecological assessments noting the crop's adaptability to mid-altitude environments with moderate rainfall. Nearly all farmers acknowledged khat's continuous harvest potential, which supports its reputation as a reliable year-round income source, as documented in previous livelihood studies [6, 7, 17].

The majority also perceived khat as beneficial for soil and water conservation—a view supported by evidence that perennial crops with deep root systems can reduce soil erosion, stabilize slopes, and improve surface cover [18]. The statistically significant association between cultivation intensity and perceived soil conservation benefits indicates that experiential knowledge may shape farmers' understanding of khat's environmental role. Similar findings have been reported in studies examining the

integration of khat into farming systems in the Hararghe highlands [12, 19]. Although khat is perceived to contribute to soil and water conservation, reliance on a single perennial cash crop may limit biodiversity and reduce system resilience over time, indicating a potential ecological trade-off.

4.4. Economic significance and household dependence

The results highlight the significant contribution of khat to household income. Nearly all respondents reported income improvements from khat production, consistent with studies showing that khat is among the most profitable cash crops in eastern Ethiopia, surpassing maize, sorghum, and coffee in income per hectare [11, 20]. The lack of a significant association between cultivation intensity and perceived income increase suggests that even households with small landholdings gain substantial economic benefits, a trend similarly observed in other Ethiopian districts [6, 20].

Nevertheless, the expansion of khat production presents trade-offs. Respondents in this study expressed concerns about declining land allocation for cereals and growing dependence on markets for staple foods. These concerns parallel findings from studies documenting that increasing khat production often reduces food-crop diversity and household food self-sufficiency [11]. As khat becomes a dominant cash crop, households may face heightened vulnerability to market shocks, price fluctuations, and disruptions in khat trade or transport [4, 21].

However, these economic benefits come with important trade-offs. Increased allocation of land to khat may reduce the production of staple crops, thereby increasing reliance on market purchases and exposing households to price volatility and supply disruptions.

4.5. Social and cultural embeddedness

Khat's deep cultural significance emerged strongly in both quantitative and qualitative findings. Respondents emphasized khat chewing's role in strengthening relationships, facilitating social reconciliation, and enhancing community dialogue. These functions are well established in ethnographic and historical analyses of khat-using communities in the Horn of Africa [1, 8].

However, concerns about reduced work hours among certain groups, particularly youth, were also noted. Such mixed social impacts have been documented elsewhere, highlighting khat's dual role as both a facilitator of social cohesion and a potential contributor to reduced productivity when used excessively [10, 17, 22].

4.6. Emerging challenges and implications for sustainable land use

Despite its substantial economic and cultural importance, the expansion of khat cultivation raises broader sustainability concerns related to land-use change, food security, and livelihood resilience. Farmers reported increasing pressures associated with declining food-crop cultivation, market instability, pest emergence, and growing dependence and reduced land allocation for food crops. These challenges align with broader debates on the long-term implications of khat expansion in Ethiopia, which include

landscape transformation, declining crop diversity, and shifts in rural livelihoods from cereals to perennial cash crops [11, 17, 19].

While khat may offer environmental benefits on sloping and erosion-prone lands, overreliance on a single cash crop. Similar patterns have been documented in other khat-producing regions of Ethiopia, where the conversion of cereal-based farming systems into perennial cash-crop systems has altered local agricultural landscapes and household production strategies [18,21,22,26].

Although khat may contribute positively to soil stabilization and moisture conservation on erosion-prone slopes, excessive dependence on monocropping can reduce agroecosystem diversity and increase household vulnerability to market fluctuations and trade disruptions. These findings highlight the importance of balancing short-term economic gains with long-term sustainability objectives. Integrated land-use planning, diversification of livelihood options, and promotion of climate-resilient farming systems are therefore essential to ensure that khat-based economies remain socially, economically, and environmentally sustainable.

