Policy Briefs

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POLICY BRIEF -1.1 | THEME | I
May 2023

Eco-friendly Entomopathogenic Nematodes Controls Termite and Improves Groundnut Yield

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Key messages

•Farmers in Eastern Hararghe who produce groundnut suffer up to 18% of yield loss due to termites.
•The application of entomopathogenic nematodes that can be locally mass-produced has significantly reduced groundnut yield losses due to termites.
•The use of entomopathogenic nematodes is eco-friendly as it reduces the use of agrochemicals on the environment and reduces pesticide import costs.

Introduction

In Ethiopia, groundnut covers about 41,761.12 ha of land. The average national yield of groundnut is about 1.1-ton ha-1 (CSA, 2021). Ethiopia is among the tropical countries where crops and pasturelands are severely damaged by termites (Abdurahman, 1990). Although with limited success, management of this pest using chemicals and cultural methods has been tried for a long time. The efficacy of the entomopathogenic steinernematid and heterorhabditid nematodes against termites has been investigated and found to be successful by many pest management professionals in several countries. Nematodes have been also isolated from naturally infected subterranean termites (Yu et al., 2008; Zadji, 2014).

It is difficult to handle the underground termites using harsh agrochemicals because they reside inside the soil which makes it impossible to reach the queen using chemicals. Therefore, farmers require a management method that can reach the queen and eliminate termites from the area. This can be achieved through the application of virulent entomopathogenic nematodes with appropriate techniques. Reducing termite damage on yield of groundnut using reduced amount of pesticide free product improves the farmers' income. This, in turn, increases the country's oil seed exports and local consumption potential and realizes the policy of partners and donors thereby achieving global priorities. Therefore, this research was conducted to manage termites using entomopathogenic nematodes as potential control agents in groundnut in Eastern Ethiopia.

Approaches and results

The study was conducted in eastern, central and western Ethiopia where there is a high termite diversity (Cowie et al., 1990) . Survey was conducted during the 2019/20 cropping season. A total of 80 survey sites were selected and a similar number of composite soil samples were collected for identification of nematodes. Entomopathogenic nematodes were collected from soil samples using Galleria mellonella as a bait. The recovered isolates of entomopathogenic nematodes were tested for their pathogenicity and virulence against termites using standard procedures. The dead termites were dissected to confirm mortality was due to nematodes.

Field experiments were conducted to evaluate the efficiency of nematode strains that were shown to be most efficient in the laboratory conditions. In the experimental fields, termites were continuously found for six months. For subterranean termites a method followed by Yu et al. (2009) was used. Once the sites determined to have termites, a pre-treatment termite count was made. Nematode viability was verified by host bioassay. Control sites received only water. Post treatment samples were taken at 1, 2, and 4 weeks after application.

From the total of 80 soil samples collected, 16 (20%) were positive for entomopathogenic nematodes. The entomopathogenic nematodes recovered from the survey soil samples belonged to three genera of nematodes, i.e., Oscheius tipulae, Heterorhabditis indica and Caenorhabditis briggsae. Among these, the genus Oscheius was the most abundant (50%). The locally isolated entomopathogenic nematodes for biological control of Odontotermes montanus were capable to manage the termite. The mortality due to the entomopathogenic nematodes on O.montanus was 88.25% by H. indica and 78.8% by O. tipulae. However, compared with the pre-isolated nematode S. yirgalemense, which caused 97.22% mortality, they can be considered as less virulent than this nematode.

Number of termites infested pods of Werer 961 variety treated with H. indica was 4.82% and 3.56% at Babile and Fedis, respectively. Field evaluation of the selected strains of entomopathogenic nematodes against Odontotermes spp. showed a promising result and could be able to reduce yield loss due to the termite. The nematodes which applied on the groundnut field was able to persist before harvest for nearly two months but their persistence decreased till the fourth month post application. Results from this study indicated that plots which are not treated with entomopathogenic nematodes suffered a yield loss of 15.5 to 17.9%. This is a large amount of yield which is lost due to the termite attack only. Now a day's countries which import agricultural products from Africa demand pesticide free products. In producing pesticide-free product, groundnut producing farmers will obtain a more stable and higher income.

Policy recommendations

- Production of groundnut using entomopathogenic nematodes is an eco-friendly production method that reduces/ eliminates the amount of chemical residue generated from the production process.
- Awareness creation and promotion of entomopathogenic nematodes should be given to development agents and farmers by Ministry of Agriculture, Oromia Agriculture and Natural Resources Bureau, East Hararghe Zone Agriculture Office; and Babile and Fedis Agriculture and Natural Resource Offices.
- Facilities should be made available for mass rearing of the entomopathogenic nematodes.

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POLICY BRIEF -2.1 | THEME | II
May 2023

Availability and Affordability of Essential Medicines are Suboptimal in Health facilities in Eastern Ethiopia

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Key messages

- ✓ Availability of generic versions of essential medicines was lower than the WHO target of 80% with only 16% of the surveyed medicines met the standard.
- ✓ Four out of five surveyed drugs were found unaffordable with the highest price being observed in private settings.
- ✓ Inappropriate dispensing practices of antimicrobial medicines without prescription were observed in Health facilities in Eastern Ethiopia.

Introduction

Universal health coverage has access to essential medicines at its core and is an indispensable element for delivery of services and requirement for a high-quality care (Bigdeli et al., 2015). Availability and affordability are dimensions of measures for access to medicines in health systems (Wirtz et al. 2017). Effective drug supply management ensures uninterrupted availability of pharmaceuticals with approved quality, safety and efficacy. Thus, accessibility and price of medicines are key measures of medicine access and determines their utilization. This is crucial to reduce the financial burden of care, preventing greater pain, shortening the duration of illness, averting needless disabilities and minimizing death toll. WHO proposed 80% target for access to essential medicines which is a key to attain the overall target of 25% relative reduction in premature mortality from chronic non-communicable diseases by 2025 (Bissell et al. 2016). A large section of population in low- and middle-income countries lack reliable access to medicines (Attaei et al. 2017). In this regard, there is a limited information on the price, availability, affordability, and supply chain management of essential medicines in health facilities as well as the practice of pharmacy professionals in the community drug retail outlets in eastern Ethiopia. Therefore, this study aimed to assess the price, supply chain management and utilization of essential medicines in eastern Ethiopia.

Approaches and Results

Data were collected from March to September, 2020, using standardized data collection tools developed by world health organization (apps.who.int/iris/bitstream/handle/WHO_PSM_PAR_2008.3_eng.pdf).

To assess the supply chain management of essential non-program drugs, a mixed quantitative and qualitative method was used. To assess the utilization of antimicrobial agents in community drug retail outlets, a structured questionnaire and simulated-patient method of visit were implemented.

