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Original Article

Grown, Chewed and Omnipresent, Catha Edulis Plant in Ethiopia, Its Livelihood Implication on Rural Households. Community Based Cohort Nutrition Study

Beyene Wondafrash Ademe[1]*

[1]Jimma University, Institute of health, Faculty of Public health, Jimma-Ethiopia

Corresponding authors*: beyenewondafrash@gmail.com

Abstract

Background: *: Catha edulis of the plant family Celastraceae is a mild stimulant plant known as Khat in Ethiopia. In Ethiopia, the history of Khat dates back to the 13th century, and communities produce and/or consume Khat leaves for social, religious, cultural and economic purposes. This study aimed to assess the association between Khat production and consumption on food security and dietary diversity among rural households in Ethiopia.*

Method*: A panel survey using quantitative methods was conducted in two regions of Ethiopia. Using an open Data Kit (ODK) a panel survey was conducted and analyzed applying a multivariable linear regression model.*

Result*: The likelihood of food insecurity was twice as high among non-Khat consumers and Khat producers compared to households who neither produce nor consume Khat, (AOR: 2.17 [95%CI: 1.25, 3.76], p<0.1. On average, households that produced and consumed Khat were 1.5 times more likely to have high dietary diversity (AOR: 1.51 [95%CI: 1.09, 2.08], p<0.01).*

Conclusion*: Although Khat is an important source of income for farmers throughout the year, our findings highlighted that Khat production and non-consumption were negatively associated with food security. The possible pathways of this association could be through the household subsistence farming and cash crop (Khat) interaction. Food security interventions should consider Khat production and consumption practices among households in Khat-producing and consuming areas of Ethiopia.*

Keywords*: Khat chewing; food security; Dietary diversity; QTR + EPI-2.*

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Introduction

Khat (*Catha edulis*): a stimulant plant which belongs to the plant family Celastraceae was named by the naturalist Peter Forsskål (1732–1767) [1]. It is also named as Abyssinian tea, Miraa, and African salad [2,3,9]. Leaves, buds and soft stems are chewed for social and cultural purposes such as ceremonial, recreational, traditional medicine, to boost energy and prevent hunger [4,5]. The legality of Khat has been questioned and internationally it is not listed as a controlled substance [7, 10,11].

Hundred grams of fresh leaves contain 36 mg cathinone and 120 mg cathine, which have appetite suppressing effect [6,13]. A recent study by Girma *et al.* reported that Khat users are physically small and have a decreased Fat Mass and Body Mass Index, which is related to a decrease in food intake [17]. In vivo trials on rats have shown that it decreased food intake and increased locomotor activity [12,15,16]. Khat consumption causes constipation, tachycardia, palpitation, increased blood pressure, anorexia, stomatitis, esophagitis, gastritis, periodontitis and oral leucoplakia [15,18.19].

In Ethiopia, Khat production and consumption are integrated into the culture, economy and livelihoods of rural households. Its farming, consumption and trading has evolved from traditional contexts into new, urban and commercial environments. The economic value in contrast with its damaging effect on health and society has led to divergent perspectives on its use. Some condemn Khat consumption as a health hazard, drains household budget, and reduces local food production [14, 22, 23].

Others found that Khat can be cultivated in small and low moisture plots with minimal investment, and it is frequently harvested to purchase food crop [8, 30]. Farmers' decision to plant Khat is also a result of its endless demand and growing market [20, 24, 36]. In 2014-2015, more than three million farmers cultivated Khat in Ethiopia [25, 26]. Khat production makes economic sense in areas where population growth has led

to a decrease in the average farm size and where households are unable to support themselves through subsistence crops or lower priced cash crops. It also provides wealth for leaf wholesalers, retailers, agents and farmers [27,29, 32].

Growing and chewing Khat could affect household food security and food diversity, potentially by displacing staple crops and, as a cash crop, reducing women's entitlement to food. Poor health and working culture are also additional pathways compromising household livelihood [33, 34, 35].

Khat generates revenue for Ethiopia. According to the 2003/04 Ethiopian economic survey, earnings from Khat exports, which were 272.4 million Birr (USD 38 million) in 1997/98, rose to 758.9 million Birr (USD 89 million)[31]. The 2012/13-2014/15 Commercial Bank of Ethiopia annual export reports that Khat contributed USD 272.4 million, accounting for 9 percent of the total export earnings in the review period [37].

