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Coronavirus Pandemic Induced Economic Cost through Fruit Products of Smallholder Farmers of Arba-Minch Zuria *Woreda*, Southern Ethiopia

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Abstract

The corona virus pandemic has influenced the production and marketing of fruits by smallholder farmers of Arba-Minch Zuria Woreda, Southern Ethiopia. This study was aimed at analyzing corona virus pandemic-induced economic cost/loss through fruit products and their impacts on the lives of households. Data were gathered through a questionnaire from 190 households who were selected using systematic random sampling. Data was also collected through interviews. To analyze the data, descriptive statistics such as percentages, mean, and inferential statistics like correlation and analysis of variance were employed using Statistical Package for Social Sciences and excel. The average economic cost found through fruit products of smallholder farmers has been estimated at 29.8 quintal or ETB 28,724.8 (US$ 844.8) due to the impact of the pandemic in three-four months. However, the average economic loss from March-June, 2020) was higher for farmers with larger farm-size and family-size, and higher annual fruit harvest that was also higher for male-headed HH (ETB 30,354.8/US$ 892.8) than the female-headed ones (ETB 22,155.3/US$ 651.6). Decline/loss of income, the difficulty of satisfying food needs, failure to afford farm inputs, and social costs were the main impact of the pandemic on fruit marketing. The corona virus pandemic led to economic costs through fruits of smallholder farmers mainly due to price-fall, lack of market options, and the perishable nature of fruits underlain by the containment measures of the government. Thus, concerned bodies should explore the untapped local and distant markets, and the government (with a feasibility study) should work for options (e.g., small-scale fruit-packing) by which value is added for the products locally.

Keywords: *banana, mango, wasted product, cheap sales, economic cost, impact, smallholder, etc.*

1. Introduction

The corona virus pandemic is critically affecting the production, distribution, exchange, and consumption of goods and services, and other economic processes (Forsido et al., 2020) throughout the world. Millions of people have gone unemployed, thousands of companies are bankrupted, and millions of people have lost sources of their livelihood means. Hence, they required aid for food and other basic needs (WHO, 2020). Global estimates reveal that a 1% lower growth in the global economy would translate to about 14 - 22 million more people living in extreme poverty due to the pandemic crisis (UNICEF, 2020). The global price of crude oil per/barrel had been dropped by about 60 % (Mitik et al., 2020). Even if the impact of the corona virus pandemic was more tremendous in countries with a giant economy (e.g., USA, China, France, UK, etc.), it brought a critical challenge in Africa. Although the magnitude of infected people in Africa seems limited, the economy of most nations of the continent was highly threatened following the containment measures of governments in the respective nations (UNICEF, 2020).

Ethiopia has been affected by the corona virus pandemic since February 2020. Nonetheless, the impact became more severe since the first infected case was identified on March 13, 2020, in the country. Since then (until Sept 1, 2020), 53,304 people have been infected; of who, 828 patients (1.6 %) died and 19,487 (36.6 %) have recovered (MoH, 2020). The impact of the pandemic on the Ethiopian economy began to be visible since the commencement of the virus expansion from China to Europe, North America, Asia, and Africa from January to February /2020. Compared to the baseline (or pre-COVID-19) scenario, the GDP of Ethiopia was estimated to be lower by 5.9 % (loss by ETB 127 billion) in the fiscal year 2019/20 and was predicted to shrink by 6.7 % (loss by ETB 159 billion) in the year 2020/21 (Mitik et al., 2020). Businesses in the domestic and foreign trade, air and road transport, hotels, restaurants, tour, etc., sectors of Ethiopia have been adversely affected by the corona virus crisis following the various preventive measures taken and the ‘state of emergency declared by the government (Goshu et al., 2020). Hence, people who lived in extreme poverty were predicted to increase significantly and those (people in Ethiopia and other African countries) who became out of poverty by the end of 2020 were predicted to be fewer by 48% due to the impact of the pandemic crisis, according to the prediction made by the UNECA (UNICEF, 2020).

Despite the low yield of the agriculture sector, the corona virus pandemic was further affecting this sector in Ethiopia. In the country, the agricultural impact of the corona virus pandemic seems to be more severe in areas where the perishable fruit products are cultivated by smallholder farmers (Adugna, 2009; Deribe & Mintesnot, 2016). Arba-Minch Zuria *Woreda* is among the localities where fruits (e.g. banana, mango, avocado, papaya, etc.,) are produced by smallholder farm-households in Southern Ethiopia (Gelaw, 2019; Kebede, 2012). The corona virus pandemic adversely influences all stakeholders in the production and marketing chain of fruits (Adugna, 2009; Trade & Agriculture Directorate/Committee for Agriculture (TAD/CA), 2020). Fruits are largely produced in rural areas and distributed to the major urban areas almost in the four corners of Ethiopia - the main market destinations for the products (Adugna, 2009; Gelaw& Kassahun, 2007). Containment measures of the virus taken by the government of Ethiopia reduce the frequency of supply of fruit products to market centers in major urban areas. This, in turn, negatively affects the earnings and lives of fruit-growing farmers, wholesalers, laborers, brokers, truck-owners, fruit unions, truck drivers, and petty traders/street vendors (Adugna, 2009; Deribe & Mintesnot, 2016; Gelaw & Kassahun, 2007). However, the impact could not be equally significant for all HH in the chain as it might vary based on differences in some attributes of the HH (Gelaw, 2019).

Some broad-level and predictive studies have been conducted on the economic cost of COVID-19 in Ethiopia so far (Forsido et al., 2020; Goshu et al., 2020; Mitik et al., 2020). However, specific studies which came up with case-area-based empirical pieces of evidence on farm-HH level effects of the pandemic seemed rare. Declined income, food scarcity, failure to afford house rent, wage/salary (for employers), the difficulty of affording income tax, and decline in remittance were among the impacts of the pandemic on the lives of urban dwellers at large (Goshu et al., 2020). Fruit-growing farmers are thought to suffer much due to the perishable nature and price-fall of fruit products unless alternative solutions are explored to curb the spoil and dwindling price-induced loss of earnings from fruits (TAD/CA, 2020). But the economic loss could not be equally significant among all smallholder farmers as it could vary depending on farm size, HH-size, gender, and annual harvest of HH (Gelaw, 2019). Analyzing corona virus-induced economic cost via fruit products, and its effects on the living condition of farm-HH and other stakeholders of fruit marketing (e.g., petty traders, women, etc.,) is valuable to inculcate issues that require changes in policy and management options. Thus, this study

was targeted to (1) measure corona virus pandemic-led economic cost (quintal and ETB/US$) via fruit products of farm-HH in Arba-Minch *Zuria Woreda*; (2) identify the correlation between the economic cost (ETB/US$) via fruit products with variables such as HH-size, farm-size, and annual fruit harvest; (3) evaluate whether HH-size, farm-size, gender and annual fruit harvest difference-based variation of average economic cost (via fruit products) among farm-HH was significant; (4) analyze the impacts of COVID-19 induced economic loss on the living conditions of fruit growing HH of Arba-Minch *Zuria Woreda,* Southern Ethiopia.

