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Research Article

The Impact of Corona Virus (COVID-19) on Food Security and Associated Factors Among Households in Yeki District, Sheka Zone, Southwest Ethiopia

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Abstract

Background: Pandemic crisis could quickly put a strain on the food supply chains. Food insecurity means not always having reliable access to enough safe, nutritious food the kind that fits people's dietary needs and personal preferences to live a healthy, active life. Therefore, this study was carried out in the Yeki District to investigate the impact of COVID-19 on household food security at the household level. *Method*: For this research, data was collected using a multistage sampling method; where Sheka zone was selected purposively, and the Yeki District was selected to address food insecurity status. A self-administered questionnaire was developed to gather relevant information. A binary logit model was employed to identify the prevalence of food insecurity, the impact of COVID-19 and related factors for food security. Model adequacy checking was done for the reliability and validity of the fitted model. *Result*: The study was included a total of 424 respondents, the main respondent for the study was the household head, 68.6% were male and 31.4% were having a female head of the household. About 75.2% (319) of the household heads exerted farming as the main source of household income and 9.4% (40) households have got their income mainly from trade and the rest 12.81% from animal rearing; 8.0% from other sources. From the respondents, 64.15% (272) were exposed to food insecurity and 35.85% (152) households were maintained their food need in the study area. Among variables, educational level, source of household income, social distancing, increased in food price, extra expense, labor shortage and current saving found statistically significant effects for predicting the household food insecurity status in the study area. However, results from the study showed that closure of rural market, family size, government feedback, lockdown, exposure for flooding and lack in farm inputs were insignificant effects on household food insecurity. Social distancing and restriction on socio-economic interaction were 2.460 times more likely to be exposed for food insecurity than the previous normal situation or before the occurrence of COVID-19 (AOR= 2.460: 95% CI= 1.30 – 3.50). During the last four weeks, a household who have had labor shortage was 2.746 times more likely to be exposed to food insecurity (AOR= 2.746: 95% CI= 2.046 – 3.684). Based on the results obtained from the study a lot should be done to prevent food insecurity by doing promoting income generation and stalk holders should be scaling up the effectiveness of the national COVID-19 response.

Keywords

COVID-19, Food Security, Binary Logistic, Yeki District, Ethiopia

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1. Introduction

Food is both a need and a human right. Enough food in terms of quantity and quality for all people is an important factor for a healthy and productive life as well as for a nation to sustain its development [1]. Food security is defined as a state in which "all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life" [2].

Lack of food security in the long term leads to hunger and starvation that can cause death [3]. Indicators of food security include availability of food, economic and physical access to food, adequate food utilization and sustainably having access to adequate food. Food insecurity exists when all people, at all times, lack secure access to sufficient amounts of nutritious food that meets their dietary needs for an active and healthy life. It occurs due to the unavailability of food, inadequate purchasing power or inappropriate utilization at the household level [4, 5].

Thus, food security is primarily a matter of getting available food to people who need it, when they need, and ensuring their regular, appropriate, and affordable access to food [6].

Ethiopia is a country with the total population of more than 110 million of which about 80% of the total population is found engaged in subsistence farming in rural areas [7]. As Misgina Asmelash pointed out many Ethiopians still face the harsh realities of poverty and not having enough food, thereby, the country has faced a high level of food insecurity [8].

The world is facing a supreme threat from the COVID-19 pandemic caused by the Corona virus. Many countries are following the advice from the World Health Organization (WHO) regarding the introduction of physical distancing measures as one of how transmission of the disease can be reduced [9]. The application of these measures has resulted in the closure of many businesses, schools, and institutes of education, and restrictions on travel and social gatherings. For some people, working from home, teleworking, and online or internet discussions and meetings are now normal practices. Food industry personnel, however, do not have the opportunity to work from home and are required to continue in their usual workplaces. Keeping all workers in the food production and supply chains healthy and safe is critical to surviving the current pandemic [9, 10].

Livelihoods encompass people's capabilities, assets, income and activities required to secure the necessities of life. However, the shocks and stresses of the recent COVID-19 pandemic may not only diminish the well-being and livelihoods of people, but also undermined the social fabric, the market and food security on which life depends [11]. As WHO suggested, the outbreak of the COVID-19 has had serious impacts on the livelihoods of households. This virus disease is highly infested [10] and so it is effect on the food security. Nevertheless, the current problems are so severe and diverse that millions of people in developing countries are suffering from food shortages and die of their predicaments. The household food insecurity is one of the major public health problems in both developing and developed nations [5]. The impact of the COVID-19 pandemic on food insecurity and poor health outcomes is complex, multilevel, and bidirectional. In this brief, we explore the impact of COVID-19 on hose hold food insecurity.

At different time, many scholars around the world have done on the area (food security status). But what makes unique this study was it considers the currently worldwide pandemic (COVID-19) effect on food security. In addition, there is no previous work on the subject area at household level – Yeki District household, southwest Ethiopia. Considering this pandemic disease, the study attempted to investigate the impact currently occurred COVID-19 pandemic and related social-economic factors influencing food security in Yeki District of Southern Ethiopia at the household level. The benefits hoped to be obtained from this study would be identified the best data sources for assessing and monitoring the impacts of COVID-19 on food security. In addition, documenting and disseminating this evidence will be key to implementing the most appropriate and effective interventions in the face of this pandemic. This study enables to address the basic information on the status of food insecurity during COVID-19 pandemic in the Yeki District.

2. Methods

2.1. Study Area

This study was conducted in sheka zone, one of the 13 zones in Southern Nations Nationalities and Peoples Region (SNNPR). The capital of the zone, Masha, is located 951 km to Northwest of Hawassa, the capital of SNNPR and 676km to Southwest of Addis Ababa. Sheka is bordered on the south by Benchi Sheko, the west by the Gambela Region, on the North Oromia region, and the east by Keffa zone administratively [12].