Khat chewers spend a substantial amount of their time and earnings on Khat and are often irritable and away from home, which could lead to family disintegration [20,21].Whether Khat cultivation affects farmers' quality of life, e.g., by providing food security and improving living standards as a long-term coping strategy, or whether it has social, psychological, physical and economic consequences, leading to poverty, unemployment and illness, is a broad research topic that should be further explored.

As the current findings are more anecdotal, ambivalent, and affected by confounding factors, more studies are needed to improve the evidence base. This study aimed to determine the association of Khat production and/or consumption with household food security and dietary diversity in rural Ethiopia.

Methods and materials

This study was conducted within two regions of Ethiopia (Oromia and the Southern Nation, Nationality and People's). Expanded Program on Immunization (QTR + EPI-2) method was used to choose Subsequent households until the sample size (1200 households) reached. Data were collected using pre-tested, interviewer-administered questionnaires with Samsung tablets using Open Data Kit (ODK). Data were regularly transferred to a server every week by wireless cellular technology.

Measurements

Khat consumer: A person who consumed Khat habitually (a minimum of once a week) in bundles (one bundle=up to 500 g of edible leaf).

Khat producer: A person who had Khat plants in the farm or backyard on minimum of 0.002 hectares.

Households Khat production and consumption status was grouped into four categories -independent variables. Khat no producer and no consumer: A household that neither produced nor consumed Khat.

Khat Producer consumer: A household that produced and consumed Khat. Khat Producer no consumer: A household that produced but did not consume Khat.

Khat no producer consumer: A household that did not produce but consumed Khat.

Confounding variables: non-food household expenditures, land size for crop production, crop variety, household size and non-agricultural income type were measured.

Household food insecurity and the Dietary Diversity Score (DDS) were considered dependent variables. DDS (HDDS) was calculated considering the number of 12 food groups consumed in the previous 24 hours, and foods were grouped into tertiles, and the highest tertile was used as the highest HDD group, while the first and second tertiles were considered the lowest HDD group [38]. Household food insecurity was measured using the household food insecurity Access Scale (HFIAS) in the past 30 days which has been validated for use in developing countries [39, 40].

Data quality

The questionnaire was pre-tested with 5% of the total sample that was not included in the actual study. A 12-day intensive training was provided to the data collectors and supervisors. The data manager reviewed the data submitted from the field on a weekly basis.

Statistical analyses

Data were exported to STATA version SE 12(Stata Corp LP, College Station, Texas, USA), and were cleaned and checked for missing values and outliers before the analyses. Bivariate analysis was performed, and the means and proportions were compared using T -tests, ANOVA and Chi-square tests after checking all assumptions. Khat production and consumption was included as the main predictor variable in both models. Multivariable linear regression was applied with HDDS and household food insecurity as a response variable. The results were presented as adjusted odds ratios (AORs) and 95% confidence intervals (CIs). All tests were two-sided, and p values <0.05 were considered statistically significant.

Ethical consideration

Ethical approval was obtained from Jimma University institutional review board. Written permission was obtained from each responsible body, and informed verbal consent was obtained from study participants. Personal identifying information was not included in the questionnaire.

Results

Of the 1200 households included in the study, complete data were available for 1169 (response rate of 97.4%). A significantly higher proportion of Khat consumers, 379 (66.7%), were also producers ($p<0.001$).

As presented in Table 1, HDDS differed between the categories of Khat production and consumption, by the groups of non-food item expenditures and between those with a lower vs. higher mean land size

(p<0.0001). Similarly, there was a difference between those with a lower mean household size and those with a higher mean household size (p<0.0001).

Table 1: Association between Khat Production-Consumption and Household Dietary Diversity Score

