



# Policy Briefs

## 2023





May 2024

## Multi-drug Resistant *Campylobacter* Isolates from Camel Abattoirs Pose Public Health Concern

Metages Yirgalem, Jelalu Kemal, Takele Wolkaro, and Yitagele Terefe

College of Veterinary Medicine<sup>1</sup>, School of Medicine and health sciences<sup>2</sup>, Haramaya University, Ethiopia.

### Key Message

- Considerable proportion (25/324) of *Campylobacter* species were isolated from camel meat, feces, and environmental samples of which the highest prevalence (13.9%) was recorded in Babile town abattoir.
- About half (48%) of the isolated *Campylobacter* species were found to be multidrug resistant which are circulating in camel meat and abattoir environment with a potential risk to the public.

### Introduction

*Campylobacter* is known as the leading cause of bacterial enteritis. It is reported to cause food-borne illnesses with an estimated cases of 400 million per year worldwide. Food-borne illness is characterized by fever and abdominal pain followed by watery or bloody diarrhoea, abdominal cramps and nausea. An acute infection can have serious long-term consequences, including neurological disorders. Recent studies reported 5% to 16.7% isolates of *Campylobacter* species from apparently healthy food animals and humans in Ethiopia. Limited studies have been conducted on *Campylobacter* species in eastern parts of the country, where camel meat is consumed widely. In addition, a rapid increase in *Campylobacter* strains resistant to antimicrobial agents, particularly fluoroquinolones and macrolides has been

reported. Besides, there is limited information on the epidemiological status and transmission of the pathogen to design appropriate control and prevention measures. Therefore, the objective of this study was to investigate the prevalence, risk factors and determine antimicrobial susceptibility patterns of *Campylobacter* species from camel slaughtered at municipal abattoirs in eastern Ethiopia.

### Approaches and Results

The sample for this study was collected from municipal abattoirs of Harar, Babile, Jigjiga and Dire Dawa towns. A cross-sectional data was conducted in October 2020 to investigate the occurrence of *Campylobacter* species from camel carcasses, fecal samples, and environmental swab samples. A total of 146 fresh fecal, 146 carcasses and 32 environmental swab samples were collected from each systematically selected abattoir. Swab samples were collected using commercially available transport tubes, containing buffered peptone water. Selected carcasses were swabbed using sterile cotton-tipped swabs fitted with a shaft on specific sites of a carcass, the abdomen (flank), thorax (lateral), and breast (lateral), which are sites with the highest rate of contamination. Environmental samples were taken from the surfaces of walls, floor, personnel hands, knives, hooks, and apron with sterile cotton tipped swabs on each sampling days as a pooled sample in a screw capped test tubes

containing 10 mL of buffered peptone water. A semi-structured interview questionnaire was presented for 60 abattoir workers regarding the hygienic and sanitary practices during slaughter and processing of camel meat.

Selective solid media for the isolation of *Campylobacter* species were prepared using chromogenic agar media (CHROMagar™ *Campylobacter* base). Selective supplement (CHROMagar™ *Campylobacter* CP572) was filter sterilized through a 0.45 µm pore size cellulose acetate filter and added to the CHROM agar according to the manufacturer's instructions. Standard microbiological and biochemical tests were used to isolate and identify *Campylobacter* species from the collected sample. Antimicrobial susceptibility test was performed by Kirby–Bauer disk diffusion

method. From the culture broth, DNA was extracted using a Genomic DNA purification kit following the manufacturer's protocol. *Campylobacter* was detected from culture samples using TaqMan real-time polymerase chain reaction (PCR).

The overall prevalence of *Campylobacter* species was found to be 7.7% (25/324). The most prevalent *Campylobacter* species was *C. jejuni* (5.5%) followed by *C. coli* (2.2%). Highest prevalence of *Campylobacter* was recorded in Babile town (13.9%), followed by Harar (7.1%). The proportion of *C. coli* in young camels was significantly higher than adult camels ( $p=0.003$ ). The highest proportion of *Campylobacter* species were isolated from environmental samples (31.25%) than other sample types with significantly higher *C. jejuni* ( $P=0.001$ ) (Table 1).

Table 1: *Campylobacter* prevalence and species distribution among different risk factors

Variable s	Categories	No. examined	No positive (%)	No. (%) of samples positive	
				<i>C. jejuni</i>	<i>C. coli</i>
Study site	Dire Dawa	86	5 (5.8)	3 (3.5)	2 (2.3)
	Harar	56	4 (7.1)	2 (3.6)	2 (3.6)
	Babile	72	10 (13.9)	9 (12.5)	1 (1.4)
	Jigjiga	110	6 (5.5)	4 (3.6)	2 (1.8)
	Total	324	25 (7.7)	18 (5.56)	7 (2.2)
	$\chi^2$ ( <i>p</i> -value)		5.1057 (0.164)	8.51 (0.037)*	0.802 (0.849)
Age	Young	79	7 (8.9)	2 (2.53)	5 (6.3)
	Adult	213	8 (3.75)	7 (3.3)	1 (0.47)
	Total	292	15 (5.1)	9 (3)	6 (2)
	$\chi^2$ ( <i>p</i> -value)		2.586 (0.108)	0.18 (0.675)	9.078(0.003)*
Sample type	Carcass	146	10 (6.8)	8 (5.5)	2 (1.4)
	Fecal	146	5 (3.4)	1 (0.7)	4 (2.7)
	Environment	32	10 (31.25)	9 (28)	1 (3.1)
	Total	324	25 (7.7)	18 (5.56)	7 (2.2)
		$\chi^2$ ( <i>p</i> -value)		28.819 (0.001)*	37.67(0.001)*

The odds of occurrence of *C. jejuni* in Babile municipal abattoir was 4.55 times more likely than Dire Dawa municipal abattoirs (Table 2).

Table 2: Multivariable logistic regression analysis for the occurrence of *C. jejuni* isolates

Variables	Categories	No. examined	No. (%) of <i>C. jejuni</i> isolates	AOR (95% CI)	p-value
Study site	Dire Dawa	86	3 (3.5)	1	
	Harar	56	2 (3.6)	0.7884 (0.1167-5.327)	0.807
	Babile	72	9 (12.5)	4.549 (1.065-19.43)	0.041*
	Jigjiga	110	4 (3.6)	1.189 (0.24-5.889)	0.83
Sample type	Carcass	146	8 (5.5)	1	
	Feces	146	1 (0.7)	0.1153 (0.01411-.9425)	0.044*
	Environment	32	9 (28)	7.5217(2.4745- 22.864)	0.001*

Molecular detection of *Campylobacter* using Real time PCR showed that out of the 24 culture samples examined, 13 (54.2%) were found to be positive for *Campylobacter* at genus level.

Among 20 isolates tested, all of them were resistant to one or more antimicrobial agents,

whereas two isolates were susceptible to 5 antimicrobials tested. The highest level of *Campylobacter* resistance of isolates was recorded to chloramphenicol (70%) and amoxicillin-clavulanic acid (65%) (Table 3).

Table 3: Antiotic resistance profile of *Campylobacter* species isolated from camel carcass, feces and environment samples in selected areas of eastern Ethiopia

Drugs	Drug potency	<i>C. jejuni</i> (n=14)			<i>C. coli</i> (n=6)			Resistance %
		S	I	R	S	I	R	
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
AMC	30 µg	2 (14.2)	2 (14.2)	10(71.4)	2 (33.3)	1 (16.7)	3 (50)	65
C	30µg	1 (7.1)	2 (14.2)	11 (78.6)	2 (33.3)	1 (16.7)	3 (50)	70
CIP	30µg	11 (78.6)	2 (14.2)	1 (7.1)	4 (66.7)	1 (16.7)	1 (16.7)	10
CRO	10µg	13 (93)	-	1 (7.1)	5 (83.3)	1 (16.7)	-	5
E	15µg	6 (43)	3 (21.4)	5 (35.7)	3 (50)	1 (16.7)	2 (33.3)	35
SAM	10µg	4 (28.6)	4 (28.6)	6 (42.8)	4 (66.7)	-	2 (33.3)	10
STX	25µg	2 (14.2)	3 (21.4)	9 (64.3)	2 (33.3)	2 (33.3)	2 (33.3)	40
NA	5µg	10 (71.4)	3 (21.4)	1 (7.1)	4 (66.7)	1 (16.7)	1 (16.7)	55

AMC: amoxicillin-clavunated, C: chloramphenicol, CIP: ciprofloxacin, CRO: ceftriaxone, erythromycin, AMP: ampicillin, STX: sulfamethoxazol-tremethoprim, NA: nalidixic acid, S: susceptible, I: intermediate R: resistant

Multi drug resistance (MDR) was observed in 12 (48%) of *Campylobacter* isolates, of which, 9 (36%) were *C. jejuni* and 3 (12%) were *C. coli*. Of these, 5 (41.7%) were from carcass, 3 (25%) from feces and 4 (33.3%) were recovered from abattoir environment samples (Table 4).