The overall result revealed that, the proportion of availability of originator brand versions of essential medicines was 3.6% (ranged: 0.0 to 31.7 %), with the public and private sectors contributing 1.43% and 5.50%, respectively. The overall percent availability of lowest price generics was 46.97% (ranged: 1.7 to 93.3 %) of which 42.5% is contributing by public and 50.8% by private sectors. About 64% of the drugs showed statistically significant median

price difference between public and private settings ($p < 0.05$). The median price ratio value indicated that the median buyers' price of drugs in private sector were more than four times the international reference price in 30% of drugs. The proportion of unaffordable medicine was 72.09 and 91.84 % for public and private facilities, respectively, with 79.17% of the medicines being unaffordable when both settings were combined.

In the assessment of utilization of antimicrobial agents, majority of responses of professionals to questionnaire-based study variables minimally agreed with their practice response to diarrhea symptom for the simulated-patient case study. Only a quarter of their knowledge response matched exactly with their practice response to acute diarrhea case scenario. Retailers with insufficient knowledge on antimicrobials and antimicrobial resistance had about three time more likely to have inappropriate dispensing practice of antimicrobial agents in response to diarrhea symptom than those with sufficient knowledge (AOR, 2.9; 95% CI: 1.23-6.89) (Table 1).

Table 1. Factors associated with the inappropriate dispensing of antimicrobial agents in response to the diarrheal symptom.

Variable	Category	COR (95% CI)	P-value	AOR (95% CI)	*P*-value
Retailer's qualification	Pharmacist	1		1	
	Pharmacy Technician	1.94 (0.81-4.6)	0.134	1.35 (0.52-3.54)	0.53
AMR understanding of retailer	Sufficient knowledge	1		1	
	Insufficient knowledge	2.78 (1.18-6.55)	0.02	2.9 (1.23-6.89)	0.015*
Retailer's dispensing behavior favors sharing antimicrobials	Yes	1		1	
	No	0.40 (0.17-0.95)	0.038	0.80 (0.21-3.07)	0.75
Retailer thinks AMR as a risk to users only	Yes	1		1	
	No	0.63 (0.27-1.47)	0.248	0.76 (0.26-2.2)	0.61
Satisfactory interaction for responding to symptoms	Yes	1		1	
	No	1.8 (0.77-4.20)	0.17	1.44 (0.59-3.5)	0.42

*Statistically significant ($P<0.05$), AMR= antimicrobial resistance

Policy recommendations

- Ethiopian Ministry of Health and the concerned stakeholders need to intervene in supporting the supply chain actors including public and private sectors for sustainable availability and affordability of essential medicines for the local community.
- Ethiopian Food and Drug Authority and regional health bureau need to implement a serious monitoring to control price variation in public and private health facilities to make essential medicines affordable.
- Ministry of Health, regional health bureau and national stakeholders need to strengthen the institutional capacity development of pharmacy professionals to prevent the inappropriate dispensing of antimicrobial agents.

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POLICY BRIEF -2.2 | THEME | II
May 2023

Teenage Pregnancy is Unacceptably High in Kersa Woreda Community, Eastern Ethiopia

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Key messages

- ✓ A high prevalence (30.2%) of teenage pregnancy was evidenced among girls out of school, who hadno formal education, and did not know their fertile p eriod during menstrual cycle.
- ✓ Family history such as divorce and having an elder sister with a history of teenage pregnancy were shown as driving factors for teenage pregnancy.

Introduction

According to the United Nations Children Fund (UNICEF), teenage pregnancy is defined as a pregnancy in girls within the age range of 13–19 years. Teenage pregnancy is considered as a serious public health and social problem globally, in which it is persistent in developing countries with unique medical and psychosocial consequences for the society. It is often associated with poor maternal and child health outcomes. Pregnant teenagers are considered to be a high-risk obstetrical population, leads with pregnancy-related complications, resulting in an increased risk of maternal death (Kalipeni et al. 2017).

About one-third of the total population of Ethiopia is adolescent and youth. Ethiopian Demographic Health Survey indicates that 13% of women between the age of 15 and 19 have already given birth, and 2% were pregnant with their first child. Living in a community with a lower proportion of contraceptive user, sexual practice before the age of 15 years, and rural dweller were positively associated with teenage pregnancy (Mamo et al. 2021). The existing studies in the country focused on all clients visiting major hospitals in cities and towns, and most importantly, the studies used retrospective clinical data, which are often incomplete and not well documented. Therefore, this community-based study aimed at assessing the prevalence and factors associated with teenage pregnancy in eastern Ethiopia.

Approaches and Results

A community-based cross-sectional study was carried out in Kersa Health and Demographic Surveillance System (HDSS), East Hararghe Zone, Oromia Regional State, for five months from January to May, 2020. Out of the 24 Kebeles under the Kersa HDSS site, 12 (50%) were selected through lottery-based method. Following the sampling frame obtained from Kersa HDSS database, the study subject was randomly selected from the designated Kebeles. A structured-interviewer-administered questionnaire was used for data collection. The questionnaire was adapted from the WHO (Illustrative-questionnaire-data base) for interview survey with young people

Data were collected by pre-trained and experienced female data collectors and 4 field supervisors at household level.

A total of 2258 households in which the female teenagers (13 to 19 years) reside were visited for data collection. The purpose of the study was explained before commencing the questionary and requested for their willingness to involve. The result obtained showed that the prevalence of teenage pregnancy was 30.2% (95% CI: 28.3, 32.1). Then, its affirmed that, teenage pregnancy was associated with various sociodemographic factors such as age, limited access to school, lack of formal education, and early marriage, as well as familial factors like parental divorce and having an elder sister with a history of teenage pregnancy, and reproductive factors (not being aware of the fertile period during the menstrual cycle) (Figure 1).

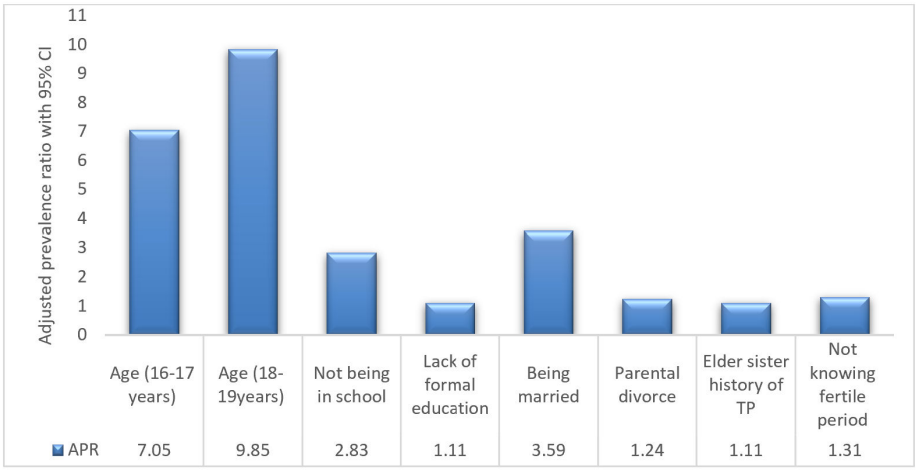

Figure 1. Factors associated with teenage pregnancy (TP) in eastern Ethiopia, January – May 2020

Policy recommendations

- ✓ Woreda health office, health extension workers, and local women, children and youth affairs office need to provide continuous awareness creation on teenage pregnancy.