Dietary diversity score(DDS) **Predictors**	High*(n/%)	Low (n/%)	Chi (p) value
Khat production-consumption			
No Khat consumer and no Khat producer	99(20.41)	386(79.59)	19.54(<0.001)
Khat consumer and Khat producer	119(32.16)	251(67.84)	
Khat consumer and no Khat producer	43(23.24)	142(76.76)	
No Khat consumer and Khat producer	21(17.50)	99(82.50)	
Non food household expenditures			
<3 types	20(11.63)	152(88.37)	34.95(<0.001)
3-5 types	192(23.82)	614(76.18)	
>5 types	70(38.46)	112(61.54)	
Crop variety			
Mono-cropping	64(18.93)	274(81.07)	7.49(0.006)
>=2crops	218(26.52)	604(73.48)	
Nonagricultural income			
No	164(24.40)	508(75.60)	0.0077(0.930)
Yes	118(24.18)	370(75.82)	
Household size (mean±SD)	6.09(±2.07)	5.82(±2.13)	-1.88(0.03)
Land area used for crop production (mean±SD)	0.68(±1.16)	0.38(±1.10)	-3.29(0.001)

As presented in Table 2, the multivariable logistic regression showed that on average, Khat consumers and producers were 1.5 times more likely to have high dietary diversity (AOR: 1.51[95%CI: 1.09, 2.08], p<0.01) than no consumer no producers. Similarly, households with 3-5 nonfood household expenditures were two times more likely to have high dietary diversity (AOR: 2.20[95%CI: 1.33, 3.62], p<0.002), and households with 6 and more non-food household items were four times more likely to have high dietary diversity (AOR: 4.06 [95%CI: 2.31, 7.16], p<0.001).

Table 2: Multivariable Logistic Regression Model Predicting the Effects of Khat Production and Consumption on Dietary Diversity Score.

DDS	AOR	Std. Err.	Z	95% CI.	P>p>z
Khat production and consumption					
No Khat consumer and no Khat producer	1.00				
Khat consumer and Khat producer	1.51	0.25	2.48	(1.09,2.08)	0.013
Khat consumer and no Khat producer	1.07	0.23	0.31	(0.70,1.62)	0.75
No Khat consumer and Khat producer	0.81	0.22	-0.78	(0.48,1.37)	0.43
Nonfood household expenditures					
Expenditure, <3 types	1.00				
Expenditure, 3-5 types	2.20	0.56	3.08	(1.33,3.62)	0.002
Expenditure, >=6 types	4.06	1.17	4.85	(2.31,7.16)	<0.001

Crop total					
Mono-cropping	1.00				
>=2 crops	1.06	0.20	0.29	(0.73,1.53)	0.77
Household size	1.03	0.04	0.77	(0.96,1.10)	0.44
Land area used for crop production (ln)	1.15	0.09	1.81	(0.99,1.33)	0.07
Con.	0.11	0.04	-6.46	(0.05,0.21)	<0.001

As illustrated in Fig 1 the different Khat producer and consumer groups differed significantly in food insecurity. The highest prevalence of food insecurity (83.3%) was observed among Khat producers and not consumers.

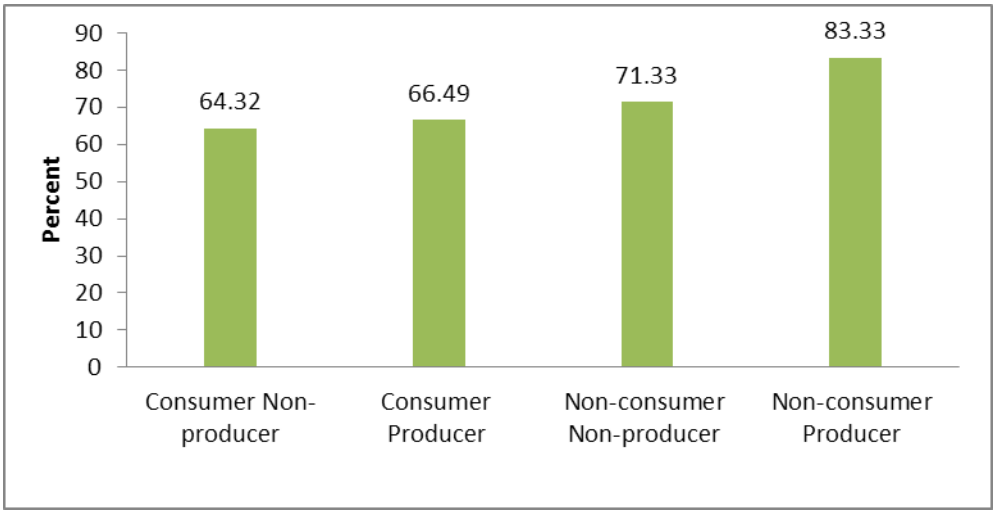

Fig 1. Proportion of Households with Food Insecurity by Khat Consumption and Production Status (p=0.001).