Table 4: Multidrug resistance profile of *Campylobacter* isolates

Number	Resistant pattern	No. of resistant isolates (%)	
		<i>C. jejuni</i> (n=18)	<i>C. coli</i> (n=7)
One drug	STX	1 (5.6)	1 (14.3)
	NA	-	1 (14.3)
Two drugs	AMC,C	2 (11)	1 (14.3)
	SAM,STX	1 (5.6)	-
	AMC, NA	1 (5.6)	-
Three & more drugs	AMC,C,E,SAM,STX,CIP,AMC,CRO	9 (50)	3 (43)
<b>Total</b>		<b>14 (78)</b>	<b>6 (86)</b>

Out of 60 respondents interviewed, 55 (91.7%) were male, while the remaining 5 (8.3%) were female. Most of the respondents age lies between 30 and 41 and nearly half (45%) of them could not read or write. Forty-three (71.7%) of them had abattoir work experience of 1 to 3 years. Among 60

respondents, all of them (100%) had not taken any course related to abattoir work. However, 23 (38.3%) of them responded that they have received lessons related to their work. Most of them (68.3%) wash their hands using water only.

### Recommendations

- ∞ Carcass cross-contamination by *Campylobacter* during slaughtering can pose a threat to humans and limits therapeutic options.
- ∞ Awareness, hygienic practices, and careful antibiotic usage must be practiced by the public to avoid infection through antibiotic resistant *Campylobacter* species.
- ∞ Regular coordinated actions should be implemented on the rational use of veterinary and medical drugs at national level together with training and awareness to workers on good hygienic practices.



May 2024

### High rate of chloroquine resistant plasmodium in Eastern Hararghe: A call to supplement first line combination therapy with primaquine

Migbaru Keffale<sup>1</sup>, Dawit Kassaye<sup>1</sup> and Zelalem Teklemariam<sup>2</sup>

College of Veterinary Medicine<sup>1</sup>, School of Medicine and health sciences<sup>2</sup>, Haramaya University, Ethiopia.

#### Key Message

- High *P. falciparum* resistance to chloroquine was detected due to *pfprt* (67%) and *pfmdr-1* (75%) gene mutations.
- Only one in ten of the participants have acute hemolytic anemia, indicating that the community in the study area is less at risk of Primaquine related hemolytic anemia.

#### Introduction

The malaria elimination planned to be achieved by the year 2030 through early diagnosis and prompt malaria medication is hampered by high rate of antimalarial (chloroquine) resistant plasmodium that seeks a potent antimalarial medication indicated for the radical cure of malaria. Ethiopia planned to eliminate malaria by the year 2030 through, vector control, early diagnosis and prompt malaria medication. However, persistent malaria transmission was observed even in elimination-targeted settings including East Hararghe zone's where six hotspot districts with unidentified factors were reported. Driven by the disseminated chloroquine (CQ) resistant *P. falciparum*, Ethiopia updated the treatment policy to incorporate primaquine. However, Glucose six phosphate dehydrogenase enzyme deficiencies (G6PD)-deficient red blood cells (RBCs) are more susceptible to oxidative drugs (e.g., primaquine) and often

manifested as acute hemolytic anemia (Recht *et al.*, 2018). Therefore, the study was aimed to assess the magnitude of *Plasmodium falciparum* chloroquine resistance pattern among malaria positive patients attending health centers and prevalence of population G6PD deficiency of all age groups in selected malaria hotspot transmission districts of East Hararghe zone, Ethiopia.

#### Approaches and Results

A cross-sectional study was done on randomly selected three districts of East Hararghe zone (Haramaya, Kersa, and Fedis) with a total of 517 self-presenting Microscopic positive *Plasmodium falciparum* (Pf)-infected patients of all age groups attending health centers in the three health centers (Haramaya (n=166), Kersa (n=146) and Fedis (n=205)) were included. A finger prick blood sample was collected, and molecular analyses were done following standard operating procedures for malaria and other neglected tropical diseases laboratory of Armauer Hansen research institute.

The finding shows that 90.9% of the participants used long-lasting insecticide-treated nets (LLIN) and 88.2% of the participants house were sprayed with in the previous 12 months. All respondents replied that they were microscopic positive on their visit, while 35.8%, 2.5%, 3.7% and 0.2% of them were infected for their first, second, third and fourth times, respectively, whereas 48.4% were not sure for the previous infections.

<sup>1</sup> Recht, J., Ashley, E. A. and White, N. I. 2018. Use of primaquine and glucose-6-phosphate dehydrogenase deficiency testing: Divergent policies and practices in malaria endemic countries. PLOS Neglected Tropical Diseases, 12(4), e0006230.

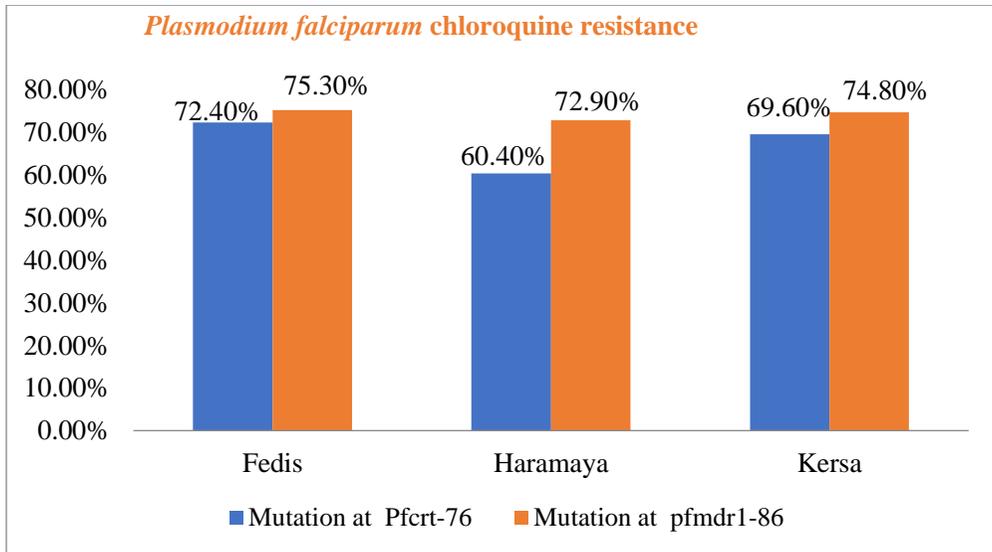


Figure: A graph showing the proportion of *Plasmodium falciparum* mutations against Chloroquine

After Pf18s RNA gene-based PCR confirmation 84.9%, 86.7%, 87.5% of the participants were *P. falciparum* positive in Fedis, Haramaya and Kersa districts. Among PCR confirmed *P. falciparum* infections pfmdr1-86 mutation (a marker for the resistance to chloroquine and partner drugs of artemisinin combination therapy) was 75.3%, 72.9% and 74.8% in Fedis, Haramaya and Kersa respectively. The prevalence of Pfcr-76 mutation was 72.4%, 60.4% and 69.6% in

Fedis, Haramaya and Kersa, respectively. There was no significant difference in the rate of mutations in the three districts in both Pfmdr1 and Pfcr markers (Figure 1).

The G6PD (A376G) enzyme deficiency (indicator of acute hemolytic anemia) of 10.7%, 10.2% and 9.6% was detected in Fedis, Haramaya and Kersa, respectively. There was no statistically significant difference among the districts ( $P > 0.05$ ).

### Policy Recommendation

- ∞ Ministry of health should promote a single low dose primaquine in combination with artemisinin-based combination therapy (ACT) to achieve the elimination of the indicated type of malaria in the study area.



May 2024

### High Mental Health Problem is Associated with Lower Social Capital among School Adolescents in Harari Regional State, Ethiopia

Gari Hunduma<sup>1</sup>, Negussie Deyessa<sup>1</sup>, Yadeta Dessie<sup>1</sup>, Biftu Geda<sup>2</sup>,  
Tesfaye Assebe Yadeta<sup>1</sup>

<sup>1</sup>College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia

<sup>2</sup>College of Health and Medical Sciences, Madaa Walabu University, Shashamene, Ethiopia

#### Key Message

- A 22.93% of mental health problems was observed among school adolescents in Harari Regional State schools that indicate an increased risk of mental health problems.
- A low level of mental health problems was strongly associated with having higher social capital, such as better network of friends at school, a high level of trust in their school or neighborhoods, and a high degree of social cohesiveness in the communities.

#### Introduction

Adolescence (i.e., Aged 10–19 years) is a human development stage when the brain, hormones, emotions, perceptions, behaviours, and interpersonal relationships are changing drastically. This stage of development is crucial as half of adult mental health problem starts when a person is 14 years old. Globally, over 46,000 adolescents commit suicide each year, placing it in the top five causes of mortality (Keeley, 2021; WHO, 2022). The SDG Target 3.4 calls for reducing non-communicable diseases (NCD) related premature mortality by one-third in 2030 through mental health promotion, prevention, and treatment. However, adolescent's mental health problems frequently remain undiagnosed, untreated, and ignored during planning and implementation strategies, particularly in low- and middle-income countries including Ethiopia. LMICs struggle to implement mental health interventions due to limited resources. Social capital interventions can be an alternative option

in effectively preventing and treating mental health problems.

Ethiopian National Strategic Plan for Adolescent and Youth Health was developed in 2016 that calls for reducing suicide and depression among adolescents and youth by half in 2020, but the target was not achieved. In line with this, policy makers need up-to-date information on mental health problems, risk factors, and its associated effect on quality of life to plan effective intervention strategies. Therefore, this study was aimed at assessing the magnitude of mental health problems, their association with social capital, and health-related quality of life among in-school adolescents in Harari Regional State, Ethiopia.