- ✓ Effective engagement of civil society organization, religious leaders, elders, and other relevant stakeholders in preventing teenage pregnancy is crucial.

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POLICY BRIEF-3.1 | THEME | III
May 2023

Repeated use of Frying Oil Poses Public Health Risks

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Key messages

•Repeated use of oils beyond five frying cycles leads to oil degradation producing toxic products which are harmful to consumers.

Introduction

Frying process is a fast and convenient food preparation method widely used in homes, street vending and commercial establishments. This process develops odor, flavor, color and texture that make food more appealing for consumption (Bora & Rathore, 2015). The consumption of fried foods has increased in recent years in Ethiopia. For instance, fried potato chips and sambusa are commonly sold on streets. Street vendors use the frying oil repeatedly for long periods to reduce the expenses of the frying oil. However, the frying process leads to a complex reaction that produces several short-chain degraded chemical compounds (Nayak et al., 2016). These compounds are believed to be carcinogenic and affect public health (Venkata & Subramanyam, 2016). Therefore, this project aims to assess the frying potentials of selected oil types in selected towns in Eastern Ethiopia and determine the frequency/cycle of oil reuse.

Approaches and Results

Data were collected in selected towns (Bate, Haramaya, Aweday and Harar) on the type of oil used by vendors, frequency of frying, product types and related information. Three oil brands (Vera, Liba and Hayat oils) commonly used in the area by vendors were purchased from the local market. Potatoes (for potato fries) and wheat flour (for sanbusa preparation) were also collected from the local market. Potato chips and sambusa were prepared following standard procedures. The frying process was repeated eight times. Samples collected from the study area were analyzed for oil quality parameters, such as free fatty acid, peroxide value and viscosity, using American Oil Chemists' Society (AOCS) methods.

The result indicated that 34.6% of the collected samples (reused oil) contained a free fatty acid (FFA concentration beyond the standard threshold level (0.5%) (Figure 1). The viscosity and peroxide values are found to be extremely higher. For example, 51.8% of the samples exceeded the threshold concentration peroxide value of 12 mEqO2/kg. This implies that the fried products that street vendors sell are more likely to cause public health problems.
lary (MB) patients were colonized by M. leprae. All healthy ECs were negative for nasal swab DNA analysis. In this study, about 27% HHCs had cohabitation for more than 96 months and one-third of were siblings and 20.8% were offsprings. The DNA positivity rate was significantly different among HHCs and ECs (P=0.022) and associated with disability grade within the patient group (P=0.003).

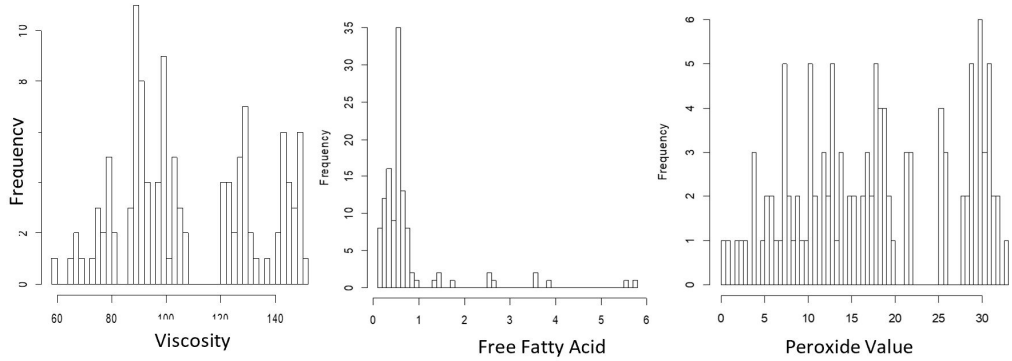

Figure 1. Quality of reused oil (FFA, peroxide value and viscosity) collected from vendors

The result of oil frying cycle indicated that change in FFA content of oil increase significantly with increase in frying cycle for both potato fries and sanbussa (P≤0.05) (Figure 2). There is a higher rate of change in FFA when frying with Vera oil compared to other brands of oil. The %FFA of each oil type has increased with increasing frying cycle up to 8th cycle.

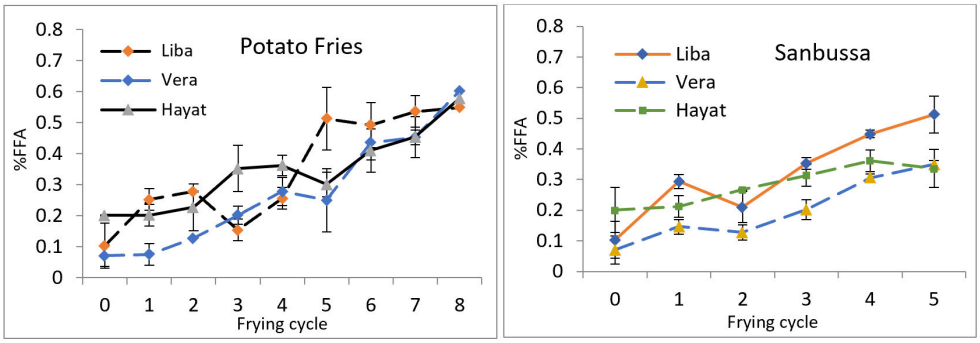

Figure 2. Change in free fatty acid at each frying cycle for all oil types under each product. Values: Mean ± SD, n=3.

However, the frying cycle cannot go beyond 5 frying cycles for Sanbusa due to the development of dark brown color, which indicates a polymerization reaction. FFA are harmful radicals, which can undergo further oxidative reactions leading to the formation of toxic products (Venkata and Subramanyam, 2016).

The result clearly showed that oil degradation is higher in sanbussa preparation than the potato fries. The variation comes from the difference in physicochemical properties between potatoes and sanbussa. Since those two products are different in composition, such as moisture content, the degree of FFA hydrolysis from the triacylglyceride molecules is different. This indicates that oil used for sanbusa frying should not be reused repeatedly compared to potato frying.