Khat production and consumption was associated with food insecurity (p=0.01). The prevalence of food insecurity decreased as the non-food household expenditure groups progressed from the lowest to highest (p<0.001). A decrease in food insecurity observed (p<0.001) when crop variety changed from mono-cropping to more than one crop type. Food insecure households had a significantly lower mean land size than those that were food secure (p=0.01). Likewise, food insecure households had a significantly higher mean household size than those that were food secure (p=0.001).The prevalence of food insecurity increased proportionally as non-agricultural income type increased.

As presented in Table 3, food security differed between the categories of Khat production and consumption, by the groups of non-food item expenditures and between those with a lower vs. higher mean land size (p<0.0001). Similarly, there was a difference between those with the group of mono cropping vs. more than one crop variety producers (p<0.0001).

Table 3. Association between Predictor Variables and Household Food Insecurity

Food Security

	Insecure (n %)	Secure (n/%)	Chi(p-value)
Khat production and consumption			
No Khat consumer and no Khat producer	346(71.34)	139(28.66)	15.56(0.01)
Khat consumer and Khat producer	246(66.49)	124(33.51)	
Khat consumer and no Khat producer	119(64.32)	66(35.68)	
No Khat consumer and Khat producer	100(83.33)	20(16.67)	
Nonfood household expenditures			
Expenditure, <3 types	150(87.21)	22(12.79)	30.64(<0.001)

Expenditure, 3-5 types	547(67.87)	259(32.13)	
Expenditure, >=6 types	114(62.64)	68(37.36)	
Non agricultural income type			
No non-agricultural income	448(66.67)	224(33.33)	8.01(0.005)
More than one non-agricultural income	363(74.39)	125(25.61)	
Crop variety production			
Mono-cropping	268(79.29)	70(20.71)	19.94(<0.001)
>One crop variety	543(66.06)	279(33.94)	
Household size (mean ±SD)	5.79(±2.11)	6.09(±2.14)	2.15(0.02)
Land area used for crop production (mean ±SD)	0.57(±1.06)	0.12(±1.10)	10.00(<0.001)

As shown in Table 4, the prevalence of food insecurity decreased by 31% among Khat consuming and non-producing households compared to non-consuming and non-producing households (AOR: 0.69[95%CI: 47, 1.01], p<0.5). In contrast, the likelihood of food insecurity was two times higher in households that produced but did not consume Khat than in households that neither produced nor consumed Khat (AOR: 2.17[95%CI: 1.25, 3.76], p<0.1). The likelihood of food insecurity decreased by 34% for each unit increase in land area used for crop production (AOR: 0.66[95%CI: 0.59, 0.74], p<0.001).

Additionally, the likelihood of food insecurity was 70% less among households with 3-5 types of nonfood household expenditures (AOR: 0.30[95%CI: 0.19, 0.50], p<0.001). Similarly, food insecurity was 71% less in households with ≥6 types of nonfood household expenditures compared with households with less types of nonfood household expenditures (AOR: 0.29[95% CI: 0.16, 0.52], p<0.001)

Table 4: Multivariable Logistic Regression Model Predicting the Likelihood of Household Food Insecurity in Rural Households of Ethiopia

Household food insecurity	AOR	[95% CI]	p-value
Khat production and consumption			
No Khat consumer and no Khat producer	Ref.		
Khat consumer and Khat producer	0.99	(0.72, 1.36)	0.94
Khat consumer and no Khat producer	0.69	(0.47, 1.01)	0.05
No Khat consumer and Khat producer	2.17	(1.25, 3.76)	0.01
Land area used for crop production	0.66	(0.59, 0.74)	<0.001
Nonfood household expenditures			
Expenditure, <3 types	Ref.		
Expenditure, 3-5 types	0.30	(0.19, 0.50)	<0.001
Expenditure, >=6 types	0.29	(0.16, 0.52)	<0.001
Nonagricultural income type			
No nonagricultural income	Ref.		
More than one non-agricultural income type	1.17	(0.88, 1.55)	0.29
Crop variety production			
Mono-cropping	Ref.		
>One crop variety	0.84	(0.60, 1.18)	0.32
Household size	1.02	(0.95, 1.09)	0.59