#### Approaches and Results

School-based cross-sectional study was conducted on 3227 in-school adolescents aged 13 - 19 years old. Multistage sampling technique was used to select respondents. A strength and difficulty questionnaire (SDQ), the social capital questionnaire for adolescent students (SCQ-AS), and the KIDSCREEN-10 were used to assess mental health, the social capital and health-related quality of life (HrQoL) statuses, respectively. The total difficulties score was divided into "normal" (0–15), "borderline" (16–19), and "abnormal" (20–40) scores using the score banding method described by Goodman (Goodman Robert *et al.*, 1998). An ordinal logistic regression model was used to investigate the relationship between dependent and independent variables.

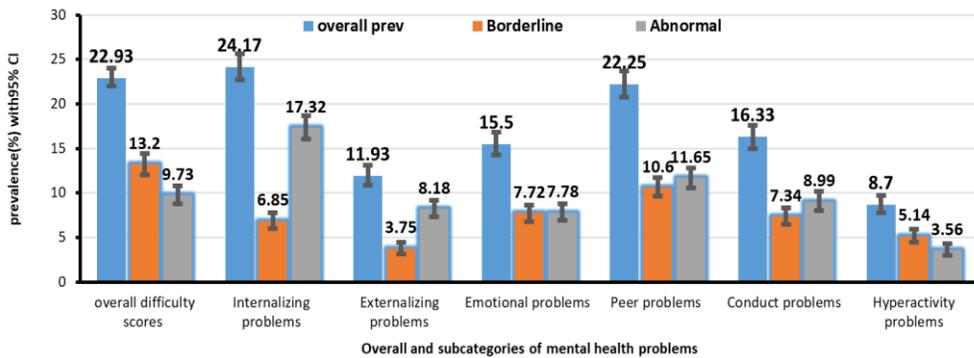


Figure 1: Magnitude of the overall and sub-categories of mental health problems among in-school adolescents (N=3227), in Harari region, eastern Ethiopia, 2020.

The finding indicated that the magnitude of mental health problems was 22.93% (95% CI: 22; 24), of which 24.17% (95% CI: 22.72; 25.67) was internalizing, i.e. inability to control negative feelings, and 11.93% (95% CI: 10.85; 13.09) was externalizing problems, i.e. issues with regulating unwanted conduct (Fig 1).

The SDQ cut-off points showed that 426 (13.20%) of the respondents scored between 16 and 19 (borderline), and 314 (9.73%)

scored above 20 (abnormal), with a maximum score of 32. In addition, adolescent boys have high proportion of mental problems than girls in all problem categories except emotional problems (Fig 2). Social capital domains such as increased school friend networks, high neighborhood or school trust, and high social cohesion in the community were associated with a decreased odds of mental health problems by 25%, 48%, and 25%, respectively (Fig 3).

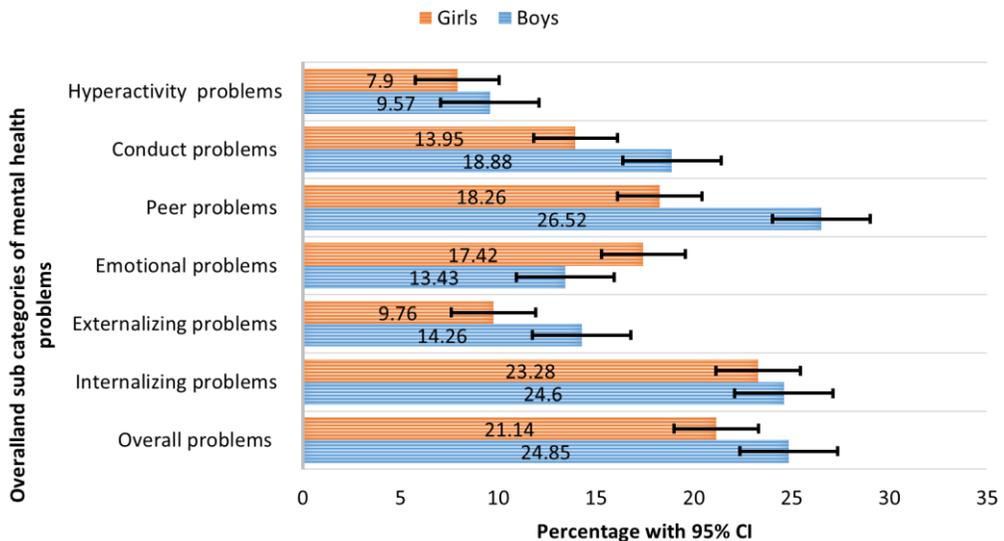


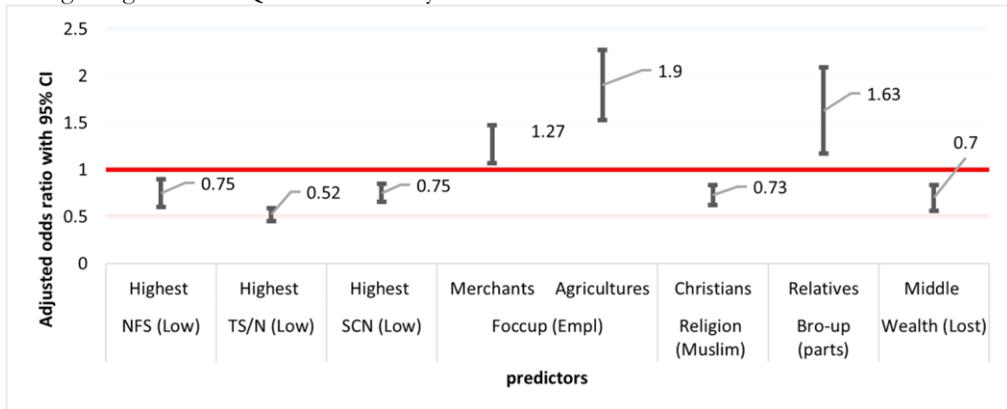
Figure 2: Magnitude of in-school adolescent boys and girls with mental health problems in Harari (N=3227), eastern Ethiopia, 2020.

According to multivariable analysis, for adolescents with abnormal and borderline levels of internalizing problems, the odds of

being in a high level of HrQoL decreased by 52% and 41%, respectively, compared to their normal counterparts. Furthermore, for

adolescents with abnormal and borderline levels of externalizing problems, the odds of having a high level HrQoL decreased by 42

and 37% ,respectively, compared to their normal counterpart (Fig 4).



N.B. NFS: a network of friends at school; TS/N: trust at school and neighborhoods; SCN: social cohesion in the neighborhood

Figure 3: Social capital factors associated with mental health problems among in-school adolescents in Harari region, eastern Ethiopia, 2020.

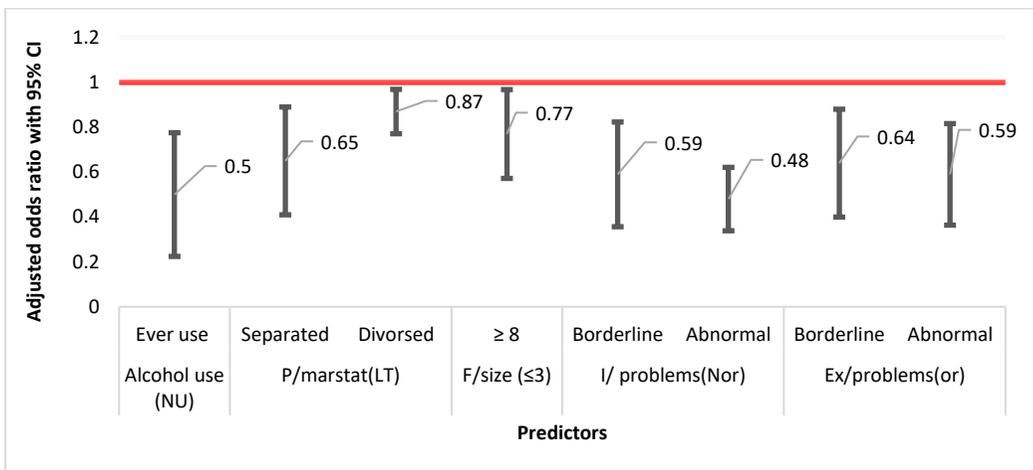


Figure 4 . Association between mental health problems and HrQoL among in-school adolescents in Harari region, Eastern Ethiopia 2020.

## Policy Recommendations

- ∞ Family, School, NGOs, regional bureaus, Ministry of education and ministry of health should promote social capital as alternative intervention strategy among students at school to minimize adolescents' mental health problems and improve quality of life.
- ∞ Ministry of education should incorporate foundational understanding of mental health into the existing educational curricula and promote school mental health programs that address adolescent mental health and related issues.
- ∞ Schools should encourage students to participate in extracurricular activities, join social clubs, and communicate with friends and classmates to build student networks and trust



May 2024

### **In-service training, availability of analgesics and protocol improves neonatal pain management practices in neonatal intensive care unit**

**Sinetibeb Mesfin<sup>1</sup>, Meron Degefa<sup>1</sup> and Habtamu Bekele<sup>1</sup>**

School of Nursing and Midwifery, College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia

#### **Key Messages**

- More than half of healthcare providers have overall good neonatal pain management practice in public hospitals of eastern Ethiopia.
- Receiving in-service training on neonatal pain management, utilization of neonatal pain management protocol, availability of guideline and analgesics in the NICU have shown improved neonatal pain management practice.