2. Study Area and Research Methods

2.1 Description of Study Area

Arba-Minch *Zuria Woreda* is located within 5042’20’’N – 6012’15’’N latitude and 37018’15’’E – 37040’01’’E longitude in Southern Ethiopia (Figure 1). Its south-southeastern part is the low-lying Southern Rift-Valley of Ethiopian. Its north-northwestern part is featured by complex interlocked spurs, ridges, hills, valleys, and steep to undulating land. Its altitude ranges from 1170 m to over 2400 m above sea level (Gelaw, 2019; Kebede, 2012).

The mean annual temperature (1987 – 2018) was 240C in the *Kola* (tropical) part and 16.70C in the *Woina- Dega* to *Dega* (sub-tropical to temperate) part of Arba-Minch *Zuria Woreda* (NMA, 2019). The mean monthly temperature is the highest in March (260C) and the lowest in July (230C) in the *Kola* part. In the *Woina-Dega* to *Dega* part, March (18.60C) is the hottest month, and July (14.90C) is the coldest month (NMA, 2019). Arba-Minch *Zuria Woreda* has two rainfall seasons: that is, Spring (March-May), with higher rainfall, is the main rainy season where it peaks in April. Autumn (September - November), with less rainfall amount, is the second rainy season where it peaks in October (Table 1). The area receives mean total annual rainfall (1982 – 2018) ranging from 870.9 mm in its *Kola* part to 1,406 mm in the *Woina-Dega* to *Dega* parts (NMA, 2019).

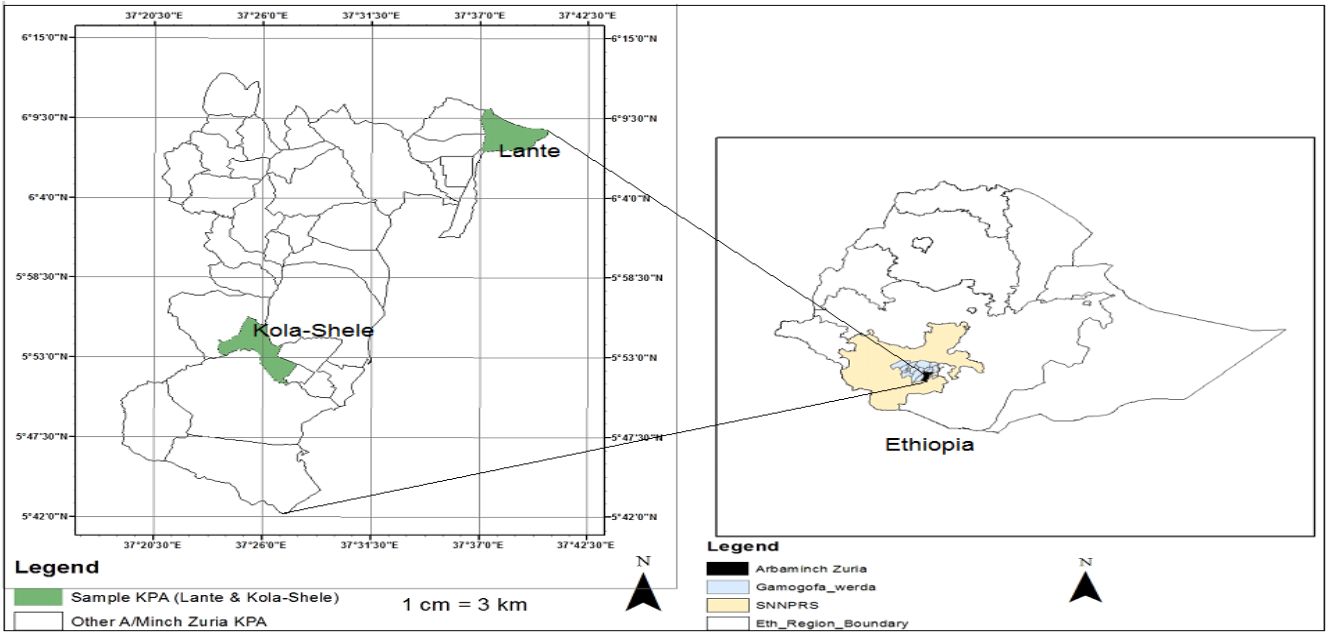

Fig 1: Arba-Minch *Zuria Woreda* and Sample *Kebele* Peasant Admins (KPA)(Lante and Kola-Shele) (**Source**: Own Design (2020) upon Ethio-GIS Database) (SNNPRS = Southern Nations Nationalities and Peoples Region)

Table 1: Mean Temperature (Temp) of 32 Years (1987 - 2018) and Mean Rainfall (RF) of 37 Years (1982 - 2018) in the: (I)*Kola* Area, and (II)*Woina-Dega* to *Dega*Part of Arba-Minch *Zuria Woreda*

Categor	Jan	Fe	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	De	Mean
(I) Temp	24.	25.	26	24.8	23.7	23.2	23.	23.6	24.3	23.7	23.1	23.	24.0
RF	26.	31.	58.1	153.	151.	61.5	41.	47.0	85.8	115.	64.8	34.	870.9
(II) Tem	17.	18.	18.6	17.2	17.1	15.6	14.	15.0	16.0	16.3	16.9	17.	16.7
RF	36.	27.	100..	229.	216.	102.	76.	139.	169.	157.	107.	43.	1406.

Source: Own Summary Based on Records of the NMA (Arba-Minch and Zigti Stations) (2019)

Arba-Minch *Zuria Woreda* experiences *Kola*/tropical and *Woina-Dega* to *Dega* agro -ecologies (Hurni, 1998). Agro-forestry (banana, mango, papaya, avocado, coffee), cereals (maize, *teff*), tubers (sweet potato, cassava, onion), vegetables (cabbage, pepper,), cotton, etc., are grown by farmers in *Kola* (tropical) area. *Enset*, potato, barley, wheat, bean, garlic, and another tuber/root crops are cultivated by farmers in *Woina-Dega* and *Dega* agro-ecology. The average annual harvest (value) of banana and mango in the sample villages (Lante and Kola-Shele) was 243.5 quintal/HH (ETB 225,731/US$ 6,639.1 per/HH) (Table 5).

Total population of Arba-Minch Zuria *Woreda* based on the 2015 survey, was 165,680; where males were 49.96 % (82,774); females were 50.04 % (82,906) (CSA, 2015). The population living in the fruit-growing *Kola* part account for 44.2 % (73,231), where males were 50.5 % (36,982) and females were 49.5 % (36,249).