4.7. Trade-offs and implications for sustainable landuse

The findings of this study underscore a fundamental trade-off in smallholder farming systems: the pursuit of economic stability through cash crop expansion versus the maintenance of food security and ecological resilience. While khat provides reliable income and may contribute to localized soil conservation [7], its increasing dominance can reduce crop diversity and heighten dependence on external food markets [7, 11, 19]. These dynamics reflect broader patterns observed in cash crop economies, where short-term financial gains may conflict with long-term sustainability goals [17, 19]. Addressing these trade-offs requires integrated policy approaches that promote diversified farming systems, strengthen food security, and support sustainable land management practices.

4.8. Implications for sustainable development goals

The findings of this study are closely linked to several Sustainable Development Goals (SDGs), particularly SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), and SDG 15 (Life on Land). While khat cultivation contributes substantially to rural income generation and livelihood resilience, its expansion may simultaneously reduce food-crop production and increase household dependence on purchased food. The study therefore highlights the importance of integrated rural development strategies that simultaneously address economic wellbeing, environmental sustainability, and public health concerns within cash crop-dominated farming systems.

5. Conclusion

This study demonstrates that khat (*Catha edulis*) cultivation and consumption are deeply embedded in the socio-economic and cultural fabric of Habro Woreda. Although communities are aware of the potential adverse health and social effects associated with excessive khat chewing, its use remains widespread due to strong cultural acceptance, family norms, and long-standing social practices.

Economically, khat has become the dominant livelihood activity, surpassing traditional crops such as coffee, largely because of its high market value, year-round harvest potential, and resilience in drought-prone and erosion-susceptible environments.

The findings highlight the dual role of khat as both a primary income source and a practical land management strategy. Field observations indicate that farmers employ intentional soil and water conservation practices, such as constructing small basins around khat plants to enhance moisture retention and reduce runoff. These practices contribute to khat's integration into local agricultural ecology and reflect the community's extensive indigenous knowledge. As a result, khat functions as a critical buffer against climate variability, declining soil fertility, and increasingly unpredictable agricultural conditions.

However, the expanding dominance of khat production also presents complex challenges. Shifts from food crops to khat may heighten household dependence on purchased staples and expose farmers to market fluctuations. At the same time, the cultural entrenchment of khat chewing, particularly among youth, underscores potential public health concerns and long-term social implications. Balancing these overlapping benefits and risks requires nuanced consideration.

Overall, the findings demonstrate that khat cultivation represents a complex socio-ecological system that simultaneously supports rural livelihoods, influences land-use dynamics, and shapes local environmental management practices. Ensuring the long-term sustainability of khat-based farming systems will require integrated strategies that promote livelihood diversification, maintain food security, strengthen ecosystem resilience, and improve public health awareness. Future policy interventions should therefore focus on balancing the economic benefits of khat cultivation with sustainable land management and agricultural diversification to minimize long-term socio-economic and ecological risks.

Declarations

Ethics Approval and Consent to Participate

Ethical clearance for this study was obtained from the Dire Dawa University Research and Ethics Review Committee. Documentation confirming the ethical clearance and compliance with the required research protocols was referenced under Ref. No. DDU/CNCS/02/104/18 (dated February 13, 2026). The study was conducted in accordance with the approved ethical procedures and relevant institutional guidelines and regulations governing research involving human participants. Verbal informed consent was obtained from all participants after providing a clear explanation of the study objectives and procedures. Participation was voluntary, and confidentiality and anonymity were maintained throughout the study.

Consent for Publication

Not applicable, as no identifying personal information is included in this manuscript.

Competing Interests

The authors declare that they have no known competing financial or personal interests that could have influenced the work reported in this paper.

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Author Contribution

L. T.: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, editing original draft, Writing—review and editing, Visualization, Supervision, Project administration. M.A.: Conceptualization, Methodology, Investigation, Writing original draft. M.K.G.: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, editing original draft, Writing—review and editing, Visualization, Supervision, Project administration. All authors have read and approved the final manuscript.

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Data Availability

The datasets generated and analyzed during the study are available from the corresponding author upon reasonable request.

Clinical Trial Number

Not applicable.

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