Yeki is one of the Districts as in the Southern Nations Nationalities and Peoples' Region of Ethiopia. It is bordered on the south by the Bench Maji Zone, on the west by the Gambela Region, on the north by Anderacha, and on the east by the Keffa Zone. Based on the 2007 Census conducted by the CSA (Central Statistical Agency) [7], this District has a total population of 134,519, of whom 68,895 are men and 65,624 women; 24,829 or 18.46% of its population are urban dwellers.

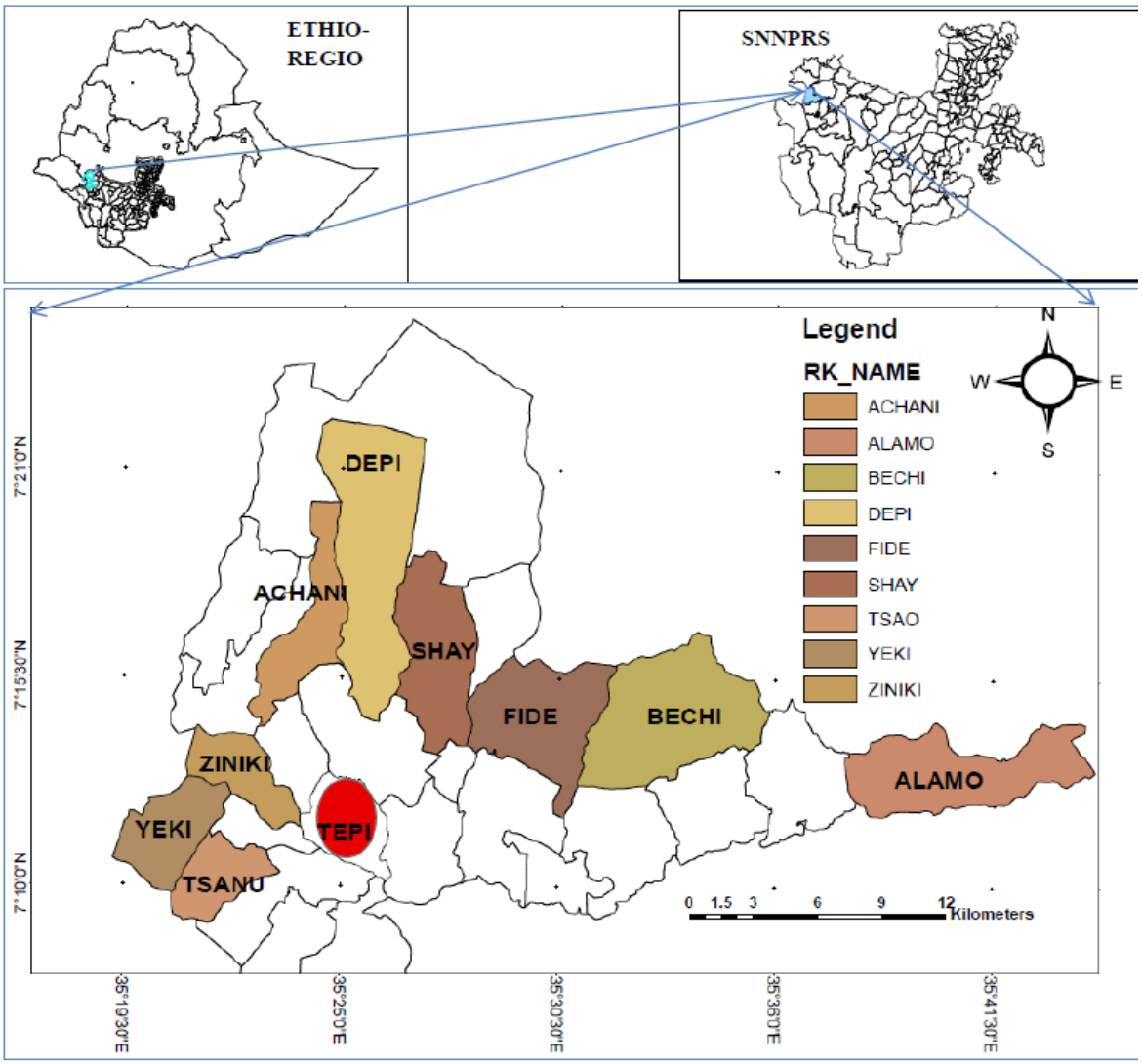

Figure 1. *Study Area: The Map of Yeki District Localities.*

2.2. Study Design

A community based cross-sectional study was carried out to investigate the impact of Corona Virus (COVID-19) on Household Food security in Yeki District of Sheka Zone at the same point in time.

2.3. Sampling Method

A multistage sampling technique was used for this study; where first Sheka Zone was selected purposively, and second Yeki District was selected to address food security status. Then at the third step, 10 Kebeles (locality) were selected by using simple random sampling followed by probability proportional to size. A total of 424 households were selected from 10 localities of the Yeki District. All the respondents were selected on the basis proportionality to the size of each locality.

A well-structured self-administer questionnaire was developed and adopted for this study to gather relevant information from the respondents and address the objectives of the study. The major respondents for this study were the head of households as we have adopted from previous studies of the same issue - Like: (Aragie and Genanu, 2017, Misgina and development, 2014, Tadesse Tantu et al., 2017). The interviewer was taken three-day training by the investigator on interviewing techniques, observational ways, cross-checking methods, and data recording to obtain better information for the problem under study. The supervision of the survey during data collection was also take-over by the researchers of the study.

2.4. Study Variables

The Household Food Insecurity Access Scale (HFIAS) questionnaire consists of nine occurrence questions that represent a generally increasing level of severity of food insecurity (access), and nine “frequency-of-occurrence” questions [At Appendix].