Discussion

This study indicated that, higher proportions of Khat consumers were Khat producers. The land area currently used for Khat plantation is 44% of that used for coffee cultivation [25]. From 2001/02 to 2014/15, the land for Khat farming increased by 160%, expanding throughout Ethiopia [31,41]. Findings from Khat growing areas have indicated that farmers intercrop Khat with subsistence crops such as vegetables, fruits and maize. Land that is not favored for other crops is also shifted to Khat plantation [26,42]. In addition, cash cropping has a possible positive `spillover effect` of providing credit, farming resources, and agricultural extension training and could potentially diversify dietary patterns [43]. By contrast, other studies have shown that chronic Khat consumption can drain family resources and that its production is intensifying at the expense of staple crops, with potential implications for food availability and consumption reduction [30,44]. However, the transformation of money from cash crops to other non-household food items and men`s control of cash crop incomes could leave women without the resources needed to feed their family [23,28,44].

This study found that households that produced and consumed Khat had greater dietary diversity than those that did not produce or consume; that could be due to its frequent harvesting in all seasons and is sold with high demand. An income from selling Khat could contribute to daily food crop purchase and consumption.

Although this study investigated the effects of Khat production and consumption on dietary diversity and food insecurity, alternative explanations such as land size for crop production, non-food household expenditures, non-agricultural income type, household size and crop diversity were addressed during the analysis. Non-agricultural income did not play a significant role in dietary diversity. This finding supports the hypothesis that farmers strategically use non-agricultural incomes to cope with the periods of poor agriculture returns or of inconsistent markets for their harvest [45,46]. Although collecting accurate income data is a challenging task, further research is needed to understand the factors that could improve and sustain household income and dietary diversity.

The results of this study indicated that farmers' household size did not play a significant role in dietary diversity for larger families. However, this finding is questionable, as it did not account for the role of human power or the proportions and composition of household members' age and gender. Studies recommend evaluating the association of household size with dietary diversity, food consumption and poverty in general with caution [47,48].

This study showed that compared to households that did not produce or consume Khat, household food security increased for consumers and non-producers but decreased for non-consumer–producers. The possible pathway for the effects of consuming and not producing Khat on food security during the lean season (data collection period) could involve the relatively low price of Khat due to the high production. However, this hypothesis should be confirmed with more evidence on the amount of Khat leaves consumed and how many family members are habituated. Not producing Khat could also suggest that land is used for crop production, while for households that do not consume but do produce Khat, food insecurity might increase due to farmers' tendency to produce or substitute their land for Khat plantation.

Food security is a multidimensional phenomenon. Crop production and sustainability, food availability and distribution (access), clean water, livelihood opportunities, education, off-farm income and access to health care are among the many predictors [49,50]. Food availability is a meaningful indicator of food security. The success of crop production depends on market access which is a better strategy for increasing food security than focusing on agricultural production alone [47].

This study indicated that in the presence of Khat production and consumption, non-agricultural income is not a pathway to food security and edible crop production from their small farm is highly valued for household livelihood. Evidence from Ethiopia and Uganda suggests that farm income accounts for more than 70% of total income. In most developing countries, subsistence agriculture in small farms contributes to food security though land and capital are scarce and the fixed land size with rural population growth is creating sub-divisions of small farms [41,51].

In Ethiopia, Khat consumption has expanded and has become a sociocultural and economic practice. Further follow-up research is needed to unpack the effect of substituting crop land for Khat. The findings of this study provoke debate whether small Ethiopian agriculture holdings should live with Khat or without it. Furthermore, questions remain regarding the outcomes of Khat production and whether Khat should be considered a controlled drug or a licit substance to be regulated.

Conclusion

This study identified that of the four household groups defined based on their Khat production and consumption, (a) Household food security was higher for consumers who were not producers but was lower for those who were neither consumers nor producers. (b) Khat producers and consumers had a more diverse diet than non-producers–non-consumers, which could be due to an increase in Khat productivity during the lean season, when income from Khat can increase and be used to purchase staple foods. Although Khat generates cash it may not have a positive effect on food security as the income from Khat can be used for other expenses. Livelihood and agricultural development interventions should consider Khat production and consumption effect among households in various Khat -producing areas of the country.

Conflict of interest
The author has no competing interests

Author contribution
BWA: Conceptualization, Methodology, Investigation, Formal analysis, Writing - review & editing.

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