#### **Introduction**

Neonates experience several painful and distressing procedures during their hospitalization in the neonatal intensive care unit (NICU). Persistent or untreated pain can lead to altered brain development and function, impaired cognitive and motor function, intracranial haemorrhage, decreased immunological response, and internalizing behaviour later in life. In addition, the pain can provoke stress reactions such as apnea, bradycardia, and hypoxia, which adversely affect the infant's neurodevelopment. Neonatal pain is nearly impossible to investigate because neonates can't tell when they are in pain. The most well-known sign of pain in neonates for the public, in general, is crying. However, the neonate will cry for several reasons. As a result, health care providers play an important role in the

assessment and management of newborn pain. However, in some cases, health care providers disregard the pain that neonates may feel during procedures. Others performed multiple painful procedures on different parts of the body at the same time, with little or no regard for pain relief in neonates. Therefore, data on neonatal pain management practice and the factors that influence it are essential to take appropriate action.

#### **Approaches and Results**

An institution-based cross-sectional study design was implemented in 13 public hospitals in Harari Regional State, Dire Dawa City Administration, west and east Hararge zones of Oromia region, that provide NICU services. The calculated sample size was distributed using proportional allocation to size based on the number of healthcare providers who had ever worked in each of the selected public hospital NICUs. Simple random sampling technique was applied to select the study participants after obtaining a list of healthcare providers who had ever worked in each facility's NICUs in the previous three years till the data collection period. However, participants for the observation were selected purposively from healthcare practitioners who were caring for ill neonates.

Table 1 Factors associated with neonatal pain management practices among healthcare providers working in public hospitals of eastern Ethiopia, 2021.

Variables		Neonatal pain management practice		COR (95%CI)	AOR (95%CI)	P-value
		Poor	Good			
Received in-service training on neonatal pain management	No	140	45	1	1	
	Yes	86	72	<b>2.605(1.65,4.12)</b>	<b>2.12(1.15,3.91)</b>	<b>0.016</b>
Knowledge about neonatal pain management	Inadequate	115	70	1	1	
	Adequate	70	88	2.06(1.34,3.18)	1.511(0.88,2.59)	0.134
Attitude about neonatal pain management	Unfavourable	115	70	1	1	
	Favourable	74	84	1.86(1.21,2.87)	1.461(0.87,2.43)	0.144
Protocol and guideline available in the NICU	No	130	55	1	1	
	Yes	61	97	<b>3.76(2.39,5.89)</b>	<b>2.94(1.76,4.91)</b>	<b>0</b>
Analgesics presented in the unit	No	149	36	1	1	
	Yes	67	91	<b>5.62(3.47,9.1)</b>	<b>4.302(2.46,7.53)</b>	<b>0</b>
Availability of standardized neonatal pain scale measurements in the unit.	No	155	30	1	1	
	Yes	122	36	1.52(0.89,2.62)	0.39(0.13,1.13)	0.133
Pain management policy in place	No	174	11	1	1	
	Yes	137	21	2.43(1.13,5.201)	2.007(0.58,6.89)	0.268
Support from leadership on neonatal pain management	No	139	130	1	1	
	Yes	46	28	0.65(0.38,1.1)	.633(0.31,1.28)	0.127

A total of 343 healthcare providers participated in this study, representing a 92.2% response rate. The study found that 185 (53.9 %; 95% CI; 48.4-59.2) of the respondents had good neonatal pain management practice with a mean of 11.38 (3.64 +SD). Receipt of in-service training in neonatal pain management (AOR=2.12, 95%, CI:1.15,3.91), availability of protocol and guideline

in the neonatal intensive care units (AOR=2.94,95%, CI: 1.74,4.91) and accessibility of analgesics in the neonatal intensive care units (AOR=4.302,95%CI: 2.46,7.53) were significantly associated with good neonatal pain management practice (Table 1).

## Recommendations

- ∞ Public hospitals offering NICU services should improve the accessibility of analgesics as well as neonatal pain management protocols and guidelines at the NICU which will aid in the promotion of good neonatal pain management practices.
- ∞ Regional and health bureau and nongovernmental organization should provide ongoing in-service training in neonatal pain management to all healthcare providers working in the NICU can help them stay up-to-date with the latest advancements in their field, ultimately leading to better care for sick new-borns.
- ∞ Healthcare providers should pay more attention to the assessment and management of neonatal pain.



### High Traffic Accident Hot Spots Identified Along Harar- Dire Dawa - Chiro Towns Road Segment

Lukas Embaye<sup>a</sup>, Akubazgi Gebremariam<sup>b</sup> and Zekreab Nega<sup>c</sup>

<sup>a</sup>Department of Civil Engineering, Haramaya University, Haramaya, Ethiopia; <sup>b</sup>Department of Computer Science, Haramaya University, Haramaya, Ethiopia; <sup>c</sup>Department of Hydraulic and Water Resources Engineering, Haramaya University, Haramaya, Ethiopia

#### Key Messages

- A total of 6423 accidents were reported on Harar-Dire Dawa-Chiro town road segments during the last eleven years (2011-2021).
- Driver's related factors (63.28%), road related factors (24.12%), and vehicle related factors (7.57%) were found to be leading causes of road traffic accidents along Harar-Diredawa-Chiro towns road segment.
- Kersa, Meta, Deder, Goro-Gutu, and Chiro districts, as well as Dengogo-Dire Dawa road segments are high-risk traffic accident hotspot areas.

#### Introduction

Road Traffic Accidents (RTAs) are currently the leading causes of loss of life and property globally. Property damage only (PDO), and several intensities of injuries leading to death are reported these days. Identification, analysis and knowledge of the major traffic accident sites/hot spots plays vital role in minimizing road traffic accidents. Geographic Information System GIS technology has been a popular tool in identifying highway hot spots and analyzing traffic accidents data. It uses without spatially analyzing crashes, variance and differences between crash locations that are difficult to identify. Among the GIS tools, spatial statistics (spatial autocorrelation) and geostatistical analysis methods are the most popular. Spatial autocorrelation is a measure of the correlation of an observation with other observations through

space with the help of vector data whereas the geostatistical methods use the raster data and bandwidth. These GIS methods can effectively analyze and identify hot spot RTAs locations with the help of graphs, maps and tables. The purpose of this study was to identify the RTAs hotspot locations along the road segment of Harar- Dire Dawa - Chiro town.

#### Approaches and Results

Primary data, such as the location of accident areas, were collected on sites using a Global Positioning System (GPS). Eleven years (2011-2021) of secondary data were collected from Harar - Diredawa - Chiro town road segment located in Eastern and western Harerghe zone and Dire Dawa city administration (Figure 1). Exact locations of accidents, types of injury, and type of vehicles were collected. The hot spots identification was conducted using ArcGIS and Micro soft Excel. Accident type, severity, location, causes, weather conditions, Road Traffic Accident victims, type of pavement surface moisture conditions during RTA, day light condition, land use of the area, pavement condition, type and classification of vehicles involved in RTA, vehicles service year, age of driver, sex of driver, driving hour, and day of the week were analyzed to identify traffic accident hot spot areas. The outputs were analyzed using spatial statistics (global and local spatial autocorrelation) and geostatistical analysis for property damage only (PDO), Serious or severe, Slight or minor, Fatal, and total RTAs.

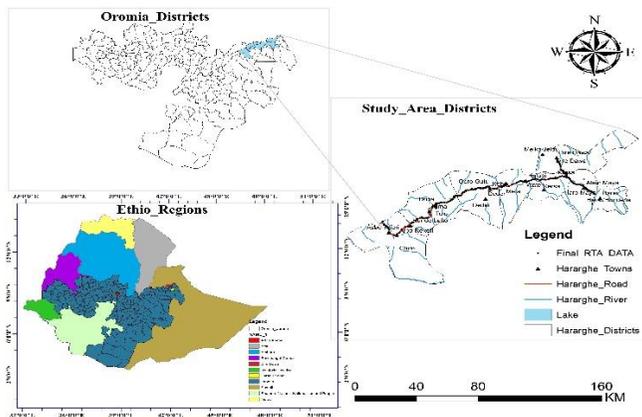


Figure 1: Map of study area (Own produced)

The result shows that a total of 6423 accidents occurred from 2011-2021 in the Harar-Diredawa-Chiro towns road segment (Table 1: Summary of RTAs data for the Harar-Dire Dawa-Chiro road segment from 2011 to 2021). Hot spot areas are represented based on their bandwidth: low (blue color), medium (yellow color), high (dark red color) and very high density (red color) accident

areas (Figure 2: Map of traffic accident hot spot area along Harar-Diredawa-Chiro road segment (Own produced). High density accident zones are concentrated in areas of Dengogo-Dire Dawa road segment, Kersa-Meta district road segment, and Chiro district road segment.