2.2 Research Methods

2.2.1 Research Design and Methods of Data Collection

This study, being based on the pragmatic lens, was made using a concurrent embedded (Quan-Qual) procedure of the mixed-methods approach; *pragmatism* offers the freedom of applying diverse data collection and analysis techniques from quantitative and qualitative approaches (Creswell, 2009). Qualitative data were embedded to address one objective and to enrich the findings of the quantitative/primary approach used in this study. A cross-sectional survey design was used for the acquisition of quantitative (questionnaire) and qualitative (interview) data in parallel through a field survey (Bryman, 2006; Creswell, 2009).

Data were gathered using a questionnaire and Key Informant Interview (KII)], and from secondary sources. The questionnaire, having close-ended and open-ended questions, was used to collect data about COVID-19-induced 'wasted products' and 'cheap sales products' of banana and mango of smallholder farmers of Arba-Minch *Zuria Woreda* during COVID-19 (March – June 2020), prices of fruits in pre-COVID-19 and during the pandemic periods, farm-size, annual fruit harvest, corona virus impacts on the lives of farm-HH, etc. KII was conducted while keeping the protocol of COVID-19 such as dressing face masks and maintaining a 2-meter distance between the interviewers (researchers) and the key informants. KII was used to gather detailed data on fruit market conditions, HH level impacts of the pandemic, and other issues. Data were also gathered from books, articles, and reports.

2.2.2 Sampling Techniques

Banana and mango are cultivated in the *Kola* (tropical) *Kebeles*/villages of Arba-Minch *Zuria Woreda*, such as Elgo, Sile, Kola-Shele, Kola-Shara, Dorga, Mile, Chalba, Lante, etc. Kola-Shele and Lante *Kebeles* were selected using purposive sampling as these *Kebeles* are among the areas where the frequency of fruit harvest is high in the *Woreda* so the economic cost of corona

virus was expected to have been greater in these *Kebeles* too. '*Kebele*' is the smallest administrative unit and '*Woreda*' is a larger one (next to *Kebele*) in the hierarchies of administrative structures in Ethiopia.

Considering inferences at a 95% confidence level, the sample size was determined using: (Kothari, 2004), where: 'n' is the sample size, 'e' is the standard error margin (0.05), 'z' is the standard value of the desired confidence level (95%, which is 1.96), 'p' is the desired sample proportion (0.16), 'q' is 1 – p (1 - 0.16 = 0.84), and N is population/total HH. Using this formula, the sample size became 190 persons (out of the 2,378 farm-HH heads) of the two sample *Kebeles* of Arba-Minch *Zuria* [Woreda of Agriculture (WoA), 2019]. Of whom, male-headed HH was 83.5 % and female-headed HH was 16.5 %. Lante accounted for 40.7 % (967 HH) and Kola-Shele constituted 59.3% (1,411 HH) of the total farm-HH (WoA, 2019). Sample HH was identified using systematic random sampling; that is, starting randomly, every 13th HH was taken from the list of total HH until the 190 samples were identified. About 20 interviewees, such as development agents (2), Fruit Unions' Officers (6), administrators (2), and elders and experienced farmers (10), were selected using purposive sampling.

2.2.3 Assumptions/Scenarios and Techniques of Data Analysis

Two scenarios were accounted for the analysis of the economic cost of the COVID-19 pandemic through fruit products of farm-HH in Arba-Minch *Zuria Woreda* (Mitik et al., 2020): ***(1) pre-COVID-19 Scenario***: is the baseline scenario (Dec – Feb 2019/20) in which fruit marketing was operating under normal condition so that products, prices and earnings of fruits, and living conditions of HH during COVID-19 are compared about this scenario. ***(2) The COVID-19 scenario***: is the scenario during March – June 2020 when transport, exchange, prices, earnings and fruit consumption, and the lives of HH were influenced by the containment measures of the government following the onset of corona virus pandemic in Ethiopia in March 2020. In this scenario, the economic cost through fruits occurred in two ways: ***(i) 'wasted product'*** – refers to the loss of earnings from fruits due to spoiling on farm plots and at home, consumption by people beyond the usual threshold, livestock, and pests, etc. ***(ii) 'Cheap sales product'*** – is the loss of earnings due to the exchange of fruit products at low price.

Once questionnaire data were entered to SPSS and Excel for analysis and summary of results, HH level corona virus pandemic-induced 'wasted product' (*wp*) and 'cheap sales product' (*sp*), in quintal (*q*), of fruit products (banana and mango) in Arba-Minch *Zuria Woreda* during March – June 2020 was computed as:

wp or *sp* (*q*) = Σ*fixi*, …… (1)

Where, '*fi* 'is the frequency of HH who lost benefits in the form of wasted product (*wp*)/cheap sales product (*sp*), and '*xi*' is the mid-value of each class/interval of the fruit product (q). The value loss (*VL*) (ETB/US$) through the 'wasted product' of each fruit type was estimated using:

VL (ETB/US$) = Σ(*pmwp*) = Σ(*pm fixi)*, ……. (2)

Where, '*pm*' is the 'mean price' of a given fruit in Ethiopian Birr (ETB)/q during pre-COVID-19 (Dec – Feb 2019/20), and '*wp*' = '*fixi*,' from equation number (1) above, is the 'wasted product.' COVID-19 induced value loss (*VL*) via the 'cheap sales product' (*sp*) of banana and mango (*q*) during March – June 2020 was estimated as:

VL (ETB/US$) = Σ(pd sp) = Σ(pd fixi), …….. (3)

Where, '*pd*' is the 'difference in mean price' of each product type between pre-COVID-19 (Dec – Feb 2019/20) (*pm*) and during COVID-19 (March – June 2020) (*pn*) periods, which is *pd = pm - pn*. Overall total economic loss/cost (*vl*) via banana and mango products of the area due to COVID-19 in March – June 2020 was summarized as:

vl (ETB/US$) = Σ[(pmwp) + (pd sp)], …… (4)

Where, Σ(*pmwp*), based on equation number (2) above, is economic loss via the 'wasted product' of banana and mango, and *Σ(pdsp)*, based on equation number (3) above, is the value loss due to 'cheap sales product' of the fruits. The average was computed about 'wasted product,' 'cheap sales product' and economic loss (ETB/US$) through the fruit products. The economic loss in ETB was converted to US$ using an average exchange rate of ETB to US$ during March – June 2020 (US$ 1 = ETB 34).