A significant rise in peroxide value (PV) was observed for all brands of oils used under both products, sanbussa and potato fries (P≤0.05) (Figure 3). It showed a gradual increase in each frying cycle for all oil types. In both products, the rise in peroxide value was high after the third frying cycle (33.09 mEqO2/kg) for Vera oil compared to Liba and Hayat oils. The peroxide value increases with the oil samples' frying frequency, temperature, and air interaction. It is observed that Hayat and Liba oils are more resistant to oxidative degradation than Vera oil.

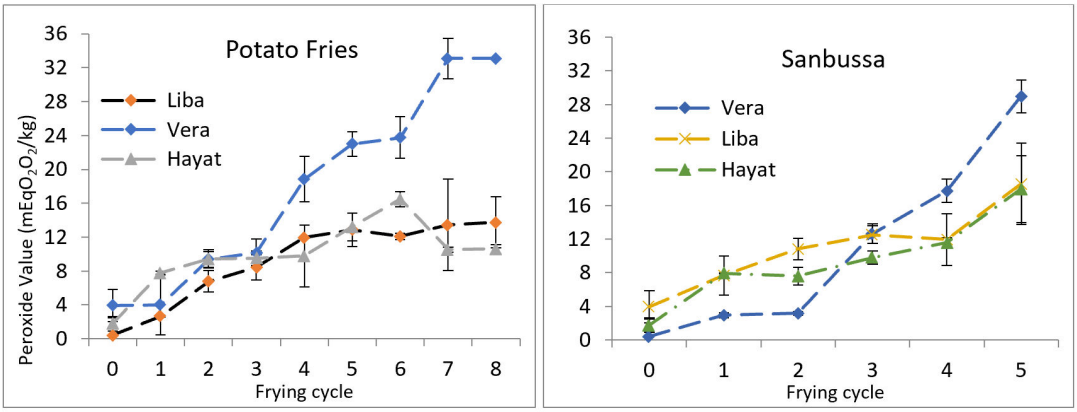

Figure 3. Change in Peroxide value at each frying cycle for all oil types (Hayat, Vera and Liba oil brands) and products. Values: Mean ± SD, n=3.

The viscosity of the oil at each frying cycle showed a significant increment (P≤0.05) between the oil types and the two products (Figure 4). The rise in viscosity in the consecutive frying cycle may be due to the polymerization of degraded compounds, such as oxidized fatty acid producing high molecular weight compounds. The oil obtained after frying sanbussa has higher viscosity compared to potato fries. Similarly, discarded oil from Liba oil has the highest viscosity among the three oil types. High viscosity is a clear indication of the formation of various chemicals through polymerization, which are toxic compounds leading to various disorders (Çağlar et al., 2012).

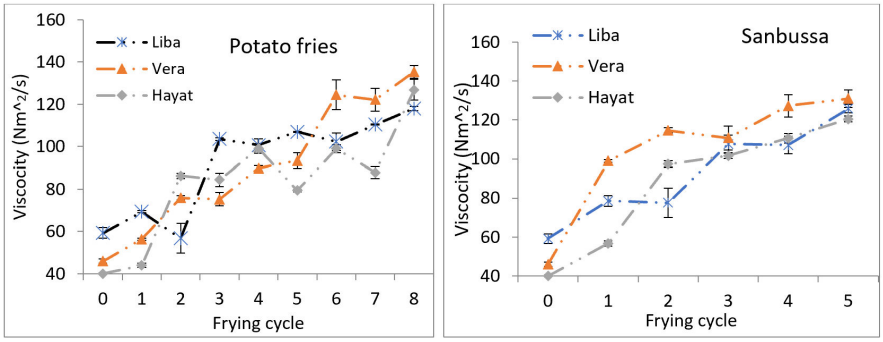

Figure 4. Effect of the frying cycle, oil and product types on the viscosity of remaining oil. Values: Mean ± SD, n=3.

Generally, Hayat and Liba oils showed good stability and consistency in the frying process with minimum oil degradation exhibiting a minimal change in %FFA, peroxide value and viscosity compared to the Vera oil. A maximum of five frying cycle oil usage was found to be at minimum public health risk.

Policy Recommendations

•Public awareness on the quality of frying oil, the frequency of reuse of the oil and products should be given to street vendors, consumers and the concerned offices.

•National and local government offices should establish laws and regulations on monitoring frying oil type and frequency of reuse.

•Ethiopian Food and Drag Authority should enforce and provide direction for oil-producing companies to produce and provide both frying and cooking oils.

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POLICY BRIEF-4.1 | THEME | IV
May 2023

Oromo Music, Drama and Performing Art as Counter-hegemonic Force: The Case of Afran Qallo Music Band

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Key messages

•Afran Qallo music has contributed for the maintenance and development of Oromo identity, unity, political consciousness, and cultural revival.
•The Afran Qallo band exhibited music, drama, and other aspects of performing arts to express their grievances, societal needs, love, anguish, philosophy, politics, their world outlook etc.
•Afran Qallo band was the voice of the Oromo against the predominance and political hegemony of the ruling class.

Introduction

As a vital form of performing arts, music is the demonstration of cultural genius of a society. This aesthetic intellect has immense cultural functions in a society in which it is created, performed, flourished, and popularized. In this regard, scholars emphasize that music can be both open and hidden transcripts. It can also give voice to national aspirations or index the emergence of new and context-based identities.

Music among the Oromo occupies an important position and served as the most widely used medium of expression in all manners of occasions, and at all times and periods of life. The Hararge Oromo use music to give voice and sound to their collective thoughts, actions and even spirituality. In this way, while the people make use of music, music makes use of them for it places on them that imprint on character, mien, thoughts and carriage which are commonly summarized as identity. It is true that music plays an influential role in reflecting the historical injustice committed by Ethiopian ruling group against them. However, it should not be forgotten that music has also a socio-cultural role which a group uses to reinforce a common cultural identity.

One of the earliest and most renowned musical bands in Hararge was Afran Qallo music Band. It was a cultural-cum-national movement established in Dire Dawa in 1962 by four founding members (Ismail Mumed, Abubeker Musa , Ali Shebo and Suleiman Yusuf). The band has focused on four nucleuses of the Oromo cultural elements, namely culture, language, history and politics.

However, there is no as such well organized and articulated academic undertaking that explored and revealed the role of the Afran Qallo music band in the purviews of the cultural influences and political role of the music band among the Hararge Oromo in particular and the Oromo in general. Accordingly, this study tries to document the contribution of this cultural genius among the Oromo of Hararge.