First, respondents are asked if they've experienced the condition at all in the last four weeks (a simple "yes" or "no" question). If they answer "yes," they're then asked how often it happened—whether rarely (once or twice), sometimes (three to ten times), or often (more than ten times) during that period, and it's is skipped if the respondent answered "No" [2].

According to Jennifer's, the household food insecurity access scale (HFIAS) is categorized as four. Food Secure, Mildly Food Insecure Access, Moderately Food Insecure Access and Severely Food Insecure Access [2]. In this study we made a little bit of modification, in which, we merge into two categories (having binary outcome). Hence: "Food Secure and Mildly Food Insecure Access" is considered as food Secure; "Moderately Food Insecure Access and Severely Food Insecure Access: is taken as food insecure.

Therefore, based on [2] a household is classified as food secure if the frequency of occurrence question response code for each question: (See the appendix)

$$Q1a = \{0,1,2,3\}$$
$$Q2a = \{0,1,2,3\}$$
$$Q3a = \{0,1\}$$
$$Q4a = \{0,1\}$$
$$and\ all\ others: Q5 = Q6 = Q7 = Q8 = Q9 = 0$$

Note that: the sum of the above the frequency of occurrence question response code is found to be $minimum = 0$ and $maximum = 9$.

And, a household is classified as food insecure if the sum of the frequency of occurrence question response code is greater than or equal to 9, to the maximum it can be 27 (when all of the occurrence question response code takes 3 ('often' happen the situation). This way of categorization is done by using Microsoft Excel and SPSS version 22.

2.5. Dependent Variable and Independent Variables

The dependent variable for this study was the household food security status categorized as "there is food insecurity" and "there is food Security".

$$Y_i = \begin{cases} Yes(1), if\ there\ is\ food\ insecurity \\ No(0), if\ food\ security\ is\ assured \end{cases} \quad (1)$$

The independent variables are the gender of household head, family size, and education level of household head, Source of household income, lockdown affected consumption, government feedback for COVID-19, commodity price change and social distancing affected socio-economic activity. Also closure of rural market, and farm place expose to flooding, difficulties to access market commodities, exposed to extra expense due to the pandemic, transport restriction affected household income are some of the independent variables.

2.6. Binary Logistic Regression

This study was employed the logit model following the footstep of many researchers and others. The dependent variable is food insecurity status is a binary outcome variable that took value of '1' if a household was found to be food insecure, '0' if a household attained food security. Hence, this study specifically applied a binary logistic regression model. In binary regression models, the 'odds of success' simply means the chance of success compared to the chance of failure. Mathematically, it's the probability of success divided by the probability of failure [13].

Let π be the probability of success, the odds of success is given by [14]:

$$\pi/(1-\pi).$$

Let Y is a dichotomous response variable of food insecurity status with categories '1' for food insecure and '0' for food secured. Imagine we have k independent variables - we can group these together and represent them as a single vector X' where, $X' = (X_1, X_2, \dots, X_p)$. The conditional probability of attribute of interest (response variable) is represented by $P(Y = 1/X) = \pi$, and it is written as equation (2) below:

$$P(Y = 1/X) = \pi(x) = \frac{e^{(\beta_0+\beta_1x_1+\beta_2x_2+\cdots+\beta_px_p)}}{1+e^{(\beta_0+\beta_1x_1+\beta_2x_2+\cdots+\beta_px_p)}} \quad (2)$$

Where, β_0 is the constant term of the model and β_i is the coefficient of the i^{th} explanatory variable. Then, the logit regression model for binary outcome variable is:

$$logit(\pi(x)) = \log\left(\frac{\pi(x)}{1-\pi(x)}\right) = \beta_0 + \beta_1x_1 + \beta_2x_2 + \cdots + \beta_px_p \quad (3)$$

For this study the variable selection process began with a univariate analysis of each independent variable. Univariate binary logistic regression and likelihood ratio (LR) chi-square tests are used to determine whether a systematic relation or association between each variable with the response variable exists are made before the final model was fitted. Thereby, a univariate binary logistic regression and a likelihood ratio (LR) chi-square test were employed to examine the importance of each explanatory variable to the response variable.

The study used a forward stepwise selection method (based on likelihood ratios) to determine which explanatory variables significantly affected households' food insecurity status (response variable.

For a set of sample data having n observations $(y_i, x_i), i = 1, 2, \dots, n$; where, y_i is a dichotomous response variable and x_i is the value of the i^{th} explanatory variable. Then, the likelihood function which maximizes the unknown

parameter $\beta' = \beta_0, \beta_1, \beta_2, \ldots, \beta_p$ is:

$$C = L(\beta) = \prod_{i=1}^{n}[\pi^{y_i}(1-\pi)^{1-y_i}]$$

$$= \prod_{i=1}^{n}\left(\frac{\pi}{1-\pi}\right)^{y_i}(1-\pi) \quad (4)$$

Then, taking the natural logarithm of both sides gives the following expression for log likelihood function which maximizes the estimate of parameter β and the software provides the ultimate result by using the Newton Raphson iteration technique.

$$C = L(\beta) = \prod_{i=1}^{n}\frac{e^{y_i\beta x_i'}}{1+e^{y_i\beta x_i'}} \quad (5)$$

The Wald statistic in binary logistic regression is used to test the significance of individual predictors (variables). It is calculated as the square of the ratio of the coefficient estimate (β) to its standard error (S.e), i.e., $Wald = \left(\frac{\beta}{S.e}\right)^2$, the Wald statistic follows a chi-square distribution with 1 degree of freedom (df) for each predictor. The 95% confidence interval for Exp(β) is constructed by $(e^{\beta-1.96*S.e}, e^{\beta+1.96*S.e})$. The interval which doesn't include 1 is statistically significant [15].