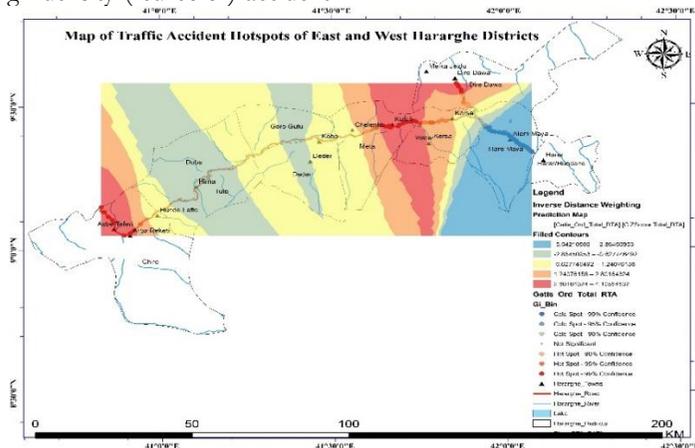


Figure 2: Map of traffic accident hot spot area along Harar-Diredawa-Chiro road segment (Own produced)

Table 1: Summary of RTAs data for the Harar-Dire Dawa-Chiro road segment from 2011 to 2021

Eleven Years RTAs data for the Harar-Diredawa-Chiro Road Segment					
Year	Fatal	Serious	Slight	PDO	Total
2011	62	115	106	215	498
2012	79	134	135	247	595
2013	53	102	112	181	448
2014	67	148	144	339	698
2015	81	119	103	270	573
2016	109	127	112	312	660
2017	90	198	147	216	651
2018	88	138	101	366	693
2019	101	147	131	231	610
2020	79	116	137	241	573
2021	56	100	98	170	424
Total	865	1444	1326	2788	6423

The leading causes of RTAs in the Harar-Diredawa-Chiro town road segment were driving beyond the speed limit (12.33%), sharp curves

(7.13%), not staying on the lane (7.54%), inappropriate/wrong turn (6.09%), and damaged roads (6.59%) among the others .

Table 2: Summary of causes of RTAs in Harar-Dire Dawa-Chiro road segment from 2011 to 2021

Causes	Type of Road Traffic Accidents				Total	Percentage (%)
	Fatal	Serious	Slight	PDO		
<b>Drivers related factors</b>						
Driving beyond the Speed limit	128	232	176	256	792	12.33%
Inappropriate/ wrong turn	36	87	76	192	391	6.09%
Illegal Overtaking	29	95	84	210	418	6.51%
Drunk Driver	27	29	35	42	133	2.07%
Not Staying on the lane	67	106	142	169	484	7.54%
Reckless driving	24	90	95	105	314	4.89%
Sleep when driving	37	42	47	166	292	4.55%
Phone talking when driving	65	32	54	63	214	3.33%
Hit and Run	11	42	66	45	164	2.55%
Rollover	63	85	31	223	402	6.26%
Side-impact	24	78	48	101	251	3.91%
Rear-end	54	57	29	69	209	3.25%
<b>Sub-total</b>						<b>63.28%</b>
<b>Road related factors</b>						
Sharp Curve	86	110	94	168	458	7.13%
Damaged Road	50	91	70	212	423	6.59%
Short sight distance	29	83	72	122	306	4.76%
Steep Slope	23	41	40	79	183	2.85%
Maintenance and rehabilitation problem	9	14	0	156	179	2.79%
<b>Sub-total</b>						<b>24.12%</b>
<b>Pedestrian Problems</b>						
Pedestrian Problem	10	35	19	0	64	0.99%
<b>Sub-total</b>						<b>0.99</b>
<b>Vehicle related factors</b>						
Multivehicle accident due to lack of service	24	14	40	87	165	2.57%
Tire defect	4	11	0	102	117	1.82%
Braking defect	18	6	0	180	204	3.18%
<b>Sub-total</b>						<b>7.57%</b>
<b>Other</b>						
Vehicle-pedestrian collision	32	54	96	16	198	3.08%
<b>Sub-total</b>						<b>3.08%</b>
Unknown	15	10	12	25	62	0.97%
<b>Sub-total</b>						<b>0.97%</b>
<b>Total</b>	<b>865</b>	<b>1444</b>	<b>1326</b>	<b>2788</b>	<b>6423</b>	<b>100%</b>

## Policy Recommendations

- ∞ The drivers should be mentally and physically fit while driving.
- ∞ The training, licencing and certifying institutions should ensure the trainees are mentally and physically fit before the provision of driving licence.
- ∞ National and regional transport and logistics authorities should regularly inspect and maintain roads and check the service year of vehicles.
- ∞ Training and education are important for the road and transportation officials.
- ∞ Enforcement and Providing Crash-Protective Roadsides are critical to reduce the accidents.
- ∞ Improving Crash and Injury Data Management should be incorporated into the relevant authority's plans so that they can be implemented in an organised manner



May 2024

### Gadaa Laws safeguarded the peace and security, aesthetic values, and environmental resources among the Hararge Oromo

Reta Duguma<sup>1</sup>, Gutema Imana<sup>1</sup>, Mohammed Hassen<sup>1</sup>, Emana Beyene<sup>1</sup>, Lema Wogi<sup>2</sup>, Tesfaye Gudeta<sup>1</sup>

<sup>1</sup>College of Social Science and Humanities, Haramaya University; <sup>2</sup>College of Agriculture and Environmental Sciences, Haramaya University

#### Key Message

- The Raaba Doorii (the gadaa system of the Hararge Oromo) had enacted many *Heeras/Seeras* to maintain peace and security, aesthetic values and protect their environmental resources.

#### Introduction

As a system, *gadaa* provided the Oromo in general and the Hararge Oromo in particular, a higher degree of grassroots participation in governance of their own affairs. In *gadaa* system, the potential leaders were groomed for positions of political and military leadership with 40 years of leadership experience. Although the institution has been under pressures overtime, it has not completely disappeared and is portrayed as a model of democratic governance in contemporary political discourse.

The *gadaa* system known as Raaba-Doorii among the Afran Qalloo, Ituu and Humbanna have five parties (*gogeessa/miseensa*). One *gadaa* period have eight years. A *gogeessa* stay on power for eight years after which it passes power to other *gadaa* party. The *gadaa miseensa* or *gogeessa* had different names among different Oromo groups. Among the Hararge Oromo there were five *miseensa/gogeessa* and these were *Hoorata*, *Sabbaqa*, *Badbaadhaa*(*Dhiphisaa*), *Faddataa* and *Daraaraa*. Therefore, the aim of this study was to investigate the role of *gadaa* laws in maintenance of peace, environment and aesthetic values among the Hararge Oromo.

#### Approaches and Results

This study employed qualitative research method using ethnographic approach. Primary and secondary sources of data are used. The primary data were collected using Key Informant and In-Depth Interview as well as Focus Group Discussions (FGD) from the actual participants of the events which were conducted in both Eastern and Western Hararge. Much of the data for this study emanated from oral interviews with well informed elders in Jarso, Kombolcha, Gursum, Babille, Fedis, Haramaya, Gurawa, Hirna, Chiro and Gelemso who are well versed with the sacred knowledge and tradition of the Hararge Oromo. The data obtained were the elaborate one that covers a long time span and a wider scope of issues. The authenticity of collected data was cross checked and validated using literature review from Addis Ababa University library. This yielded relatively relevant data on the general ways through which the Oromo kept their internal peace, aesthetic values and their environmental resource protection.

According to the *gadaa* system, *Heera* and *Seera* of the Oromo were revised and enacted within every eight years. Among the Hararge Oromo, these laws were enacted and promulgated at Oda Bultum, the center of the Eastern Oromo *Gadaa* system, with illustrious ceremonies during *gadaa* power transfer ceremony. One of the recent power transfer ceremonies and enactment of *Gadaa* laws at Odaa Bultum was made in 2023 (Figure 1).



Figure 1. Photo showing power transfer from *Sabbaqaa* party to *Badbaadbaa* (*Dhiphisaa*), at Oda Bultum, 2023 (The new *Abaa Gaada* to the right—taking *Halangee*, symbol of power, during power transfer ceremony).

The finding on peace and conflict resolution mechanisms, values related with the Oromo culture, traditions, norms etc indicate that the Oromo have elaborate *Heera* and *Seera* laws. These *Seera* and *Heera laws* reveal that the Raaba Doorii system of Hararge Oromo has the most complex and detailed *Heera/Seera* laws which were concerned with the different aspects of the Itu, Humbana and Afran Qallo. In *toto* ninety-nine *heeras* which include nine *fannoo* and ninety- *fannisaa* laws were enacted and were broadly divided as *Heeraa* Oda and *Heeraa* Garbi. These laws were governing different aspects of Hararge Oromo life. Some of them were concerned with laws in relation to *gadaa* officials, justice, relations between intra-and-inter- clans, neighbors, *Heera dhaalaa* (levirate marriage), family , marriage, theft, adultery, robbery, rape, *gumaa* (blood money) and *diyaa* (physical injury), *guddifachaa*, *moggaasaa*, etc. The findings on the aesthetic values of *gadaa* laws indicated that, the *Abba Gadaa* has to have some qualities like physical fitness, bravery, has to be *hayyu* or knowledgeable, has to have oratorical skills and has good voice and charisma. He has to have his own wealth and dress well. The candidate should not be the one who could easily be offended by situations. broken *irbuu* by frightening men, treated the people unequally, refuses to listen to others as the saying goes “*dubbi babuu hin dborkinaa, galuu dborkaa malee.*” This can be literally

translated as one’s idea has to be heard but it is accepted based on whether it is useful or not.