Approaches and Results

This research work is qualitative in nature. Both primary and secondary sources of data are used in this research. The primary data was collected through first-hand information using interview from the actual participants of the events found in Dire Dawa, Harar, Addis Ababa and some towns of Hararge. In addition, individuals who have been closer to the

events were interviewed. Hence the study tries to draw its data through a large-scale interview with former Afran Qallo musicians and from those who were eye witness of the events. The reliability and validity of the gathered data were triangulated and interpreted.

Afran Qallo music band has made a significant contribution to the cultural revival of the Oromo, growth of Oromo language, rise of the Oromo national consciousness, group cohesiveness, modernization of Oromo music, growth and internationalization of Oromo music etc.

The findings also reveal that Afran Qallo music band assisted the people to maintain their unity, identity and serve in inspiring cultural Revolution. One of the central and founding musical poems of the Afran Qallo is given below.

Afaan Oromo
Ijoolleen Afran Qallo dardara amman tana
Mee kootta wal-barranaa yeroon keenya ammaa
Ka'aa hirribarraa kootaa wal barannaa
Kootaa ni taphannaa wallee amaantanaa

Gloss
Sons of Afran Qallo, the days youth
let us come together, our time is now
Wake up from your sleep, let us understand each other
Let us play, the dance [shagoyye] of the day

In another song Abdi Qophe produced his first song for Ali Birra which has a political message addressing mainly the economic exploitation and cultural segregation of the Oromo by the ruling class and runs as follows:

Afaan Oromoo
Maal je'ani maal himanii
Hoggaa yaadaan dhiibamanii
Aahi! Jiruu afaan wallaalanii
Jiruu afaan wallaaalanii
Kan lafa dhabee horii saamamee
Kan roorroo jibbee gaaratti gamee
Maal herreega maal dubbata mee?
Maal maal dubbata mee
Kan facaafate kadhaa mudatee
Karraa hoongawee waani abdatee
Maal odeessaa? Waan isa mudatee
Waan waan isa mudate
Kan arra ergamu dur ergatee
Bantii duroomarraa konkolaatee
Hiyyummaaf duroomarraa maal dubbattee
Maal maal dubbate mee?

Gloss
What do they speak and tell
When someone is pushed aside because of his ideas/thoughts
Oh! Denying the existence of our language
Denying the existence of our language
Cattle is confiscated from those who have no land
Those who resisted oppression flocked to the jungle
What did he think and speak about this?
What did he say of this?
Those cultivators turned out to be beggars
Is there any hope when someone is in hunger
What did he speak of his experience/encounters
Things that he faced
Those who were the master earlier became servant
Being fallen from the climax of being rich
What did he speak of being poor and rich
What did he say

Dur qarayyoon boonee kan har'a jaamee
Kan ifni jiruu guyyaan itti dhaamee
Maal anaannata gufuun yoo dhawamee
Kan roorroon alagaa mukatti galchitee
Kan bilisummaan dhiiga qaadhimtee
Maal gaabbinsaa isa yoo duuti isa argattee
Maal je'ani maal maal himanii
Hogaa yaadaan dhiibamanii
Jiruu afaan wallaalanii wallaalanii, wallaalanii
Jiruu afaan wallaalanii.

When someone who can see earlier turned out to be blind now
Not able to see in the day light
It is not surprising to see him falling down on the ground
The oppression by aliens forced him to join the jungle
Getting freedom requires sacrifices/blood
Is there any regret if he faced death in doing so?
Is there anything they speak and tell
If someone is pushed aside for his ideas/thoughts
Denying the existence of our language time and again
By denying the existence of our language

Policy recommendations

- ✓ Federal and Regional government bodies should work earnestly towards the establishment of asort of foundation for Oromo nationalists (artists, heroic fighters, politicians etc) who became victims of the successive governments of Ethiopia.
- ✓ Haramaya University should open up Oromo cultural centre and/or an academic program like department or school that stringently work on the promotion and expansion of Afaan Oromo Music, drama and other sorts of art.
- ✓ A concerted effort should be made by all concerned bodies (Government and non-government) to help the destitute families of former artists who are presently without any support.
- ✓ Scholars in the field should engage in advancing epistemological horizon on Hararge Oromo music in particular and the Oromo in general.

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POLICY BRIEF-4-2 | THEME | IV
May 2023

Context Based Close Packing of Crystals Structure Supported with 3D-virtual Model Facilitates Students' Understanding and Achievement

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Key message

•Teaching concepts of crystal structures using context based close packing of crystal structure supported with 3D-virtual model enhanced students' understanding of the concepts and improved their achievement.

Introduction

Crystal chemistry deals with the relation between crystal structure and physical or chemical properties of matters. The properties of solids are defined by their structures and interatomic or intermolecular forces. For instance; the fragility of salts, the ductility of metals and the hardness of inorganic polymers are direct consequences of their crystal structures. In line with this, understanding the three-dimensional arrangement of units in the solid is indispensable to realize the relation between crystal structure and materials' characteristic. In crystals, close packing refers to the efficient arrangement of constituent particles in the lattice.

However, chemistry and material sciences students have problems of understanding crystal structures. Hence, it is important to design and implement intervention mechanisms to minimize students' difficulty in understanding crystals structure. However, there is a limited studies reported on students' difficulty in crystal structure and intervention mechanism in Ethiopia. Therefore, this study was initiated to develop context-based close packing of crystals structures supported with 3D-virtual model and evaluate its effect on students' academic achievement, and attitude on the approach.

Approaches and Results

The nature of this study was a quasi-experimental design. For this purpose, 61 third-year undergraduate chemistry students of Haramaya University (37 students representing control group and 24 students representing intervention groups) have participated. The intervention group was taught the concept of crystal structures using the proposed method (context based close packing of crystal structure supported with 3D-virtual model), while the control group learned the same topics using the traditional lecture method. Relevant data from the participants of study were collected using multiple data collection instruments namely, chemistry achievement tests, questionnaire, interviews, and observation). The data were analysed using qualitative and quantitative methods.

The context based close packing of crystal structure was designed by researchers using uniform multi-colored spherical balls-toy (kids-toys) purchased from supermarket. Besides, the researchers installed 3D virtual model software (crystal maker) on computers. The treatment groups were trained on how to construct crystal structures of different atoms/ions and molecules using the software and context based close packing (based on the self-developed manual). Thus, intervention group students were practiced construction of different crystals structure and their

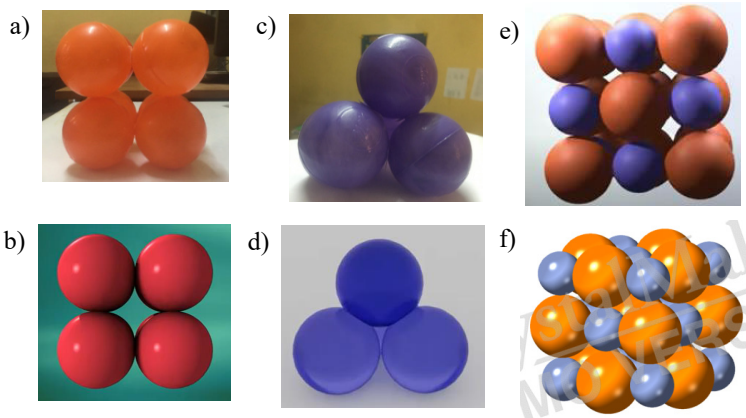

Figure 1. Decision Trees for Diagnosis and Treatment of major types of cattle disease (respiratory, reproductive & non-infectious diseases).