Inferential statistics such as correlation and one-way ANOVA were used for generalizations about COVID-19-induced economic costs via fruit products (Kothari, 2004). Pearson's correlation was used to assess whether the corona virus-led magnitude of economic loss (ETB) via the products was significantly associated with farm/plot size (ha) of fruits, HH-size, and annual fruit harvest

(quintal/HH) of farm-HH. ANOVA was used to evaluate whether gender, farm size (ha), HH-size, and annual fruit harvest (quintal) difference-based variation in average economic cost (ETB) through fruits among farmers was statistically significant. Evidence of interview was used to address HH level consequences, and to enrich interpretations and discussion of the findings.

3. Results and Discussion

3.1 Magnitude of Corona virus Pandemic-Induced Economic Loss/Cost via Fruit products

The Ethiopian economy has been adversely impacted by the COVID-19 pandemic since the first case was identified on March 13, 2020, in the country. The impact of the pandemic was significant on the production and marketing of fruits by smallholder farmers of Arba-Minch *Zuria Woreda*, Southern Ethiopia. Table 2 illustrates the amount of wasted/ spoiled banana product in the Lante and Kola-Shele areas of Arba-Minch *Zuria Woreda* due to shortage of market and the corresponding value loss (ETB and US$) estimated using mean price (*pm*) of the product in pre-COVID-19 scenario (Dec – Feb 2019/20). Slightly less than two-fifth (37.9 %) of the HH (missing) did not report wasted product of bananas. Farm-HH of the study area reported wasted banana product (sum in bracket) of 1 – 10 (368.5), 11 – 20 (372), and 21 – 30 (357) quintals due to COVID-19 induced decline in market demand for the fruit in March – June 2020, were 35.3 %, 12.6 %, and 7.4 %, respectively (5th and 6th column, Table 2); the corresponding financial value loss (due to spoiling of the fruit) of the respective proportions of the HH was estimated at US$ 10,101.2 (21 %), US$ 10,197.2 (21.1 %) and US$ 9,786 (20.3 %) (See 9th column, Table 2). The wasted product of the fruit ranges from 1 – 80 quintals for 62.1 % of the total HH of the study area. The average wasted banana product within March - June 2020, was estimated at 14.9 quintal/HH for the farmers of Arba-Minch *Zuria Woreda* (Table 2).

Table 2: Level of Wasted Products (*wp*) of Banana, in Quintal (*q*), in Mar – Jun 2020 and its Estimated Value Loss (*VL*) Using the Product's Mean Price (*pm*) in Dec – Feb 2019/20, Arba-Minch *Zuria Woreda*

N0	Product/w_p (q)		Farm HH		$w_p(q)$	p_m	$v_l = p_m w_p = p_m (f_i x_i)$		
	Class	x_i	f_i	P (%)	$= f_i x_i$	(ETB/q)	ETB	US$	P (%)
1	1 - 10	5.5	67	35.3	368.5	932	343,442.0	10,101.2	21.0
2	11 - 20	15.5	24	12.6	372.0	932	346,704.0	10,197.2	21.1
3	21 - 30	25.5	14	7.4	357.0	932	332,724.0	9,786.0	20.3
4	31 - 40	35.5	4	2.1	142.0	932	132,344.0	3,892.5	8.1
5	41 - 50	45.5	5	2.6	227.5	932	212,030.0	6,236.2	12.9
6	51 - 60	55.5	1	0.5	55.5	932	51,726.0	1,521.4	3.2
7	61 - 70	65.5	1	0.5	65.5	932	61,046.0	1,795.5	3.7
8	71 - 80	75.5	1	0.5	75.5	932	70,366.0	2,069.6	4.3
9	81 - 90	85.5	0	0.0	0.0	932	0.0	0.0	0.0
10	91 - 100	95.5	1	0.5	95.5	932	89,006.0	2,617.8	5.4
11	Missing	0	72	37.9	0.0	932	0.0	0.0	0.0
	Total	-	190	100.0	1,759	932	1,639,388.0	48,217.3	100.0
	Mean	-	-	-	14.9	-	13,893.1	408.6	-

Source: Summary of Own Survey Data, 2020. [**Note:** Missing = No Response. US$ 1 = ETB 34)

An informant, 57 years old, stated that market shortage-induced spoiling of banana product during the corona virus pandemic was aggravated by the outbreak of a fruit disease/pest and the unusual torrential and frequent rainfall of the study area during 2020. The average value loss due to spoiling of banana product was estimated at ETB 13,893.1 (US$ 408.6) per/HH in the same period (Table 2), which was 6.5 % of the average annual earning [ETB 213,055.2/US$ 6,266.3 per/HH (Table 4)] from the fruit-product.

Corona pandemic-induced average wasted product of banana (quintal) revealed significant variation based on the difference in 'farm-size' (ha) among farm-HH of Arba-Minch *Zuria Woreda* at 99 % confidence level, where the F-statistic was 5.3 and sig-value was 0.000. Similarly, variation in average wasted product of banana is also significant based on the difference in the annual harvest of

the fruit-product among farm-HH (with F-statistic of 7.7 and sig-value of 0.000) (Table 1a, 1b & 1c, Appendix). The implication of these ANOVA results is that the average wasted product of banana (quintal) in the area was larger for farm-HH who have larger 'farm-size' (ha) and higher annual harvest of the fruit. However, 'HH-size' difference-based variation of the average wasted banana product (quintal) among the farm-HH of Arba-Minch *Zuria Woreda* was not statistically significant even at a 95 % confidence level (with F-statistic of 0.9 and sig-value of 0.439) (Table 1b, Appendix).

Table 3 illustrates the amount of mango product (quintal) that was sold at a cheap price by 20 % of the farm-HH of Arba-Minch *Zuria Woreda*, wasted product (quintal) of the fruit due to corona virus-induced market shortage (by 16.3 % of the farm-HH), and the estimated value loss (*VL*) (ETB/US$) of the product during COVID-19 (March – June 2020) in Ethiopia. Farm-HH of the study area who experienced mango-related loss due to corona virus pandemic from March – June 2020 was 20 % only. The estimated average 'cheap sales product' of mango was about 43.2 quintal/HH from March – June 2020; market shortage-led spoiled/wasted product of the fruit was 15.2 quintal/HH in the same period (Table 3).