Brave/hero(*Jagna*) and knowledgeable elders (*hayyus*) are believed to have been identified at early childhood as the saying goes “*tokko hadha garattii beeka, tokko haadha ukkatii beeka (yeroo xiqqatti), kaanis dhadbachaa Heeratti beeka.*” This can be literally translated as one learns in mother’s womb, the other learns during childhood, while the other one learns in court. Another wisdom within the *Gadaa* laws is related with the behavior of children both during and after birth. If the child listens to what family talks by stopping breast feeding for a while, the child is considered to be a *hayyuu*/man of wisdom/ while a foolish child simply feeds on the breast and cares if a pregnant mother craves for foods like milk, and honey, is believed to give birth to *hayyuu* child; whereas if she craves for foods likes meat, the child is believed to become a beggar. If the mother craves for and eats a soil, the child will be *harashi*/ farmer. These are believed to have been some of the criteria used to identify a person who become a leader, a *hayyu*, etc.

Regarding clothes and materials of aesthetic values, *Abba Gadaa* beautifies himself by holding *gojobaa Abba Gadaa* or *faaya jagna* and wearing clothes made of white, red and black colors. Women’s *faayaa* are *gumii*, *qarmaa*, *ulee siinqee*, while the *Abba Gadaa* hold large spear with stick made from *gololee* plant. There are 64 materials with which *Abba Gadaa*’s properties are named such as

*Gurbee, gudii, gadaa, gudaadaa* (best land earmarked for the *Abba Gadaa* for *dhiyana*/liverhood/ *Abba Gadaa*), *glaasa* put on mule back, *guchii*, etc.

The findings in relation to the protection of environmental resources and wild animals indicate that there were laws in relation to *Heera lafaa*, *Heera malkaa*, *Heera tulluu (gaara)*, *Heera namaa*, *Heera gosa*, *Heera maatii*, *Heera ambaa*, *Heera diinaa*, *Heera beeyiladoota* (laws on the use and protection of wild life), *Heera mana baaloo*, *Heera mana Wadaajaa*, *Heera lafaa* (earth) and *samii* (sky), *Heera mukaa* (those

trees to be cut or not) and all environmental resources and their utilization. These laws are important for the Oromo society to maintain internal peace and solidarity with each other and to protect their environment. These are among the lessons learned from Raaba Doorii of the Hararge Oromo in relation to various laws proclaimed at different times while the *gadaa* system was in practice.

## Policy Recommendations

- ∞ The procedure, legislations, norms, customs, and values practiced in Gadaa system should be mainstreamed in the education system and school curriculum from the primary to higher education to hand down the knowledge system to posterity.
- ∞ The best practices of *Gadaa* Laws should be integrated with modern governance structure towards solving socio-economic, political and environmental challenges encountering Ethiopia in general and Oromia in particular.
- ∞ Oromia culture and tourism Bureau has to devise strategies to protect and sustain the practices in Gadaa system.
- ∞ Awareness creation trainings are recommended for stakeholders to preserve the endangered *Gadaa* laws.



May 2024

### Women Membership in Multi-Purpose Cooperatives in Eastern Hararghe Enhanced Maize Productivity and Food Security

Melkamu Girma<sup>1</sup>, Tekalign Tuluka<sup>1</sup>, Helen Fikreyohannes<sup>1</sup> and Kedija Kediro<sup>2</sup>

<sup>1</sup>School of Agricultural Economics and Agri-business, Haramaya University; <sup>2</sup>School of Rural Development and Agricultural Innovation, Haramaya University.

#### Key Message

- Women household participated in multi-purpose cooperatives intake 759.11 Kcal/AE/Day (28.5%) more calories than non-participating women.
- Maize crop productivity of women's household membership in MPC was increased by 28.33% compared to that of non-participant.

#### Introduction

Global and national evidence indicate that women in rural areas play a vital role in bringing food and economic security at a household level. They make up to 43% of the agricultural labor force and could boost total agricultural output by 2.5 - 4% in developing countries. Productivity in rural farming is largely characterized by low mechanization and unequal allocation of resources between men and women. In particular women are economically disadvantaged. To overcome these challenges, women have been joining multi-purpose agricultural cooperatives as one of the main institutional mechanisms for empowering economically disadvantaged members of the society and for sustainable agricultural and economic development. Women having access to economic resources invest more on family wellbeing and their children are well-nourished. However, women's participation in multi-purpose

cooperatives is generally very low in Ethiopia, particularly, in Eastern Hararghe zone. This study aims to assess the impact of women participation in multi-purpose cooperatives on maize productivity and food security of women households in East Hararghe zone.

#### Approach and Results

The study employed a cross-sectional data collected from randomly selected ten districts of East Hararghe. A total of 385 women households were selected employing a multi-stage sampling techniques among which 178 were participants and 207 were non-participant in multi-purpose cooperatives. The ten districts that were selected, together with their corresponding kebeles, are: Fadis (Dinhaqaa), Kombolcha (Roobaa), Gursum (Abaadir), Dadar (W/Guddina), Babile (IfaaDiin), Haramaya (Haramaya Univeristy), Qarsa (Adeelee), Meetta (Calanqoo 02), and Jarso (Gida lixa).

The result indicated that access to credit, (frequency of extension contact), use of chemical fertilizer, distance to the nearest market and use of improved seed positively affects women farmers participation in multipurpose cooperatives whereas the age of women household head and distance from the cooperative office negatively affects the participation of women in multipurpose cooperatives.

Table 1. Factors affecting women's participation in multi-purpose cooperative (Logit Result)

Variables	Dy/dx	Std. Err.	Z	P-Value
Age of the women farmer (AGEWF)	-0.007	0.003	-2.12	0.034*
Education level of women farmer (EDUCWF)	0.005	0.007	0.66	0.512
Land holding size (LHSWF)	0.011	0.027	0.42	0.672
Distance from cooperative (DSTCOOP)	-0.053	0.012	-4.25	0.000*
Distance from nearest market (DSTMKT)	0.001	0.001	2.03	0.042*
Access to credit (ACCRDT)	0.252	0.036	7.00	0.000*
Frequency of extension contact (FROEXSR)	0.025	0.006	4.40	0.000*
Access to Off/Non-farm income (ACCNOI)	0.114	0.094	1.22	0.224
Farming experience of women (FRMEXPR)	0.003	0.004	0.87	0.382
Owning fertile soil (FERTSOIL)	-0.004	0.039	-0.09	0.926
Family size with adult equivalent (FAMAE)	0.015	0.013	1.20	0.230
Livestock ownership (ILU)	-0.006	0.016	-0.39	0.700
Use of small-scale irrigation (USEIRRG)	0.019	0.046	0.42	0.675
Use of Fertilizer and chemical (CHEMFERT)	0.168	0.055	3.04	0.002*
Use of improved seed (IMPSEED)	0.266	0.031	8.68	0.000*

Source: Own survey computation (2023)

Women participated in multipurpose cooperatives positively affected their household maize productivity and food security, resulting in higher average calorie intake (3418.11 Kcal/AE/Day) compared to non-participant women (2659.70 Kcal/AE/Day) with an increase of 28.5%. The

average maize crop productivity of women participant in multipurpose cooperatives was 7.61 quintals, while that of non-participating women households was 5.93 quintals, which shows 28.33% increment.

Table 2. Average Treatment Effect of Cooperative Membership of women households

Outcome variable	Sample	Treated (PWH)	Control (NPWH)	Difference	Std. Err.	t-value
Calorie intake (Kcal/AE/Day)	Unmatched	3407.68	2553.54	854.14	182.06	4.69***
	ATT	3418.11	2659.70	758.41	291.55	2.60***
Maize Crop productivity (Quintal)	Unmatched	7.72	5.16	2.55	0.42	6.00***
	ATT	7.61	5.93	1.67	0.64	2.60***

Source: Model output, (2023), PWH – Participant Women Household and NPWH – Non-participant women Household

## Policy Recommendations

- ∞ Governmental and non-governmental organization should create access to credit and related financial services, and improve the current extension services provided to women farmers by creating a suitable capacity building program.
- ∞ Concerned bodies should improve accessibility of multipurpose cooperatives to women household by establishing primary multipurpose cooperative close to their kebeles.
- ∞ The government and relevant stakeholders should provide women farmer access to improved seed and agro-chemical to increase agricultural productivity.



May 2024

### Implementation of Climate Change Adaption Strategies Improved Household Welfare in Eastern Hararghe

Yohannes Kefale Mogess<sup>1</sup>, Dereje Degu Ayen<sup>2</sup>, and Dereje Yonas Aborre<sup>3</sup>

Affiliation

#### Key Message

- Climate change adaptation strategies (CAS), including irrigation, intercropping, and joint adaptation improve household welfare, with irrigation offering a higher payoff (9811.8 Birr), while joint adopters earned more income of 2094.92 Birr.