The result of post-test indicated that intervention group students performed better in the post-test exam than the control group students (Table 1). This shows that the propensity of using context based developed close packing supported with 3D-virtual model softwares enhanced students' visualization and reason-out ability of crystals structure concepts, and improved their achivement.

Table 1. Comparison between experimental and control group students' on crystal structure post-test by using two sample t-test (N = 61).

Test	groups	N	Df	Mean	SD	DoM	t-value	*p-value
posttest	Experimental group	24	59	19.66	6.82	6.98	3.78	0.0004
	Control group	37		12.68	7.18			

**At the 0.05 level, the difference of the population means are significantly different; N = number of experimental and control group students, P = probability, SD = standard deviation, Df= degree of freedom, DoM = difference of means.*

Most of the intervention group students have positive attitude towards the approach, which helped them in understanding the concepts (Table 2). The approach also helped them to develop the experience of working together.

Table 2. Questions responded by experimental(intervention) group students on using context based close-packing of crystal structure supported with 3D-virtual model learning experience.

No	Statements	% of respondents		
		Positive	Neutral	Negative
1	Building structure of different types of crystals systems with my colleagues enhanced my understanding.	91.66	4.16	4.16
2	My group members discussed together and helped each other during the approach.	75	16.66	8.33
3	I had good time during the approach.	100	-	-
4	The approach helped me to score better results in this topic.	79.16	20.83	-
5	The approach helped me to visualize the 3D crystal structure of atoms/ions and molecules.	79.16	12.5	8.33
6	The approach helped me to recall and memorize the structure of ions/atoms or molecules easily.	91.66	8.33	-
7	Building different solid crystal structures with the approach helped me to understand and predict their properties.	70.83	25	4.16

Based on the result of the study, the researchers concluded that context based close packing of crystals structure supported with 3D-virtual model would entice learners' interest, participation, and enhance their understanding. However, implementation of the approach requires adequate training and computer skills.

Policy recommendations

- ✓ Curriculum designers should interject context based close packing of crystal structure supported with 3D-virtual model in chemistry curriculum.
- ✓ Federal and regional education offices should train chemistry teachers on the use of different context based close packing of crystal structure supported with 3D-virtual model to teach crystal structure concepts.

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POLICY BRIEF-5-1 | THEME | V
May 2023

Low Dietary Diversity is Prevalent in Rural Households of Haramaya District, Eastern Ethiopia.

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Key messages

•Approximately 70% of sampled households were found to fall into the Low Dietary Diversity category, which represents many households (0-3 food groups consumed over the previous 24 hours).

•The households mostly consumed staple foods including cereals, and roots, while consumption of animal sources and vegetable foods are limited.

Introduction

Low-quality and monotonous diets are common in resource-limited across the globe. In low-income countries, most rural households are poor and members of these households are often malnourished. Risks for a range of micronutrient deficiencies are high when grain or tuber-based staple foods dominate, and diets lack vegetables, fruits, and animal-source foods. Dietary diversity (DD) is defined as the number of food groups consumed over a reference period. It reflects the concept that increasing the variety of foods and food groups in the diet helps to ensure adequate intake of essential nutrients that can promote good health, physical, as well as mental development. Since no single food can contain all essential nutrients, the more food groups included in the daily diet, the greater the likelihood of meeting nutrient requirements. Dietary diversity is, therefore, a key determinant of nutritional outcomes. With that background, a sufficiently diverse diet may reflect nutrient adequacy. Hence, dietary diversity can be viewed as a proxy measure of food security. Understanding household dietary diversity may, therefore, be an alternative pathway to estimate household food security. Previous of studies seem to be focusing on determinants of dietary energy consumption (quantity), at the expense of dietary quality and diversity (reference). Therefore, need, arises to focus on determinants of dietary diversity as it is critically important for infants and young children in terms of supply of micronutrients and energy for physical and mental growth. Therefore, this study aimed at assessing dietary diversity and associated drivers among rural households' of Haramaya district, eastern Ethiopia.

Approaches and Results

Using multi-stage sampling procedure, a total of 178 sample households were included in the study from Haramaya district. Cross sectional data was collected from sample respondents using interviewer administered questionnaire.

The study employed both descriptive and econometric analysis. The study applied multinomial logistic regression, by creating three mutually exclusive dietary categories, as an econometric model.

From the total sampled households, about 70% were fall into the low dietary diversity category; and around 14% of the sampled households moved to the high dietary diversity category (table 1). On average, the rural households consumed 2.7 food groups, in the previous 24-hour, and produced about 4 food groups, in the previous 12-months. This entails that production diversity is not translated into dietary diversity in the households.

Table 1: Mutually exclusive dietary diversity categories

	Low Dietary Diversity	Medium Dietary Diversity	High Dietary Diversity
Dietary Diversity Score	0-3	4-6	**7-12**
No of Respondents	**124 (70%)**	**40 (22%)**	**14 (8%)**

Source: Survey result, 2019

The regression results show that access to home gardens, education, gender, income, participation in irrigation schemes, production diversity, and ownership of small livestock had a positive and significant influence in attainment of high dietary diversity.

This suggests that production of diverse agricultural products, participation in irrigation scheme, gender of household head, education and ownership of home garden and small-livestock can enhance household dietary diversity and food security in the study area (table 2).