Table 3: Value Loss (*VL*) via the Cheap Sales (*sp*) and Wasted Product (*wp*) of Mango, Quintal (*q*), in Mar – Jun 2020 when Mean Price of Mango *(pm)* = ETB 612/*q* (Note: *pm* = Mean Price in Dec – Feb 2019/20)

N0	***Product* (*q*)**		**s_p (HH)**		**s_p (*q*) = $f_i x_i$**	**w_p (HH)**		**w_p (*q*) = $f_i x_i$**	***Price* (ETB/*q*)**		**$v_l=(p_d s_p) + (p_m w_p)$**		
	Class	**x_i**	**f_i**	**%**		**f_i**	**%**		**p_m**	**$p_d = p_m - p_n$**	**ETB**	**US$**	**%**
1	1 – 10	5.5	10	5.3	50.5	13	6.8	71.5	877	265	76,089	2,237.9	12.2
2	11 – 20	15.5	11	5.8	170.5	9	4.7	139.5	877	265	167,525	4,927.2	26.8
3	21 – 30	25.5	7	3.7	178.5	7	3.7	178.5	877	265	203,848	5,995.5	32.6
4	31 – 40	35.5	7	3.7	248.5	1	0.5	35.5	877	265	96,987	2,852.6	15.5
5	41 – 50	45.5	1	0.5	45.5	1	0.5	45.5	877	265	51,962	1,528.3	8.3
6	51 – 60	55.5	2	1.0	111	0	0	0	877	265	29,415	865.1	4.7
7	Missing	0	152	80.0	0	159	83.7	0	877	265	0	0	0
	Total		190	100.0	1,641	190	100.0	470.5	-	-	625,826	18,406.6	100.0
	Mean/average		-	-	43.2	-	-	15.2	-	-	16,469.1	484.4	-

Source: Own Survey Data, 2020 (**Note:** Missing = No response. pd = Price Difference. US$ 1 = ETB 34)

Similar to the case of bananas, the spoilage problem of mango was aggravated by the outbreak of a strange disease (fungi/pest), rising climate variability as well as frequent and unusually high rainfall, according to a 34 years-old informant from Lante village. Price fall and wasted product-led estimated financial loss of the farm-HH of Arba-Minch *Zuria Woreda* through mango product was about ETB 625,826/US$ 18,406.6 within March – June 2020. Of this, about 32.6 % (US$ 5,995.5) and 26.8 % (US$ 4,927.2) of the total loss via mango product was accounted for by only 3.7 % and 5.8 % of the farm-HH, respectively (column 5 & 13, Table 3). The net average loss through 'wasted/spoil and cheap sales product' of mango of the farm-HH was estimated at ETB 16,469.1 (US$ 484.4) per/HH or 18.8 quintals per/HH (ETB 16,469.1 ÷ ETB 877/quintal = 18.8) roughly in 3 - 4 months.

Table 4 illustrates the estimated monetary value loss via the sale of the banana product at a low/cheap price following the COVID-19-induced restriction of fruit transportation to markets in major urban areas of Ethiopia since March 13, 2020. Farm-HH of Arba-Minch *Zuria Woreda* which faced losses due to the pandemic-led decline price of bananas from March – June 2020, accounted for 82.6 %. The maximum amount of banana product, which was sold at a cheap price in the period considered was about 286 – 300 quintals /HH (Table 4). The range (sum in bracket) of banana product (quintals) which was sold at cheap price by 16.3 %, 22.6 %, 13.7 %, 7.4 %, 4.7 % and 5.8 % of the farm-HH was about 1 – 15 (248), 16 – 30 (989), 31 – 45 (988), 46 – 60 (742), 61 – 75 (612) and 76 – 90 (913) quintals (column 5 & 6, Table 4). And, the financial value loss of the respective proportions of the farm-HH through the corresponding amount of banana product was estimated at US$ 2,210.1 (3.3%), US$ 8,813.7 (13 %), US$ 8,804.8 (13 %), US$ 6,612.5 (9.8 %), US$ 5,454 (8.1 %) and US$ 8,136.4 (12 %) (Column 11 & 12, Table 4). Closure of government and private secondary and tertiary institutions in and nearby Arba-Minch town, where fruits were retailed/street-vended, was a huge demand-side impact of corona virus on fruit markets (Forsido et al., 2020).

Table 4: Value Loss (*VL*) via the Cheap Sales Product (*sp*) of Banana, Quintal (*q*), of HH during Mar – Jun 2020 when it's Mean Price *(pn*) = ETB 629 (Note: *pm* = Banana's Mean Price in Dec – Feb 2019/20)

N0	**Product(*q*)**	**Farm-HH**			$s_p\ (q) = f_i x_i$	***Price* (ETB/*q*)**		$p_d = p_m - p_n$	$v_l = p_d\ (s_p) = p_d\ (f_i x_i)$		
	Class	x_i	f_i	**%**		p_m	p_n		**ETB**	**US$**	**%**
1	1 – 15	8	31	16.3	248	932	629	303	75,144	2,210.1	3.3
2	16 – 30	23	43	22.6	989	932	629	303	299,667	8,813.7	13.0
3	31 – 45	38	26	13.7	988	932	629	303	299,364	8,804.8	13.0
4	46 – 60	53	14	7.4	742	932	629	303	224,826	6,612.5	9.8
5	61 – 75	68	9	4.7	612	932	629	303	185,436	5,454.0	8.1
6	76 – 90	83	11	5.8	913	932	629	303	276,639	8,136.4	12.0
7	91 – 105	98	5	2.6	490	932	629	303	148,470	4,366.8	6.4
8	106 – 120	113	5	2.6	565	932	629	303	171,195	5,035.1	7.4
9	121 – 135	128	4	2.1	512	932	629	303	155,136	4,562.8	6.7
10	136 - 150	143	4	2.1	572	932	629	303	173,316	5,097.5	7.5
11	151 – 165	158	1	0.5	158	932	629	303	47,874	1,408.1	2.1
12	166 – 180	173	3	1.6	519	932	629	303	157,257	4,624.2	6.8
13	286 - 300	293	1	0.5	293	932	629	303	88,779	2,611.1	3.9
14	Missing	0	33	17.4	0	0	0	0	0	0	0
	Total	-	190	100.0	7,601	932	629	303	2,303,103	67,738.3	100.0
	Mean sales and value loss (banana)				48.4	-	-	-	14,669.4	431.5	-
	Mean annual harvest and value				228.6	932	-	-	213,055.2	6,266.3	-

Source: Own Survey Data, 2020 (**Note:** Missing = No response. PD = Price Difference. US$ 1 = ETB 34)

The maximum loss due to the price-fall of banana products in March – June 2020 was about US$ 2,611.1 per/HH, which was 3.9 % of the total earning loss due to cheap price (columns 11 & 12, Table 4). An informant, aged 49, from Kola-Shele *Kebele*, stated that the magnitude of economic loss (via banana) due to COVID-19 was higher for farmers who use chemical fertilizer than for those who use organic fertilizer and who do not use any fertilizer; this person perceives that no fertilizer and

organic fertilizer-based banana product stays longer without damage on the farm-plot when the market is lacking. The same informant says that the yield and frequency of harvest of the fruit increase for farmers who use chemical fertilizers; however, more of the chemical fertilizer-based product of banana was observed to have been damaged on the farm plot due to market shortage during COVID-19 since the fruit matures faster than the no fertilizer-based and/or the organic fertilizer-based product of banana. However, an expert in agriculture (52 years-old development agent) was not sure whether this opinion of the farmer proved to be true. An average banana product that was sold at a cheap price by farm-HH of Arba-Minch *Zuria Woreda* within March – June 2020 was about 38 quintal/HH. And, COVID-19-induced financial loss via the fruit product was ETB 14,669.4/US$ 431.5/HH in three-four months, which accounts for 6.9 % of the average annual earnings from bananas (US$ 6,266.3/HH) (Table 4).