3. Results and Discussion

3.1. Socio-Demographic Characteristics

This empirical study included a total of 424 respondents, the main respondent for the study was the household head, where 291 (68.6%) were male and 133 (31.4%) were having a female heads of the household. As of educational background, the majority of the respondents 152 (35.8%) had Primary school, and 20 (4.71%) of the household head had 1st degree & above. In the same manner, about 75.2% (319) of the household heads exerted farming as the main source of household income. Few of the respondents have practiced animal rearing (7.3%), trade (9.4%) and others (8%).

Table 1. *Demographic Profile of Respondents in Yeki District - Southwest (SW) Ethiopia, 2020.*

Variable Name	Category	Count (frequency)	Percentage (%)
Gender of HH Head	Male	291	68.6%
	Female	133	31.4%
Education Level of Head of HH	Illiterate	117	27.6%
	Primary school	152	35.8%
	Secondary School	97	22.9%
	Diploma	38	8.96%
	1st Degree & Above	20	4.71%
Source of HH Income	Farming	319	75.2%
	Animal Rearing	31	7.3%
	Trade	40	9.4%
	Others	34	8%
Family Size (in Number)	Max: 16 / Min: 1 / Mean: 5.58 / Standard deviation: 2.15		

The above Table 1 also showed that the average family size was six persons, which is important for generating a labor supply, the vital factor for agricultural production, especially in those poor developing countries. The standard deviation statistic for family size is found to be 2.15.

Table 2. *The Occurrence of the Household Food Security Assessment Tool (HFIAS) Conditions among Survey Participants in Yeki District, Southwest Ethiopia, 2020.*

HFIAS Indicators	Responses			
	Yes		No	
	Count (Freq.)	Percentage (%)	Count (Freq.)	Percentage (%)
Worry about not having enough food	292	68.9%	132	31.1%
Unable to eat preferred food	281	66.3%	143	33.7%
Eat just a few kinds of food	309	72.9%	115	27.1%
Eat food really do not want	196	46.2%	228	53.8%
Eat smaller amounts in meal	240	56.6%	184	43.4%
Eat fewer meals in a day	181	42.7%	243	57.3
No food of any kind in household	109	25.7%	315	74.3%
Go to sleep hungry at night	92	21.7	332	78.3%
Go a whole day and night without food	57	13.4%	367	86.6%

Table 2 showed that 292 (68.9%) households worried about food inaccessibility and 281 (66.3%) households were unable to eat the kinds of food they preferred due to lack of resources. Moreover, about 309 (72.9%) households reported that they did not consume a variety of food they preferred, 196 (46.2%) ate unwanted food, 240 (56.6%) ate a small amount of a meal. The proportion of households who experienced lack of food to eat was 109 (25.7%) and going to bed without eating was 57 (13.4%) households.

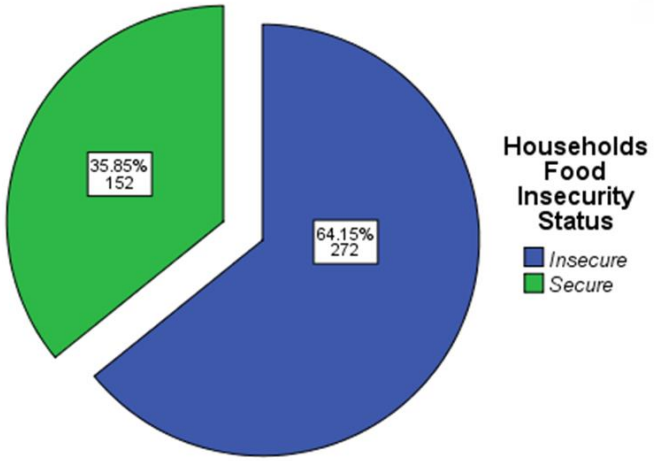

Figure 2. *The Prevalence of Food Insecurity (FI) Status in Yeki District Households, southwest Ethiopia, 2020.*

The current status of household food insecurity in the Yeki District is depicted in Figure 2 above. From this, of 424 households 272 (64.15%) were expose to food insecurity and 152 (35.85%) households were maintained their food need in the study area during the current situation. The prevalence rate is the ratio of the proportion of the insecure households over the proportion with the secure households [16].

Table 3. *Awareness about Corona Virus (COVID-19).*

Variable Name	Category	Count (Frequency)	Percentage (%)
Heard about Corona (COVID-19)	No	65	15.3%
	Yes	359	84.7%
[---Source]	Radio (FM)	207	48.8%
	Social Media	42	9.9%
	Friend (Neighbor)	54	12.7%
	Family Member	43	10.1%
	Other	13	3.1%
Listen Radio (FM) per week	Rarely	136	32.1%
	Sometimes	177	41.7%
	Often	111	26.2%
Know Disastrous of Corona Virus	No	59	13.9%
	Yes	365	86.1%
	I don't know	22	5.2%
N^{o} of Days without showing Sign of COVID-19	2-7 days	116	27.4%
	2-14 days	133	31.4%
	7-17 days	26	6.1%
	7-21 days	127	30.0%
COVID_19 can Transmit from person-to-person	No	18	4.2%
	Yes	361	85.1%
	I don't know	45	10.6%
Vaccine for Covid-19	No	229	54%
	Yes	53	12.5%
	I don't know	142	33.5%
Uncooked Meat could Transmit COVID-19	No	84	19.8%
	Yes	214	50.5%
	I don't know	126	29.7%
Social distancing could minimize the spread of Corona Virus	No	14	3.3%
	Yes	356	84.0%
	I Don't Know	54	12.7%
A Person can be Recovered from COVID once S/he Affected with it	No	102	24.1%
	Yes	302	71.2%
	I Don't Know	20	4.7%

Table 3 showed that, out of 424 households surveyed 359 (84.7%) households were heard about coronal virus (COVID_19). From this, 207 (48.8%) of the respondents were reported as they head from Radio (FM).