Table 2: The multinomial logistic regression results

Explanatory Variables	Parameters	Determinants of Household Dietary Diversity			
		Low Dietary Diversity (LDD)		High Dietary Diversity (HDD)	
		B	p-Value	B	p-Value
Intercept	β0	-3.532	.042	-8.417	.000
Age	β1	.004	.718	.000	.978
Gen	β2	.876	.087	-.184	.003**
MS	β3	.232	.227	.452	.247
IrigP	β4	1.731	.212	2.352	.048*
Edu	β5	-.136	.042*	.165	.033*
EmpS	β6	.165	.643	.084	.831
HHS	β7	-.035	.656	-.104	.274
AcsG	β8	-1.171	.044*	2.707	.022*
AcsF	β9	1.052	.067	.478	.467
Inc	β10	.000	.181	.001	.010**
OwLV	β11	.674	.274	1.324	.155
OwSL	β12	-1.498	.004**	1.726	.008**
MkOR	β13	-1.244	.173	2.224	.162
PD	β14	-1.874	.003**	1.448	.002**
Base Category		Medium Dietary Diversity (MDD)			
N0. of Observations		178			
LR Chi-Square		174.243 **			
Pseudo R-Squared		.684			

Policy recommendations

- ✓ Improving the purchasing power (income) of rural communities by unleashing rural income sources, promoting investment in small-livestock production, broadening women's knowledge of the health and nutritional benefits of a varied diet,
- ✓ Investing in irrigation schemes, encouraging home gardens, and promoting agricultural production diversity are pathways to improve dietary diversity and food security in the study area.

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POLICY BRIEF-5-2 | THEME | V
May 2023

Food and Nutrition Insecurity are Widespread in Pastoral and Agro-Pastoral Areas of Oromia Regional State, Ethiopia

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Key message

•Food and nutrition insecurity are rampant in (agro-)pastoral areas of the Oromia regional state, calling for an urgent intervention by the regional government and its development partners to realize holistic pastoral livelihood transformation.

Introduction

Food and nutrition security problem is highly prevalent in moisture deficit highlands and in the low-land pastoral and agro-pastoral areas. Even in years of adequate rainfall and good crop harvest, households in these areas remain food insecure and in need of food assistance. The food security situation during the October to December 2020 period showed that about 6.7 million people required urgent action to save lives, reduce food gaps, save and protect livelihood, and reduce and prevent acute malnutrition (IPC, 2021). The number of food insecure households could have been much higher had food assistance not been provided to around 18 million people through emergency food assistance and productive safety net programmes. This clearly reflects the deeply entrenched poverty and problem of food and nutrition insecurity in the country. Although considerable efforts have been made by the Ethiopian government and its multi-lateral development organizations to enhance production and productivity, the average annual food production growth lags behind the population growth rate, thus widening the food need gap and exposing citizens to food and nutrition insecurity and transient food aids (FDRE, 2018). Moreover, lower production and productivity, coupled with limited knowledge of nutritional concepts, poor access to health services and poor water quality, sanitation and hygiene, continuous consumption of cereal-based diets, and limited resource base of the society are underlying causes of food and nutrition insecurity in the country (Baye et al., 2013). Therefore, the current study was conducted to assess food and nutrition security status, identify determinants of food and nutrition security, and assess food insecurity coping mechanisms of pastoral households in the Oromia regional state.

Approaches and Results

A cross-sectional data was obtained from seven zones and 18 Woredas covering a total of 1,153 randomly and proportionately selected sampled households from pastoral areas of Oromia regional state of Ethiopia. A mixed methods approach has been employed to carry out this research. The data gathered from primary and secondary sources were analyzed using descriptive statistics and econometric models. The calorie acquisition method with 2200 kilocalories/AE/day as a threshold level, and household dietary diversity (daily nutrition intake) were used to measure food and nutrition security, respectively. Logit model was employed to identify factors affecting household food and nutritional security status.

The key findings of the study revealed that 54.55 % of the sampled households were food insecure whereas 87 % were nutritionally insecure (table 1). Households in East and West Hararghe zones were relatively food secure than the remaining zones.

Table 1. Food security status by zone in Agro-pastoral and Pastoral Zones of Oromia regional State

Table 1. Food security status by zone in Agro-pastoral and Pastoral Zones of Oromia regional State

Zones	Food insecure		Food secure		Total
	No.	Percent	No.	Percent	
East Hararghe	94	34.81	176	65.19	270
Bale	66	73.33	24	26.67	90
East Bale	144	68.57	66	31.43	210
Borena	53	56.99	40	43.01	93
Guji	112	60.54	73	39.46	185
West Guji	65	61.32	41	38.68	106
West Hararghe	95	47.74	104	52.26	199
Total	**629**	**54.55**	**524**	**45.45**	**1153**

The mean calorie intake was 2402.23 kcal, which is greater than the minimum threshold level (table 2). However, the mean daily calorie intake of food insecure households is 1460 kcal, which is far below the threshold level. The food secure households' mean daily calorie intake was found to be 3533.27 kcal.

Table 2. Calorie intake and diet diversity among food secure and food insecure pastoral households of Oromia region

Characteristics	Food Insecure N=629		Food secure N=524		t-value	Total N=1153	
	Mean	Std. Dev.	Mean	Std. Dev.		Mean	Std. Dev.
Diet diversity	2.713	0.97	3.31	1.40	-8.29***	2.99	1.22
Per capita calorie intake	1460.00	452.28	3533.27	2049.04	-24.664***	2402.23	1756.21

*** indicate statistical significance at 1%

The econometric analysis further shows that the mean dietary intake of households below the minimum threshold level. This implies that those households who fall in the low dietary diversity category consume 2.7 (on average) food groups within 24 hours period. This result indicates that nutrition insecurity is very high in the study area.

Table 3. Food security status of households using household dietary diversity score and per capita calorie intake

		Food security status (Calorie intake)				Total	
		Insecure		Secure			
		No.	Percent	No.	Percent	No.	Percent
HDDS status	Low	595	51.60	409	35.47	1004	87.08
	Medium	34	2.95	115	9.97	149	12.92
Total		629	54.55	524	45.45	1153	100

When comparing food and nutrition security, about 10 % of the respondents (shown in green in Table 3) werefood secure and 'medium' dietary diversity. About 35% of the respondents were food secure but 'low' dietary diversity. The majority of households in Oromia regional state are both food and nutritionally insecure (shown in red in Table 3).

The result also indicates that households with large family size, older household heads, and those found in relatively distant locations from the main market were found to be food insecure. Households with larger land holding, those engaged in agro-pastoral activities, and having access to varieties of food were better off in terms of food security. Age household head has also negative effects in the case of nutrition security while livestock holding (TLU) and off-farm activities have positive and significant effects. The results of the qualitative analysis showed that the major trigging factors of seasonal food insecurity were drought, invasion of pests, and high food prices. Households used various coping strategies against food insecurity, such as selling of livestock, livelihood diversification, reduced number of meals, reduced non-food expenditure, and sale of firewood/charcoal.

Policy recommendations

- Since agro-pastoralists are more food secure than pure pastoralists, the regional government should design innovative policy strategies and interventions that help to improve livestock and crop productivity
- Humanitarian assistance programs should primarily target households with large family size, older household heads, land and stockless households, those households whose livelihoods depends solely on livestock rearing and those pastoralists far from the market
- Infrastructures, such as road and market should be promoted to engage households in different livelihood diversification strategies.
- The regional government and its development partners should put much more resources for continued research and development interventions to realize holistic pastoral livelihood transformation.