Price-fall induced average value loss (from banana) revealed significant variation among smallholder farmers of the area based on the difference in 'farm-size (ha)' (with F-statistic of 20.2 and sig-value of 0.000) and annual harvest (quintal) of banana (with F-statistic of 45.0 and sig-value of 0.000) at 99 % confidence level. HH-size difference-based variation (with F-statistic of 2.9 and sig-value of 0.024) of average value loss among the farm-HH was also significant at 95 % confidence level (Table 1a, 1b & 1c, Appendix). The implication is that due to COVID-19 induced price-fall, the farm-HH of the area with a larger average 'farm-size' (ha) and higher annual banana harvest (quintal) faced a larger average earning loss during March – June 2020.

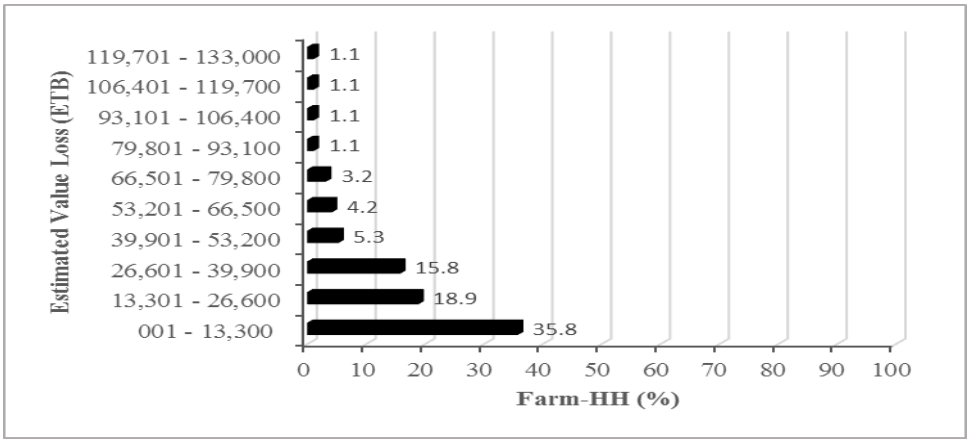

Figure 2: Share (%) of HH of Arba-Minch *Zuria Woreda* based on Level of Earning Loss (ETB) due to Corona-Led Spoil and Price Fall of Banana and Mango in Mar – Jun 2020 (**Source:** Own Design via Excel, 2020)

Figure 2 above displays the proportion of smallholder farmers of Arba-Minch *Zuria Woreda* based on overall economic loss (ETB) via the 'wasted products' of banana and mango and the 'cheap sales product' of the fruits due to the corona virus pandemic in March – June 2020. The overall economic loss did not exceed about ETB 13,300 (US$ 391.2) slightly larger than one-third (35.8 %) of the farm-HH. The estimated value loss due to wastage (spoil) and cheap price of the fruit ranges in ETB 13,301 – 26,600 (US$ 391.3 – 782.4), ETB 26,601 – 39,900 (US$ 782.5 – 1,173.6), ETB 39,901 – 53,200 (US$ 1,173.7 – 1,564.8) and ETB 53,201 – 66,500 (US$ 1,564.9 – 1,956.0) for 18.9 %, 15.8 %, 5.3 % and 4.2 % of the HH, respectively (Figure 2). The maximum value loss was estimated at ETB 119,701 - 133,000 (US$ 3,520.9 – 3,912.0) for 1.1 % of the farm-HH (Fig 2). The huge economic loss through fruit products of smallholder farmers had stemmed from the declined demand and dropped consumption of fruits in the food service channels (e.g., hotels, restaurants, cafés) underlain by containment measures of government such as restriction of transportation to main urban market centers, closure of schools, universities, colleges, open markets and street-vending (Goshu et al., 2020; TAD/CA, 2020).

The summary was about the average annual benefits of banana and mango products and COVID-19-induced economic costs (quintal and ETB/US$) through the fruit products of smallholder farmers of Kola-Shele and Lante *Kebeles*/villages in Arba-Minch *Zuria Woreda*, Southern Ethiopia (Table 5).

Table 5: Average Benefit and Economic Loss (due to COVID-19 during March – June 2020) via Fruit Products of Farm-HH of Arba-Minch *Zuria Woreda,* in Quintal (Q) and Monetary Value (ETB)

N0	Description of Benefit and Loss via the Fruit Products	Product (Q)	Value (ETB)	HH
1	Average loss through spoil and cheap price of banana products	26.94	25,111.4	157
2	Average loss through spoil and cheap price of mango products	18.78	21,732.3	38
3	Average loss through spoil and cheap price of banana and mango	29.78	28,724.8	166
4	Average/mean annual harvest and value of banana and mango	243.5	225,731.0	188
5	% of 'average loss' to 'average annual benefit' of both fruits	12.2	12.7	166
6	Average loss of male-headed HH via both fruits	-	30,354.8	151
7	Average loss of female-headed HH via both fruits	-	22,155.3	39
	Total sample households used for the study	-	-	190

Source: Own Survey Data, 2020 (**Note:** ETB 34 = US$ 1)

Average product loss due to the pandemic-led spoil and price-fall of banana and mango in Mar – Jun 2020, was 29.8 quintals/HH, and the estimated average value loss was ETB 28,724.8/US$ 844.8/HH (Table 5). The pandemic-induced 'average loss' (quintal/ETB) of banana and mango benefits in 3-4 months was 12.2 % of the estimated 'mean annual harvest' (243.5 quintal/HH) and 12.7 % of the 'mean annual value' (ETB 225,731/US$ 6,639.1/HH) of the fruit products (row # 3, 4 & 5 of Table 5). The economic loss (via fruits) seems low, and further loss was reduced due to the declined supply-led improvement of fruit prices since the end of April/beginning of May (2020) underlain by the loosened containment measures by the government of Ethiopia. The supply of fruits from the study area is often low from April/May - September.

Amount of corona virus-led 'earning loss' (ETB/US$) via banana and mango products of smallholder farmers of Arba-Minch *Zuria Woreda* in March – June 2020 revealed a significant association with 'farm/plot size (ha) (0.726**) and 'annual harvest' (quintal/HH) (0.830**) of the fruits, and 'HH-size' (0.240**) of the farm-HH at a standard error of 0.01 (Table 2, Appendix). The implication is that the amount of earning loss due to the impact of COVID-19 on fruit products was high for the farm-HH with large 'farm/plot size and high annual harvest of the fruits, but it was low for those farmers with small 'plot-size' and low annual harvest of the fruits.