#### Introduction

Agriculture plays a crucial role in Ethiopia's economy, accounting for around 40% of the GDP, 80% of export earnings, and 80% of employment opportunities. Nevertheless, the sector is impacted by climate change. Smallholder farmers, in particular, are severely affected by climate change and have experienced an increase in food insecurity. Moreover, these households have limited capacity to implement climate change adaptation strategies that could enhance their welfare. The Intergovernmental Panel on Climate Change (IPCC) and World Bank assert that climate change is a significant contributor to the rising level of food insecurity among farm households. However, limited empirical evidences are available to support the nexus between nature-based climate change adaptation strategies (CAS) and household welfare. Therefore, the main objective of this study was to analyze the effect of climate change adaption strategies on farm households' welfare in the Eastern Hararghe.

#### Approaches and Results

The effect of climate adaptation strategies (CAS) on farm household welfare was assessed using primary socioeconomic farm household data collected from Eastern Hararghe zone and National Aeronautics and Space Administration (NASA) high-resolution gridded climate data. The

differential effect of climate variables and other socio-economic factors on welfare among adopters and non-adopters of climate change adaptation strategies were examined. Furthermore, the average adoption treatment effect of crop diversification, irrigation, and joint adaptation on welfare were explored and the vulnerability of households to climate change were quantified. A set of multiple endogenous switching regression models (MESR) were used to estimate the nexus between CAS and welfare measures.

The result shows (Table 2) that all CAS, such as intercropping (IC), irrigation (IR), and joint adaptation (JA), improved farm household welfare while irrigation gives a higher payoff. Irrigation adopters earn Birr 9811.8 (\$200) and joint adopters of IR and IC earn additional income of 2094.92 (\$43) than non-adopters. However, farmers who solely adopted intercropping (IR0IC1) experience the lowest income growth when compared to those who opt for irrigation alone or a combined adoption approach.

In terms of the adoption of Climate Change Adaptation Strategies (CAS), the study focuses on four (2<sup>2</sup>) possible combinations of practices, as presented in Table 1. Among the total of 417 households (with 1408 observations, as it pertains to household plot-level data), 18.47% did not adopt any CAS on their plots. As indicated in Table 1, 50.78% of households solely practiced intercropping (IR0IC1), while 3.91% exclusively adopted irrigation (IR1IC0). Furthermore, 26.84% of the households adopted both irrigation and intercropping (IR1IC1).

Table 1: Adoption combinations of climate change adaptation strategies

CAS choices	adaptation combinations	Frequency (%)						
		Haramaya District (n=212)	Babile District (n=189)	Fedis District (n=191)	Kersa District (n=218)	Kombolcha District (n=253)	Meta District (n=345)	Full sample (N=1408)
1	IR <sub>0</sub> IC <sub>0</sub>	30	15	21.92	7.69	17.31	8.08	18.47
2	IR <sub>0</sub> IC <sub>1</sub>	12.31	11.19	14.83	17.06	17.20	27.41	50.78
3	IR <sub>1</sub> IC <sub>0</sub>	1.81	25.45	14.55	16.36	23.64	18.18	3.91
4	IR <sub>1</sub> IC <sub>1</sub>	11.9	14.81	5.29	17.72	19.05	31.22	26.84
Total		15.06	13.42	13.48	15.48	17.97	24.50	100

Notes: IR<sub>0</sub>IC<sub>0</sub>—non-adopters; IR<sub>0</sub>IC<sub>1</sub>—adopted Intercropping only; IR<sub>1</sub>IC<sub>0</sub>—adopted irrigation only; IR<sub>1</sub>IC<sub>1</sub>—adopted both irrigation and intercropping.

Farmers who adopted irrigation practices demonstrate an average labor demand of 733.39, while non-adopters display a significantly lower average demand of 4.18. Furthermore, joint adopters of adaptation strategies exhibit an

average demand for labor of 17.992 compared to non-adopters (5.022). The substantial difference of 729.217 and 12.97 indicates irrigation adopters and joint adopters, respectively, experienced higher welfare levels compared to non-adopters.

Table 2. MESR-based average treatment effects (ATE) of adoption of CAS on household welfare

CAS Choice	Outcome variables					
	Farm household income			Demand for labor		
	Adoption status		Average Treatment Effect (ATE)	Adoption status		Average Treatment Effect (ATE)
	Adopting (j=2,3,4)	Non-adopting (j=1)		Adopting (j=2,3,4)	Non-adopting (j=1)	
	(1)	(2)	3=(1)-(2)	(4)	(5)	6=(4)-(5)
IR <sub>0</sub> IC <sub>1</sub>	7182.64	7147.92	34.72	13.75	8.54	5.20***
IR <sub>1</sub> IC <sub>0</sub>	16766.01	6954.21	9811.80***	733.39	4.18	729.22***
IR <sub>1</sub> IC <sub>1</sub>	8958.14	6863.22	2094.92***	17.99	5.02	12.97***

Notes: j represents adoption combination of nature-based climate change adaptation strategies defined in Table 1. \*\*\*P < 0.01.

## Policy Recommendations

- ∞ Concerned stakeholders are recommended to engage in awareness creation on the benefits associated with the joint adoption of irrigation and intercropping practices.
- ∞ Regional agricultural bureaus, zonal and woreda agricultural offices are advised to support smallholder farmers to practice irrigation and/or complement it with intercropping to maximize farm household welfare.



### Ethiopia's agro-pastoral and pastoralist youth aspire to engage in agribusiness

Getachew S. Endris<sup>1</sup>, Muluken G. Wordofa<sup>1</sup>, Chanyalew S. Aweke<sup>1</sup>, Jemal Y. Hassen<sup>1</sup>, Jeylan Wolyie<sup>2</sup>, Dereje Kifle<sup>1</sup>, Million Sileshi<sup>3</sup>, Kadija K. Geche<sup>1</sup>, Abdulmuen M. Ibrahim<sup>1</sup>, Kidesena Sebesibe<sup>1</sup>

<sup>1</sup>Haramaya University, School of Rural Development and Agricultural Innovation

<sup>2</sup>Haramaya University, School of Foreign Languages and Journalism

<sup>3</sup>Haramaya University, School of Agricultural Economics and Agribusiness

#### Key Messages

- Youth aspirations are diverse and heterogeneous, driven by a desire to live a fulfilled life, and dictated by norms and value systems.
- Male and female youth face environmental, political, policy, financial, cultural, knowledge and technical capacity constraints affecting their ability to tapping into available opportunities.
- Majority of youngsters (male and female youth) in pastoral and agro-pastoral areas are interested in self-employment and starting businesses in agriculture.

#### Introduction

The youth demographic dividend constitutes a significant portion of the pastoral and agropastoral labor force in agriculture and food production in Ethiopia. Yet, the literature on rural youth and their role in rural and agricultural transformation as farmers, producers, and agents of change is limited. Hence, the evidence bases to inform the policy debate on effective strategies for promoting rural youth development is very tenuous. Thus, it is necessary to conduct primary studies on rural youth aspirations and transitions to inform policies and strategies targeting youth in fragile ecosystems. This requires an understanding of the rural youth in a local socio-cultural context - how their aspirations are formed, how those aspirations relate to, opportunity structures, support mechanisms, and challenges. The current study aimed at understanding this scenario and

proposing strategies to guide the development of research, policies, and interventions for targeting and engaging youth in pastoral and agropastoral livelihood systems in Ethiopia.

#### Approaches and Results

A qualitative comparative case study design was followed. Qualitative data were collected using key informants' interviews (29), focus group discussions (20), and life history interviews (32). The qualitative data collection methods are carefully chosen to motivate the youth to speak out and share their grievances, current realities, aspirations, unfulfilled (unmet needs), and challenges in an atmosphere of openness and trust. An iterative and reflexive process was employed throughout data collection (Bryman and Burgess 1994) and analysis. Data were analyzed using combinations of interpretive or relational content analysis (Hardy et al. 2004) and thematic analysis.

Youth aspirations are diverse and heterogeneous, driven by a desire to live a fulfilled life which is locally conceptualized as "a state of well-being with good health, income, access to good food, clean water, good housing, and electricity." But most aspirations were not met. These aspirations are influenced by gender, local context, and norms and value systems, which shape the distribution of resources and responsibilities.

Youth career aspiration is not an individual's ego-centric pursuit. It is influenced by factors such as access to productive resources (access to land, finance, and skill), levels of education, individual personal characteristics, media narratives and peer

influence, and family wealth background. Youth aspiration and willingness to pursue agriculture as a career are influenced by factors such as perceived financial gains from agriculture (current level of satisfaction), generational or historical trends, youth-specific characteristics (age, sex, educational attainment, wealth level, and family background) and geography.

Majority of youngsters (male and female youth) in pastoral and agro-pastoral areas are interested in self-employment and starting businesses in agriculture. They want to participate in modern crop-livestock farming with high returns as producers, processors, and market actors. They expressed need for access to affordable financial services, time and labor-saving technologies such as such as drought-resilient crop & livestock technologies, training, capacity-building support, research, and market linkages.

There are several opportunity structures with the potential to support youth engagement in market-oriented mixed-livestock-crop farming in pastoral and agro-pastoral areas: policies and proclamations supporting youth access to land, finance, and education; potential for agricultural and non-agricultural business opportunities; availability of organization, program, and services (micro-finance, agricultural extension, education, health care); and other supporting infrastructure and services. However, there are critical deficiencies. The major constraints to youth engagement in pastoral and agro-pastoral areas were limited access to affordable and culturally appropriate finance, limited market access and networks, agricultural extension services, climate change and drought, access to agricultural inputs, limited technical capacity, and lack of peace and stability.