Among the respondents', 359 (86.1%) have known the disastrous of the currently occurred COVID-19 pandemic, but few of them, 59 (13.9%) did not know about its disastrous. 22 (5.2%) of the respondents were not know when the sign of the virus starts to appeal once after someone is infected with it. While assessing the awareness of the pandemic, of the total

424 respondents, 361 (85.1%) of them have known that the virus can transmit from one person to another (Table 3).

Table 4. *Corona Virus (COVID-19) Raised and Related Factors for FI Status in Yeki District Households, Southwest Ethiopia, 2020.*

Variable Name	Category	Count (Frequency)	Percentage (%)
The Lockdown affected Consumption	No	82	19.3%
	Yes	342	80.7%
Satisfied with government feedback for Corona Virus	No	227	53.5%
	Yes	197	46.5%
Change on Commodity Food Price	No	38	9.0%
	Yes	386	91.0%
Social Distancing effect Socio-Economic activity	No	71	16.7%
	Yes	353	83.3%
Closure of Rural Food and Livestock Market	No	281	66.3%
	Yes	143	33.7%
Farming Place have Exposed to Flooding	No	204	48.1%
	Yes	220	51.9%
Difficulties to access for Market Commodities (Salt, onion & oil)	No	61	14.4%
	Yes	363	85.6%
Extra Expense after COVID-19	No	50	11.8%
	Yes	374	88.2%
Transport Restriction Affect HH income	No	56	13.2%
	Yes	368	86.8%
Farm Inputs (DAP & Urea) are Ready	No	195	46.0%
	Yes	229	54.0%
Meet Food Needs with the Current Savings (Food Stock)	Less than a week	84	19.8%
	7-14 Days	112	26.4%
	15-30 Days	129	30.4%
	More than a month	99	23.3%
Labor Shortages have impacted on Harvesting & Field Preparation	No	200	47.2%
	Yes	224	52.8%

Regarding to lockdown (movement restriction) it affected consumption rate which is assumed to influence household food security accounts 342 (80.7%). Similarly, there are 224 (52.8%) of households sampled who were found that the labor shortage has impacted their harvesting and field preparation. by government feedback for the pandemic COVID -19 and the remaining 197 (46.5%) responded that not satisfied the government feedback against COVID-19. From the total respondents 91% (386) agreed with change in commodity food price due to COVID-19 and the remaining didn't agree the change in commodity food price. Social distancing affected 83.3% (383) of respondent's socioeconomic activity and on the other hand 16.7% (71) respondents didn't affect their socio-economic activity by COVID-19. Due to the recommendation of the ministry of health (MoH) staying at home there is a shutdown of local livestock and food markets in rural areas. From total respondents 33.7% (143) agreed on the implementation, and the rest two-third of respondents, 66.3% (281) said that their local food and animal markets had not shutdown. From total respondents 51.9% (220) responded farming lands

exposed to flooding and the remaining 48.1% (204) responded farming lands didn't expose to flooding. The other event due to COVID-19 difficulties to access for market commodities and from total respondent 85.6% (363) got difficulties to access market commodities like oil, onion, salt etc. and remaining 14.4% (61) didn't get difficulties for market commodities.

From total respondents, 88.2% (374) have been exposed to extra expense due to COVID-19 and 11.8% (50) responded don't get extra expense. Transport restriction affected their house hold income 86.8% (368) and the remaining 13.2% (56) didn't affect the hose hold income. Farm inputs like DAP and Urea were not ready for 46% (195) of the total respondents and were ready for 54% (229) from total respondents. Currently respondent's saving for current use from stock indicated less than a week is 19.8% (84), 7-14 days 26.4% (112), 15-30 days 30.4% (129) and more than a month is 23.3% (99). From total respondents 52.8% (224) got labor shortage and impacted on crop harvesting and field preparation, the remaining 47.2% (200) didn't get labor shortage for crop harvesting and field preparation.

To understand which factors were linked to household food insecurity, the study used a binary logistic regression model. The researchers also measured how well all the predictors together explained food insecurity status using Nagelkerke's R^2 (as shown in the model summary) [17].

3.2. Binary Logistic Regression Analysis

A regression analysis type adopted in this study is binary logistic regression, which would allow identifying the specific impact of predictors on outcome variable while accounting for other influencing factors. Therefore, it is important of carrying out a statistical analysis that could incorporate more than a single explanatory variable.

As it is presented under table 8 below, for the education level of head of household - primary school, diploma and 1st degree and above; for the source of household income - trade and animal rearing; lockdown (movement restriction); rises in commodity food price; social distancing; land exposed to flooding; extra expense after COVID_19; for meeting food need with current saving (food stock) - all categories (7-14 days, 15-30 days and more than a month) were responsible for the current status household food insecurity. Thereby, those explanatory variables were found to be the significant determinants of household food insecurity in Yeki District, Southwest Ethiopia.

Table 5. *Model Summary.*

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	264.906[a]	.748	.824

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Dependent Variable Encoding	
Original Value	**Internal Value**
Secure	0
Insecure	1

In logistic regression to evaluate how well the model fits the data, the likelihood ratio test is applicable. This test compares two models: a basic null model (with just an intercept) and the full model with all predictors. The difference in their fit follows a chi-square distribution [18]. From the Model Summary, the value of -2 Log Likelihood statistic is 264.906. This statistic measures how the model predicts the household food security in insecure status. The binary response variable was coded as 0 – food secure and 1 – food insecure.

Logistic regression uses pseudo-R^2 statistics (Cox and Snell, Nagelkerke) that parallel linear regression's R^2 in concept, though with important differences [19]. These provide estimated measures of model fit, reported in the summary from the logit model. The result under Table 5 revealed that 74.8% of the variance in the dependent variable was explained by the predictor, representing a substantial effect size.

Table 6. *Goodness-of-Fit Test Results (Hosmer-Lemeshow).*

Step	Chi-square	Df	Sig.
1	6.343	8	.609

As it is observed from the table above (Table 6), the Hosmer and Lemeshow test result revealed a chi-square statistic of 6.343 (p = 0.609), which is not statistically significant at the 5% level. This indicates a model fits the data well, with no meaningful difference between the observed outcomes and the model's predictions.