One-way ANOVA was conducted so as to evaluate whether or not there was a statistically significant variation in the economic cost/loss' (ETB/US$) due to COVID-19-led market shortage and price-fall of banana and mango fruits based on the difference in farm-size, annual fruit-harvest, and HH-size among farm-HH of Arba-Minch *Zuria Woreda* (Table 6). Thus, COVID-19 induced average value loss (ETB 28,724.8/US$ 844.8 per/HH) (Table 5), via the fruit products revealed significant variation among HH based on the difference in 'plot-size' (ha) of fruits (with F-statistic of 18.8 and sig-value of 0.000) and 'annual harvest' of the fruits (with F-statistic of 24.9 and sig-value of 0.000) at 99 % confidence level. Average value loss (ETB/US$) through the fruit products also showed significant variations among farmers of the study area (at 95% confidence level) based on the difference in HH-size, which affects the production of smallholder farmers by influencing labor supply; that is, where the F-statistic was 2.8 and sig-value was 0.028 (Table 6). This means the average economic loss (ETB/US$) via fruits was high for farmers having large family-size and low for those with small HH-size.

Table 6: One-Way ANOVA of Corona-Induced Economic Loss (ETB) via Fruit products based on Variation in (I) Farm-Size (ha), (II) Annual Harvest of Fruits (Quintal/HH), (III) HH-Size, and (IV) Gender as Factors of Comparison

N0	Factor	Measure	Sum of Squares	df	Mean2	F	Sig.
I	Farm-size (ha) (plot-size of fruits)	Between groups	400.687	15	26.712	18.829	0.000
		Within groups	212.807	150	1.419		
		Total	613.494	165			
II	Annual harvest of fruits (quintal/HH)	Between groups	468.876	19	24.678	24.914	0.000
		Within groups	144.618	146	0.991		
		Total	613.494	165			
III	HH-size (#)	Between groups	39.923	4	9.981	2.795	0.028
		Within groups	571.325	160	3.571		
		Total	611.248	164			
IV	Loss (ETB)*by gender (Mean comparison)	Between groups	10.050	1	10.050	2.731	0.100
		Within groups	603.444	164	3.680		
		Total	613.494	165			

Source: Own Analysis via SPSS (version 25) based on Own Survey Data, 2020

Although the average economic cost of COVID-19 via fruit products revealed variation between male-headed HH (ETB 30,354.8/US$ 892.8) and female-headed HH (ETB 22,155.3/US$ 651.6) (Table 5), the variation was not statistically significant (with F-statistic of 2.731 and sig of 0.100) (Table 6). This was due to the low proportion of sample female-headed HH (20.5 %) compared to the high share of male-headed HH (79.5 %).

3.2 Household Level Adverse Effects of the Impact of COVID-19 on Fruit Marketing

The COVID-19 pandemic-induced losses of benefits via banana and mango fruits, in turn, have been adversely influencing the living conditions of inhabitants of Arba Minch *Zuria Woreda* whose source of livelihood means is, partly or wholly, linked to the production and marketing of fruits (Table 7). Smallholder farmers of the area have faced various challenges due to the pandemic-led restriction of fruit transport to distant markets of urban areas in the four corners of Ethiopia. The highest proportion of the HH of the study area indicated the declining income from fruits and/or its overall shortage' (98.4 %); the difficulty of affording social costs (e.g., *equib, edir, etc.*,)' (78.9 %); the declining of purchasing capacity (64.2 %), and 'the shortage of food supply other than fruits' (51.6 %) considered as the main effects of the pandemic on the marketing of fruit products (Table 7). Failure to afford

expenses of basic needs (45.3 %), the difficulty of purchasing farm inputs such as fertilizer and improved seeds (37.4 %), the inability to accomplish ongoing construction (e.g., houses) (13.2 %), and the shortage of overall food supply (12.6 %) were also among the pandemic-led adverse effects on the lives of fruit-growing HH of Arba-Minch *Zuria Woreda*, Southern Ethiopia (Table 7).

Table 7: Main COVID-19 Pandemic-Led Adverse Effects on the Living Conditions of Fruit-Growing HHof Arba-Minch *Zuria Woreda* Based on Sample Respondents of Lante and Kola-Shele *Kebeles*, 2020

N0	**Challenges/Adverse Effects**	***f* (HH)**	**P (%)**
1	Shortage of food supply other than fruits	98	51.6
2	Shortage of overall food supply in general	24	12.6
3	Failure to afford expenses of basic needs other than food	86	45.3
4	Difficulty of affording social obligations/costs (e.g.*equib, edir, etc.)*	150	78.9
5	Decline income from fruits and/or its overall shortage	187	98.4
6	Difficulty of completing ongoing construction	25	13.2
7	Difficulty of purchasing agricultural inputs	71	37.4
8	Decline purchasing capacity of people	122	64.2
9	Missing/no response (HH who didn't mention any effect)	3	1.6
	Total	190	100.0

Source: Own Survey Data, 2020 (**Note:** Table 7 above is based on multiple response-options)

In Table 7, '*equib*' is a social institution organized by volunteers who often have similar income status and who contribute equal-amount of money (tens, hundreds, or thousands) to the institution at a specified time interval (a day, week, or month) when the lottery is regularly drawn so that the collected money is awarded to a lucky member of the institution at a time. Drawing the lottery continues until all members become lucky by excluding members who were lucky in earlier periods (weeks/months) in a single round. It is a cultural way of saving income and solving the economic problems of people in Ethiopia. Many of the weekly-based '*equibs*' of fruit-growing HH in the area were interrupted temporarily due to the impact of the pandemic on fruit marketing in Ethiopia. Again '*Edir,*' is often a village-level or interest group and monthly financial contribution-based social grouping in Ethiopia, organized to support members whenever they and their families face condolences, accidents, and other incidences. Anyway, '*edir,*' together with other HH needs, was one of the threats to fruit-growers following the prevalence of the pandemic and the containment measures by the government of Ethiopia.

The livelihood impacts of the pandemic were multiple since the income from the sales of fruits for most farm-HH of Arba-Minch Zuria *Woreda* is used to cover the expenses of most basic needs of the HH such as food items (e.g., maize, *teff*, lentil, pea, onion, tomato and so on), clothes, medical care and treatment, education (schooling), '*edir*' fee, farm inputs (fertilizer and improved seeds) and others. Thus, most HH (62.1%) of the area had faced the difficulty of affording the expenses of these and other basic needs. The impact was aggravated due to the high reliance of most HH on fruit (monoculture) farming for satisfying livelihood needs. Studies also revealed that food insecurity, decline/loss of income, failure to afford basic needs, the difficulty of purchasing farm inputs, dependency on aid, and others were among the main impacts of the COVID-19 pandemic on HH in various economic activities (Mitik et al., 2020; Forsido et al., 2020; Goshu et al., 2020).