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POLICY BRIEF 6-1 | THEME | VI
May 2023

Long-term Exposure to E-waste From Electronics and Electrical Maintenance Workshops Poses Public Health Risk

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Key message

•Surface dust collected from electronic and electrical maintenance workshops accumulated significant amounts of polycyclic aromatic hydrocarbons (PAHs) which pose public health risk.

Introduction

Polycyclic Aromatic Hydrocarbons (PAHs) are a group of carbon-containing organic compounds with two or more fused aromatic rings. The United States Environmental Protection Agency (USEPA) and the International Agency for Research on Cancer (IARC) have categorized PAHs as 'priority pollutants' due to their inherent carcinogenic properties. These international organizations indicated that the total PAHs level in indoor environments should not exceed 500 µg/kg. Anthropogenic activities such as irregular electronic waste (e-waste) processing cause a considerable release of PAHs and their derivatives into the environment. Particularly, the problem is very high in developing countries as there is limited information regarding PAHs in e-waste. Therefore, this study was proposed to determine the levels of selected PAHs in surface dust samples collected from electronics and electrical devices maintenance workshops in Dire Dawa, Haramaya, Haramaya University (HU), and Harar using standard method (QuEChERS procedure). Furthermore, the potential public health risk assessment associated with the exposure to PAHs was conducted.

Approaches and Results

The extraction of PAHs was carried out using optimized QuEChERS method (Figure 1). Briefly, 10 mL of acetonitrile and 1 min vortexing time were adopted as optimum conditions. The optimized method exhibited excellent linearity (R2 ≥ 0.9997), sensitivity (LOD, 0.005−0.011 µg g-1), and precision (≤ 2.93% intra-day and ≤ 6.18% inter-day RSD) with very good percentage recovery (92.1%−99.8%) in the acceptable range indicating the potential of the method in PAHs analysis in real-world dust samples.

The concentrations of fluorene, naphthalene, and phenanthrene in the surface dust samples collected from the maintenance workshops ranged from 1.50–2.04, ND–1.58, and 1.43–5.20 µg/g, respectively (Table 1). None of these were detected in the reference (control) surface dust samples. Compared with the total PAHs in various dust samples reported in the literature, the total concentrations of the selected PAHs in this study, 3.24–8.33 µg/g, are found to be significantly large. The highest concentration of PAHs was recorded in the samples collected from Dire Dawa (Table 1).

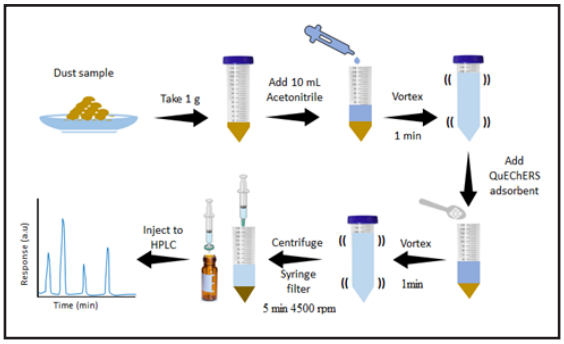

Figure 1. Schematic representation of QuEChERS method.

Table 1. Levels of PAHs (µg/g) in workshops and reference dust samples (mean±SD, n = 3).

Table 1. Levels of PAHs (µg/g) in workshops and reference dust samples (mean±SD, n = 3).

Sample	Fluorene	Naphthalene	Phenanthrene	Total
Dire Dawa	1.55±0.01	1.58±0.09	5.20±0.38	8.33±0.48
Haramaya	2.04±0.09	ND	2.81±0.23	4.85±0.32
HU	1.50±0.02	ND	3.48±0.43	4.98±0.45
Harar	1.81±0.05	ND	1.43±0.08	3.24±0.13
Reference	ND*	ND	ND	ND

*ND = not detected

Public health risk assessments indicated that intake dose (ID) values were 2.88–7.40 ng kg−1 d−1 for adults implying a substantial risk of non-dietary PAHs for exposed workers. The Hazard quotient (HQ) ≤2.60×10−3, and Hazard index (HI) ≤3.02×10−3, values were below 1 indicating non-cancer risk. Even though the estimated Increment life cancer risk (ILCRtotal) for adults (6.25×10−6–1.6×10−5) seems in a tolerable level for lifetime cancer risk, the highest attained ILCRtotal (1.6×10−5) is above the critical value (10−5) which suggests that exposure to maintenance workshops dust may pose cancer risk.

Table 3. Risk assessment of PAHs in collected dust samples in the workshops

Parameter		Dire Dawa		Haramaya		HU		Harar	
		Adult	Children	Adult	Children	Adult	Children	Adult	Children
ID (ng kg^{-1} d^{-1})		7.40	29.6	4.31	17.2	4.42	17.7	2.88	11.5
HQ ($x10^{-5}$)	Fluorene	3.44	13.8	4.53	18.1	3.33	13.3	4.02	16.1
	Naphthalene	7.02	28.1	-	-	-	-	-	-
	Phenanthrene	65.0	260	35.1	141	43.5	174	17.9	71.5
HI ($x10^{-4}$)		7.55	30.2	3.97	15.9	4.69	18.7	2.19	8.76
$ILCR_{ingestion}$ ($x10^{-9}$)		14.6	6.07	8.42	3.53	8.64	3.63	5.62	2.36
$ILCR_{inhalation}$ ($x10^{-11}$)		56.1	14.7	32.6	8.57	34.0	8.80	22.0	5.72
$ILCR_{dermal}$ ($x10^{-6}$)		16.0	9.46	9.34	5.51	9.59	5.66	6.24	3.68
$ILCR_{total}$ ($x10^{-6}$)		16.0	9.46	9.35	5.51	9.60	5.66	6.25	3.68

In general, the results revealed that surface dust from E-waste processing accumulates PAHs with varied concentrations across locations. Dire Dawa had the highest total PAHs followed by Haramya University, Haramaya, and Harar sites. Although the detected concentrations not beyond the permissible limit, long term exposure through ingestion, inhalation, and dermal contact pathways might cause a serious health risk. Hence, continuous monitoring and relevant interventions are required to prevent the associated public health risks.

Policy recommendations

- ✓ Awareness creation about the effect of exposure to E-waste on public health and on environment shouldbe conducted by relevant offices.
- ✓ The electrical and electronic materials maintenance workers must follow appropriate safety protocol inthe workplace.
- ✓ Children are recommended to avoid a long-time stay in the electronic materials maintenance workshops.