Table 7. *Classification Table of Food Insecurity (FI) Status.*

Observed			Predicted Food Insecurity Status of Households		Percentage Correct
			Secure	Insecure	
Step 1	Food Insecurity Status of Households	Secure	231	39	85.6
		Insecure	76	75	49.7
	Overall Percentage				72.7

a. The cut value is .500

A classification table is used to show how reliable the model's predictions are. This can be checked by sensitivity (how good the model is at correctly identifying when events will happen and specificity (how good it is at correctly identifying when events won't happen) [14]. Thus, as it is observed in table 7 above, 85.6% of households who were maintained their food need was correctly classified, whereas 49.7% of households who were exposed to food insecurity had accurate predictions. Across all cases, the correct prediction rate was found to be 72.7%. It is obtained as the ratio of true positive (=231) + true negative (=76) and total (=421).

Therefore, the final binary logistic regression model with the significant explanatory variables can be written as follows:

$$logit\,[p(FI = 1/x)] = -2.533 - 1.911X_{11} - 1.09X_{12} - 1.201X_{13} + 1.50X_{21} - 1.199X_{22} + 1.260X_3 + 1.10X_4 + 0.90X_5 + 1.502X_6 + 0.691X_7 - 0.992X_{81} - 0.708X_{82} - 1.337X_{83} + 1.01X_9 \quad (6)$$

Where, FI – is food insecurity status; x's are explanatory variables – specifically, X_{11} – secondary school education level of household head, $X_{12}\ and\ X_{13}$ are for diploma and 1st degree and above certified household heads respectively; $X_{21}\ and\ X_{22}$ indicated the main source of household income for trade and animal rearing respectively; X_3 – lockdown effect on consumption; X_4 – is risen in commodity food price; X_5 – Social distancing; X_6 – is the household exposed to extra expense. X_7 denotes transport restriction effect on household income And, $X_{81}, X_{82}, and\ X_{83}$ denoted the household meet food need for about 7-14 days, 15-30 days and more than a month with their current saving (food stock) respectively and X_9 denotes labor shortage for field preparation and harvesting.

From the above equation [6] one can infer the following: Often it is easier to interpret the effects of explanatory factors in terms of adjusted odds ratios (AOR), where $AOR = e^{\beta}$ than the parameters β [20]. The 95% confidence interval is constructed for Exp(β).

The education level of head of the household was a significant determinant factor for the current status of household food insecurity. A household head completed his/her secondary school was 0.148 times less likely to be exposed for food insecurity than illiterate household heads (AOR= 0.148: 95% CI= 0.093 – 0.236), A household head who acquired his/her diploma was 0.333 times less likely to be exposed for food insecurity than illiterate household heads (AOR= 0.333: 95% CI= 0.177 – 0.654). Similarly, a household head who graduated with a 1st degree and above was 0.301 times less likely to be exposed for food insecurity than illiterate household heads (AOR= 0.301: 95% CI= 0.250 – 0.650), keeping other variables in the model constant.

Source of household income was another significant determinant factor for food insecurity, a household whose income is generated from trade was 4.482 times more likely to be exposed for food insecurity than those households' income mainly depends on farming practice (AOR= 4.482: 95% CI = 0.30 – 0.70).

Households relying on animal rearing for income were 0.302 (about 70%) less likely to face food insecurity compared to those depending solely on farming (adjusted odds ratio [AOR] = 0.302; 95% confidence interval: 1.51- 4.01), after accounting for other factors.

According to the results from the study, social distancing and restriction on socio-economic interaction have influenced the food insecurity status of households. During the last four weeks, social distancing & restriction on socio-economic intersection had 2.460 X greater likelihood to exposed for nourishment insecurity than the previous normal situation or before the occurrence of corona virus (AOR= 2.460: 95% CI=

1.30 – 3.50). A risen in commodity food price has also impacted household food security, during the last four weeks, a risen food price was 3.01 times more likely to be exposed for food insecurity of a household than the previous commodity food price (AOR= 3.01: 95% CI= 1.840 – 4.904), once keeping other factors constant.

When after the outbreak of novel corona virus, the household those expended extra money (expense) was 4.491 times more likely to be exposed for food insecurity than household that didn't have extra expense during the last four weeks (AOR= 4.491: 95% CI= 2.460 – 8.17), after kept other variables constant.

The current saving (food stock) was also one of the main determinant factors for the household food insecurity status in Yeki District. A household those who could maintain their food need for 7-14 days with the current saving (food stock) was 0.371 times less likely to be exposed for food insecurity than those of households who could sustain their food need for less than a week with the current saving (AOR= 0.371: 95% CI= 0.191 – 0.721), once keeping other variables constant. The household who could assure their food need for about 15-30 days was 0.493 times less likely to exposed for food insecurity than those of households who met their food need for less than a week with the current saving (AOR= 0.493: 95% CI= 0.263 – 0.923), after other variables were kept constant.

Similarly, households who could able to satisfied their food need for more than a month was 0.263 times less likely to exposed for food insecurity than those of households who couldn't able to maintain their food need for more than a week with the current saving or food stock (AOR= 0.263: 95% CI= 0.126 – 0.547), under the consideration of keeping other variables unchanged.

While assessing the effect of labor shortage in the time of harvesting and field preparation, it is found to be a significant explanatory variable. Hence, during the last four weeks, a household that have had labor shortage was 2.750 X greater likelihood to exposed for nourishment insecurity compared to households that had not labor shortage in their harvesting & field preparation time (AOR= 2.750: 95% CI= 2.046 – 3.684), under the consideration of keeping other variables in the model constant (unchanged).