## Policy Recommendations

- ∞ Government and policymakers should address youth issues by understanding agro-pastoral/pastoral youth's complexities, internal dynamics, constraints, and aspirations, while focusing on strategies for effective intervention.
- ∞ Ministry of Agriculture and Natural Resources should design a tailored inclusive extension system that targets both male and female youth. Additionally, the Ministry should prioritize youth entrepreneurship development through training, technical training, financial support, market information, and infrastructural development.
- ∞ Government and development partners should work together to improve grassroots social capital and community-based mutual support groups for rural youth livelihood transformation.
- ∞ Concerned bodies are recommended to promote culturally appropriate financial services and co-learning and partnerships between formal and non-formal systems to address sociocultural barriers to youth transformation.
- ∞ Local government, customary institutions, and NGOs operating in the study area should work together in partnership to identify and address all forms of discrimination and its impact on the aspirations, employability, empowerment, and overall livelihood and welfare of male and female youth.



### Advancing Hybrid Microgrid Systems Address Energy Demands in Rural Communities of Eastern Hararghe, Ethiopia

Haftu Brhane Gebremichael<sup>1</sup>, Teshager Argaw Endale<sup>1\*</sup>, Gelana Amente Raba<sup>1</sup> and Tadesse Lemma Wakijira<sup>1</sup>

<sup>1</sup>College of Natural and Computational Sciences, Haramaya University, P.O.Box: 138

#### Key Messages

- A maximum yearly global solar radiation of 6.92 KWh/m<sup>2</sup>/day was projected at Melka Jebdu compared to Babile, Kombolcha, and Deder areas 6.63KWh/m<sup>2</sup>day, 6.73KWh/m<sup>2</sup>day, and 6.23KWh/m<sup>2</sup>day, respectively.
- Photovoltaic/battery hybrid systems were found to be the most cost-effective energy system with loads ranging from 3 kWh/d to 13 kWh/d in terms of the reliability, solar resource, and diesel fuel price compared to other hybrid combinations of solar PV-generator set, wind turbine-generator set, and/or generator set operating alone.

#### Introduction

Energy is the principal economic artery of all countries, and the demand is increasing with rapid population growth. Currently, 80% of global primary energy sources is from fossil fuels, which are non-renewable and expensive. In developing countries, 55% of the rural population has access to energy, however in Ethiopia, 46% only utilize electricity for day-to-day operations such as food preparation and other work (Getie, 2020). The hunt for green and sustainable energy sources has emerged as an alternative solution to the rapid depletion of conventional fossil fuels, global warming, and ever-increasing energy demand. Microgrid (MG) systems emerged as one of the alternative and promising energy sources for developing countries with limited access to

electricity. A microgrid system can reduce randomness, alleviate oversizing, and increase supply dependability by incorporating generation systems, storage units, and regulated loads (Akinyele et al., 2018). Off-grid electrification is becoming a viable energy option for rural areas and solar energy is a more reliable energy source. In line with this, the Ethiopian government is working on the expansion of off-grid rural electrification to increase access to power and improve living standards. To support government initiatives, solar energy potential and consumption in rural areas of eastern Ethiopia should be assessed and evaluated. Therefore, the primary goal of this research is to evaluate solar energy potential areas, estimate energy consumption, and design and evaluate the performance of a hybrid micro-grid power supply system such as solar PV-battery set, solar PV-generator set, wind turbine-generator set, and/or generator set operating alone for a rural area in eastern Ethiopia.

#### Approaches and Results

The research was carried out in selected rural areas in the eastern Hararghe Zone (Deder, Babile, and Kombolcha) and Dire Dawa city administration (specifically, Melka Jabdu) during 2019-2022. The solar energy potential of the selected areas was analyzed. The study found that the mean annually estimated global solar radiation over Melka Jebdu, Kombolcha, Babile, and Deder, were 6.92KWh/m<sup>2</sup>day, 6.73KWh/m<sup>2</sup>d, 6.63KWh/m<sup>2</sup>day, and 6.23KWh/m<sup>2</sup>day, respectively (Figure 1).

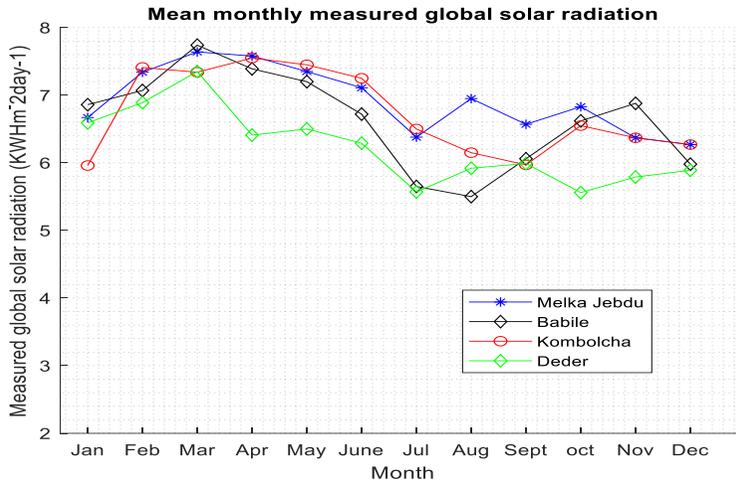


Figure 1. Mean monthly measured global solar radiation of Melka Jebdu, Kombolcha, Babile, and Deder.

Based on the quantified solar energy potential of selected sites, Melka Jebdu was selected for the design and evaluation of a hybrid solar and wind micro-grid power supply system. For this purpose, HOMER software was used for the design and performance analysis of a hybrid solar and wind microgrid power supply system and compared against a generator with a Generic 10kW Fixed Capacity Genset (Diesel). HOMER software proved the intuitive assumption that putting a system in a place with higher average solar radiation advantages PV/battery systems over hybrid systems as the threshold is raised to larger loads.

A solar PV system costs 2,435,735.00 Birr to install. The levelized cost of a solar PV system

alone was 3.12/kWh Birr. PV/battery systems were found to be the most cost-effective up to loads ranging from 3 to 13 kWh/d, depending on reliability, solar resource, and diesel fuel price. A combination PV/generator/battery system performed best for loads above this level. The exact threshold for a specific situation is affected by reliability needs, solar resources, and fuel pricing.

Table 1 below compares the net present cost of PV, Wind, and Generator using HOMER optimization. Based on the results, the renewable hybrid power source has the lowest cost. It is the finest alternative for isolated off-grid areas.

Table 1: Net present costs of energy sources

Name	Capital (\$)	Operation (\$)	Replacement (\$)	Salvage (\$)	Resource (\$)	Total (\$)	Production	Percent (%)
Hybrid micro-grid renewable energy sources	Fronius Galvo 3.1-PV	30,000	1,293	0.00	0.00	0.00	31,293 9.248	0.727
	Wind: XANT M [100kW]	24,000	3,232	0.00	0.00	0.00	27,232 1,262,149	99.2
	Generic 10kW Fixed Capacity Genset (Diesel)	3,000	2.31M	0.00	-241.55	6,356	2.32M 1,118	0.0879
<b>Total</b>							<b>1,272,515</b>	<b>100</b>

As shown in the Table 1, Generic 10kW Fixed Capacity Genset (Diesel) requires less money in terms of initial cost. However, due to its life span, operation hours, emission of gas to the environment, the capacity of energy production per day, recycling (renewability) usage solar

PV/wind hybrid is preferable and gives surplus energy which can cover 4.96 times (1,262,158.248/254.58) the required energy demand of the area.

Table 2: Production summary

	<b>Component</b>	<b>Production (kWh/yr)</b>	<b>Percent</b>
Hybrid micro-grid renewable energy sources	Fronius Galvo 3.1-1 with Generic PV	9,248	0.727
	Wind: XANT M-21 [100kW]	1,262,149	99.2
	<b>Total</b>	<b>1,271,393</b>	<b>99.927</b>
	Generator: Generic 10kW Fixed Capacity Genset (Diesel)	1,118	0.0879
	<b>Total</b>	<b>1,272,515</b>	<b>100</b>

Long-term planning requires an understanding of future energy demand trends. When estimating energy consumption, factors such as population increase, economic development, and lifestyle changes should be taken into account. This helps to ensure that the solar energy system is built to meet future demands. Over the range of small systems evaluated here, fuel price had remarkably little effect on the threshold between PV/battery and hybrid systems where good dependability was

required. However, allowing some unsaved energy into the system caused it to become a more prominent factor.

Overall, the HOMER software simulation produces a list of viable combinations of solar PV, wind turbine, converter, and battery. In summary the finding showed that a hybrid power supply system that combines two or more power sources will provide a more reliable and cost-effective power source.

### Policy Recommendation

- ∞ Hybrid micro-grid renewable energy sources offer the most economical and sustainable energy option for remote areas/off-grid places. Besides, a combination of solar PV and wind energy can provide better output and cost-effectiveness.
- ∞ Concerned government and non-governmental organizations need to provide financial support to give rural areas access to reliable and cost-effective electric power which replace the traditional electric power for the communities living in the off-grid areas.