4. Conclusion and Management Options

Smallholder farmers of Arba-Minch *Zuria Woreda*, with annual earnings of ETB 225,731 (US$ 6,639.1) per/HH per/year from banana and mango, had better living status in comparison with the lives of other rural HH in Ethiopia. The farm-HH encountered significant economic loss, by 29.8 quintal or ETB 28,724.8/US$ 844.8 per/HH, due to spoiling and price-fall of fruits in 3 – 4 months (Mar – Jun 2020) of the pandemic in Ethiopia. The loss was aggravated by fruit diseases' (pests') incidence. The pandemic-led economic cost via the fruit products was significantly higher for the farm-HH having larger farm and family size, and higher 'annual fruit harvest'. Moreover, male-headed HH faced a larger loss than female-headed ones since the loss was proportional to the annual earnings of the HH from fruits.

Declined income from fruits, declined purchasing capacity, the difficulty of affording food, social costs, farm inputs, and other basic needs were the main impacts on the lives of farm-HH due to COVID-19 led shortage of fruit market. Containment measures of the Ethiopian government such as restriction of fruit transport channels to markets of major distant urban areas in Ethiopia, closure of schools, colleges, and universities (vital local market sources of fruits), and lack of market options during emergencies have resulted in the huge loss of benefits from fruits. Generally, the significant COVID-19-induced economic cost on fruit farmers was mainly due to price-fall, lack of market

options, and the perishable nature of fruits underlain by the containment measures of the government.

To curb the challenges of fruit-growing farmers, the concerned bodies (e.g., government, experts, and/or farmers) should explore the untapped local and distant market options at first, for instance, where fruits are still costly in Arba-Minch and other local urban centers. ***Second***, work for small-scale fruit-packing projects locally so that markets shortage-led wastage and the problems for price-fall of fruits to be alleviated sustainably. ***Third***, diversify the crops grown (other than fruits) and other income sources of the HH. ***Fourth***, conduct a comprehensive study on the diseases/pests threatening the yield of banana and mango and whether chemical fertilizer use increases the frequency of harvest of bananas by shortening its ripening duration in the study area.

Contribution statement:

Abren Gelaw, Getu Lema, Mulugeta Debele and Asrat Haile conceived and designed the study, analyzed and interpreted data, contributed materials, analysis tools or data and wrote the final paper.

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Appendix:

Table 1a. One-Way ANOVA of Average: (I) Banana and Mago Harvest, (II) Wasted Banana, (III) Banana Product Sold at Cheap Price, and (IV) 'Wasted Banana and Mango' Based on Variation in 'Farm-Size' (ha/HH)

N0	Variable	Measure	Sum of Squares	df	Mean^2	F	Sig.
I	Average bananaand mango harvest (Quintal/HH/Year)	Between groups	2646.0	15	176.4	54.4	.000
		Within groups	557.6	172	3.2		
		Total	3203.6	187			
II	Average wasted banana product (Quintal/HH)	Between groups	124.4	15	8.3	5.3	.000
		Within groups	158.2	102	1.6		
		Total	282.6	117			
III	Average banana product sold at cheap price (Quintal/HH)	Between groups	943.3	15	62.9	20.2	.000
		Within groups	438.1	141	3.1		
		Total	1381.4	156			
IV	Average wasted banana and mango product (Quintal/HH)	Between groups	131.3	15	8.8	4.9	.000
		Within groups	202.2	115	1.8		
		Total	333.5	130			

Source: Own Survey Data, 2020 (At 99% Level of Significance)

Table 1b. ANOVA of Average: (I) Banana and Mago Harvest, (II) Wasted Banana, (III) Banana Product Sold at Cheap Price, and (IV) Wasted Banana and Mango Product Based on Variation in 'HH-Size' of Farmer-HH

N0	**Variable**	**Measure**	**Sum of Squares**	**df**	**Mean^2**	**F**	**Sig.**
I	Average banana and mango harvest (Quintal/HH/Year)	Between groups	391.981	4	97.9	6.4	0.000
		Within groups	2806.116	182	15.4		
		Total	3198.096	186			
II	Average wasted banana product (Quintal/HH)	Between groups	9.224	4	2.3	0.9	0.439
		Within groups	272.468	112	2.4		
		Total	281.692	116			
III	Average banana product sold at cheap price (Quintal/HH)	Between groups	97.960	4	24.5	2.9	0.024
		Within groups	1280.476	151	8.5		
		Total	1378.436	155			
IV	Average wasted banana and mango product (Quintal/HH)	Between groups	11.606	4	2.9	1.1	0.344
		Within groups	320.363	125	2.6		
		Total	331.969	129			

Source: Own Survey Data, 2020

Table 1c. ANOVA of Average (I) 'Wasted Banana 'and (II) 'Banana Sold at Cheap Price' Based on Variation in 'Annual Harvest of the Fruit', and (III) 'Wasted Banana and Mango Product' Based on Variation in 'Annual Harvest of the Fruits'

N0	Variable	Measure	Sum of Squares	df	Mean^2	F	Sig.
I	Average wasted banana product (Quintal/HH)	Between groups	164.547	18	9.1	7.7	0.000
		Within groups	118.038	99	1.2		
		Total	282.585	117			
II	Average banana product sold at cheap price (Quintal/HH)	Between groups	1180.111	18	65.6	45.0	0.000
		Within groups	201.214	138	1.5		
		Total	1381.325	156			
III	Average wasted banana and mango product (Quintal/HH)	Between groups	151.490	18	8.4	5.2	0.000
		Within groups	181.945	112	1.6		
		Total	333.435	130			

Source: Own Survey Data, 2020

Table 2. Correlation (r) between HH-Size, Farm-Size (ha) of Banana and Mango, Annual Harvest of Both Fruits (Quintal/HH), and Monetary Value Loss (ETB/HH) via the Fruits

Variables	Measure	Value Loss (ETB)	Farm-size (ha)	Annual harvest (Q)	HH-size
Value loss (ETB/HH)	'r'	1			
	Sig				
	N	166			
Farm-size (ha/HH)	'r'	0.726**	1		
	Sig	0.000			
	N	166	188		
Annual harvest of Fruits (quintal/HH)	'r'	0.830**	0.895**	1	
	Sig	0.000	0.000		
	N	166	188	188	
HH-size (#/HH)	'r'	0.240**	0.362**	0.334**	1
	Sig	0.002	0.000	0.000	
	N	165	187	187	189

****.** Correlation is significant at 0.01 level (2-tailed). (**Source:** Own Survey Data, 2020)