Table 8. *Variable in the Equation.*

List of Explanatory variables		B	S.E.	Wald	df	Sig.	95% C.I. for Exp(B)	
							Lower	Upper
Step 1[a]	Gender (Male)	-.051	.255	.041	1	.840	.577	1.565
	Family Size (in Number)	0.104	0.056	3.390	1	.066	0.993	1.240
	Head of household education Level (Ref* - illiterate)			5.063	3	.001		
	Secondary school graduate	-1.911	0.239	63.933	1	.000	0.093	0.236
	Diploma Graduate	-1.099	0.344	10.206	1	.001	0.177	0.654
	1st degree and above graduate	-1.201	0.30	16.0	1	.000	0.25	0.65
	Source of HH – income (Ref* - Farming)			15.224	3	.001		
	Trade	1.50	0.35	18.4	1	.001	0.30	0.70
	Animal Rearing	-1.199	0.301	15.87	1	.002	1.51	4.01
	Other	.499	.444	1.263	1	.261	.690	3.932
	Consumption is affected due to lockdown (Yes)	1.260	.400	9.945	1	.002	1.611	7.720
	Government feedback for COVID- 19 (Yes)	-.088	.239	.137	1	.711	.573	1.462
	Commodity Food Price After Corona virus (Yes)	1.10	0.25	19.36	1	.003	1.840	4.904
	Effect of Social Distancing Socioeconomic Activity (Yes)	0.90	0.201	20.31	1	.0.01	1.30	3.50
	Closure of Rural Market (Yes)	.422	.252	2.803	1	.094	.930	2.499
	Land Exposed to Flooding (Yes)	.303	.290	1.090	1	.296	.767	2.391
	Difficulties to access for market commodities (Yes)	-.043	.387	.013	1	.911	.449	2.044
	Exposed to Extra Expense After COVID_19 (Yes)	1.502	0.321	24.9	1	.001	2.46	8.17

List of Explanatory variables	B	S.E.	Wald	df	Sig.	95% C.I. for Exp(B)	
						Lower	Upper
HH Income Due to Transport Restriction (Yes)	0.691	0.109	40.20	1	.041	1.59	2.48
Farm inputs ready timely (Yes)	-.068	.245	.076	1	.782	.578	1.511
Meet Food needs with Current Savings (Less than a week –Ref*)			14.493	3	.002		
7-14 Days	-.992	.339	8.536	1	.003	.191	.721
15-30 Days	-.708	.320	4.891	1	.027	.263	.923
More than a month	-1.337	.374	12.745	1	.000	.126	.547
Labor Shortage on Field Preparation (Yes)	1.01	0.15	45.34	1	.002	2.046	3.684
Constant	-2.533	.788	10.322	1	.001		

4. Discussion

This study analyzed the impact of COVID-19 and associated factors on household food insecurity after movement restrictions were implemented by the Ethiopian ministry of health and the Government for addressing the impact according to policies implemented by the Ministry of Ethiopian health.

Our study revealed that the source of household income was a factor for food insecurity. Food insecurity crises are often due to declines in agricultural food production. Fitzgerald and fellow researcher showed that Epizootic pandemics, such as avian flu, directly reduced animal-sourced food output [21], However COVID-19 is likely different. The pandemic is disrupting resource chains at all levels, and causing instability in food supply and food prices [22]. This study indicated that the respondents whose source of household income by trade and animal rearing are more exposed to food insecurity as compared to farming was their source of income during the investigation period. The result is supported by the idea of world food program stated as People owning businesses or engaged in casual labor or petty trade appear most impacted [23]. A serious implication of agricultural decline is reduced food security, not only for families involved directly in agriculture but also for urban populations reliant on purchasing food.

A majority of surveyed farm households maintained ongoing agricultural activities during the research period. The respondents reported that their agricultural production had decreased during the pandemic, compared to their previous year's production (i.e., before the outbreak). Interestingly, farm families in both COVID-19 affected and unaffected areas reported similar levels of reduced crop yields the difference was not statistically meaningful. The result suggested that most of the societies living in the district are rural and the basic source of the house hold income is agriculture. Among the study area about 72.2% of the population lives on the basis of agriculture. Our finding is supported by Kubatko's and fellow researchers insight which stated that corona virus is already impacting food systems through immediate supply-demand effects and secondary reductions in economic access and production/distribution capabilities as well as agricultural system [24]. The authors Amusan and Agunyai stated, Farmers producing agricultural products have lost access to markets, due to movement restrictions agricultural inputs are trapped and access to farmlands is limited [25].

The present study indicated that the majority of the households were exposed to food insecurity. From the above result most of the respondents did not consume varieties of food and eat a small amount of meals for four months. This result is supported by [26] that Ethiopia is highly food-insecure, with 54 percent of the population (52 million people) consuming less than 2,100 calories a day. Additionally, Moges and Melkamu predicted that food prices increased because of supply shocks and the prior food insecurity coupled with the current COVID-19 can immensely increase the vulnerable population in Ethiopia [27]. The United Nation's Framework for the Immediate Socioeconomic response reported that the virus would most likely increase poverty, food insecurity (FINS), and inequalities on a global scale [28].

In Ethiopia awareness creation about the pandemic disease was given by different stockholders and government organizations. Across surveyed communities, the predominant share of households almost knew about the pandemic disease (COVID-19). But some of the respondents were not have any information about the disease and means of transmission.

According to the study, social distancing, restriction on socio-economic interaction, and rise in commodity food prices have influenced on food insecurity status of households (AOR= 2.460: 95% CI= 1.30 – 3.50; and AOR= 3.01: 95% CI = 1.840 – 4.904) respectively. This result is supported by

World's food program scheme stated that COVID-19 has caused widespread disruption to livelihood food security, driven primarily by movement restrictions, social distancing, raise in commodity food price and concerns about leaving the house. Some authors such as Teachout and Zipfel suggested restriction on socio-economic interaction could potentially decimate savings of about 30% of the population in Sub-Saharan Africa while an additional 9.1% have immediately fallen into extreme poverty [29]. Elsahoryi and fellow researchers indicated that COVID-19 and its follow-up quarantine period (restriction on socio-economic interaction) have a tangible impact on food security levels for the populations [30]. Those authors also showed that compulsory mobility restriction mandates demonstrate superior efficacy for pandemic transmission. A World Bank high-frequency survey of firms in Addis Ababa demonstrated that movement restriction and other restrictions of socioeconomic interaction impacted business activity in all sectors through significant falls in demand for products and services [31].

Food stock was another factor for household food insecurity status in the study area. A household that could maintain their food need for 7-14 days with the current saving was more exposed for food insecurity. In line with this households who could assure their food need for about 15-30 also exposed for food insecurity. Similarly, households who could able to satisfy their food need for more than a month were showing food insecurity. In a general sense the respondent families meet food needs with the current savings for more than one month was highly food secure than the rest. COVID-19 pandemic risks further escalating the food insecurity, with likely significant rises in humanitarian needs [32].

The labor shortage was another factor in which the pandemic leads to household food insecurity. Therefore, during the last four weeks, a household who have had a labor shortage within the selected participant pool was at risk of food insecurity than those who hadn't labor shortage in their harvesting & field preparation time. Larue showed that during the pandemic in the agriculture and food sector, several hundred thousand restaurant workers have lost their jobs. Hence, the rise in unemployment, the closing of restaurants and schools, and social distancing have triggered demand reductions for certain commodities and foods and demand increases for others, bringing along changes in demand for inputs including labor [33]. Due to widespread labor shortages, a significant impact of these lockdowns in different parts of the world will be on food-related activities such as the timely seasonal production and movement of raw agricultural and livestock products mostly in the areas which are intensive in food production and depend on agriculture labor [34].

One of the short-term effects of COVID-19 is the shortage of labor due to restriction of movement to contain the pandemic [25]. The agriculture labor force shortage in the anxiety of the disease could significantly affect the production of crops and livestock in Ethiopia. Such restriction of movement impedes many laborers not to move to their places of work or carry out their jobs in the Central Rift Valley of Ethiopia, where most vegetable production occurs, labor is becoming scarce [25].

5. Conclusion

The foregoing analysis attempted to analyze the determinants of household food insecurity in the Yeki District, Southwest Ethiopia. First, an attempt has been made to describe the socio-economic characteristics of the food insecure and food secure sample household groups by using descriptive statistics. Second, to classify the household food insecurity status, nine occurrence questions have been included in the survey. Then, based on the nationally accepted standard of the study, the food insecurity (FI) status is categorized as secure and insecure.

Finally, an attempt has been made to identify factors that determine the household food insecurity status using binary logit regression model. This paper explored the consequences of COVID-19 and related factors for household incomes and food security in the Yeki District. Findings indicated a decline in food security among respondents in the district during the COVID-19 period relative to the pre-pandemic period.

A binary logit model was utilized to address the core objectives of the study. Among the selected predictors; source of house hold income, education level and food stock were the significant factors for predicting the outcome the household food insecurity status in the Yeki District of Southwest Ethiopia. On the other hand, closure of the rural market, gender, family size, government feedback about the pandemic and transport restriction didn't have a significant effect on the household food insecurity in the Yeki District of Southwest Ethiopia. Based on the results obtained from the study, the following recommendations were made:

1. A lot should be done to prevent food insecurity by doing Promoting income generation and food security, increasing access to health services, and Participation in economic activities before and after COVID-19.
2. The stalk holders should be scaling up the effectiveness of the national COVID-19 response.
3. To tackle the concerns highlighted in this research, future studies should explore more factors that could influence the results.
4. As unemployment rises, many families are struggling to afford enough food or maintain a balanced diet. Stronger social safety nets are essential to support those without jobs and prevent food insecurity, especially for the most vulnerable.
5. The concerned bodies should focus first on supporting local food production this will help keep food supplies steady while making seeds, tools, and funding easier for farmers to access.
6. Workers who have lost their livelihoods because of the outbreak need access to job support services. Getting people back to earning is critical - when paychecks disappear, families often struggle to put food on the table.

7. The government should be correctly issued guidelines that exempt farm operations and supply chains. But implementation problems leading to labor shortages and falling prices should be rectified.

Abbreviations

AOR	Adjusted Odds Ratio
CI	Confidence Interval
COVID-19	Coronavirus Disease of 2019
CSA	Central Statistical Agency
Df	Degree of Freedom
FI	Food Insecurity
HFIAS	Household Food Insecurity Access Scale
HH	Household(s)
LR	Likelihood Ratio
MoH	Ministry of Health
SNNPR	Southern Nations Nationalities and Peoples Region
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

Author Contributions

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Conflicts of Interest

The authors declare no conflicts of interest.

Appendix

Table A1. *The household Food Insecurity Access Scale (HFIAS) Measurement Tool [1].*

N^{o}	Question	Response Outputs	Code
1.	In the past four weeks, did you worry that your household would not have enough food?	0 = No (skip to Q2) 1=Yes	_____
1a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	_____
2.	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	0 = No (skip to Q3) 1=Yes	_____
2a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	_____
3.	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q4) 1=Yes	_____
3a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	_____
4.	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	0 = No (skip to Q5) 1=Yes	_____
4a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks)	_____

N°	Question	Response Outputs	Code
		2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
5.	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0 = No (skip to Q6) 1=Yes	_____
5a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	_____
6.	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	0 = No (skip to Q7) 1=Yes	_____
6a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	_____
7.	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	0 = No (skip to Q8) 1=Yes	_____
7a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	_____
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0 = No (skip to Q9) 1=Yes	_____
8a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	_____
9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	0 = No (questionnaire is finished) 1=Yes	_____
9a.	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	_____

Source: [2]

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