**INDONESIAN JOURNAL OF SOCIAL AND ENVIRONMENTAL ISSUES (IJSEI)**
Journal Homepage: https://ojs.literacyinstitute.org/index.php/ijsei
ISSN: 2722-1369 (Online)
**Research Article**

| Volume 3 | Issue 2 | August (2022) | DOI: 10.47540/ijsei.v3i2.604 | Page: 135 – 145 |
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# Evidence Regarding Ethiopia's Import-Export of Mushrooms

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ARTICLE INFO

*Keywords*: Import-Export; Mushroom Productions; Trade Balance.

*Received* : 14 July 2022
*Revised* : 24 August 2022
*Accepted* : 25 August 2022

ABSTRACT

Ethiopia has favorable agro-climate, topography, relatively low-cost labor, and rich fungal biodiversity. However, the country has a poor response to mushroom production and hence, currently, a huge amount of mushrooms is imported to the country. Information on the import-export trends of the mushrooms trade and market is lacking for taking appropriate measures. The study aims to evaluate the current status and future trends as well as prospects of mushroom import export in Ethiopia. The imported-exported data were collected from Ethiopian Custom Commission in the years of 1997 – 2020. The analysis was conducted using descriptive statistical tools and the ARIMA model in excel and STATA, respectively. The result indicates that the average imported and exported quantity is 88.3 and 5.1 tonnes of mushrooms per year, respectively. Similarly, the country spent an average of US$ 154,199 per year on imported mushrooms while it earned an average of US$ 11,074 per year from exported mushrooms, which is a trade deficit. The result further indicated that on average the quantities of mushrooms imported to the country and the expenditure to import increased yearly by 53 % and 44%, respectively. The forecasted result shows that Ethiopia will spend 483,528.3 US$ on mushroom imports in 2040 as indicated in the findings. However, mushroom productions pave the way for national revenue if given serious consideration and will reduce the food import value. Further, it is recommended that the country has to emphasize the expansion of mushrooms to meet the growing demand and substitute the imported mushroom.

## INTRODUCTION

Mushrooms are macrofungi with a form of fungus having distinct fruit bodies produced either above ground or below ground. It can be easily noticed in moist habitats in and around forests, grassland, on tree trunks due to their peculiar appearance (Semwal et al., 2014; Gebretsadkan, 2015; Mutema et al., 2019). Mushrooms grow naturally in the wild or in cultivation and are the most popularly documented edible forest products (Gebretsadkan, 2015; Oguntoye et al., 2022). It is estimated 16,000 identified mushroom species are edible from 7000 of them, with roughly 3000 being excellent eating mushrooms and 700 being considered beneficial therapeutic mushrooms (Chang and Wasser 2017; Li et al.; 2021; Niazi and Hafoor, 2021). It grows on a vast number of substrates and environmental conditions (Semwal, et al., 2014).

The mushroom cultivation practices can raise the economy of the country and can enhance food security with sustainable use of natural resources (Semwal et al., 2014). Edible mushrooms are traditionally collected from the forests but now some are cultivated (Zhang et al. 2014). Wild mushrooms are seasonal, so cultivation guarantees a constant supply to the market all year round. Mushrooms have multiple benefits that include high nutritional value, are used as food supplements, and are grown throughout the year using cheap materials thereby improving food security. Mushrooms have important medicinal values which improve health (SIRDC, 2017). Mushrooms are packed with four key nutrients namely selenium, vitamin D, glutathione, and ergothioneine which help mitigate oxidative stress and prevent different diseases. Moreover, it offers a strong natural

umami flavor, allowing consumers to reduce salt proportion in mushroom meals by 30-40%, thereby benefitting health (Li et al., 2021).

Mushroom production has increased globally by 10 times in the past four decades (Zhang et al. 2014). A gradual increase in world mushroom production had been observed from 2000 to 2007 those production was 26 million tons and it rose to 33.4 million tons in 2007 (Gebretsadkan, 2015). The increase in mushroom output has been attributed to improvement in mushroom biotechnology, expansion of market demand, beneficial effects, the reduced life cycle of mushrooms, high tradability of mushrooms, and low capital investment (Bradley 2013; Raman et al., 2018). Evedences also showed that the global mushroom industry has expanded very rapidly in the last two decades by the addition of newer types of mushrooms for commercial cultivation (Sharma et al., 2017). The global mushroom market size was valued at USD 50.3 billion in 2021 and is expected to expand at a compound annual growth rate (CAGR) of 9.7% from 2022 to 2030. The production, marketing, and economic value of mushrooms are expected to increase globally due to increasing vegetarian population demand, rising health consciousness, penetration of the retail network, expansion of the food processing industry (Amin et al., 2014; Lu et al., 2020; Niego et al., 2021). Because of the increasing mushroom demand, it is expected that the total value of the global mushroom market per annum will exceed USD 50 billion in the coming few years(Raman et al., 2018). The global market value of edible mushrooms is forecasted to reach up to USD 62.19 billion in 2023 (Grand View Research, 2021). Among mushroom products, the medicinal mushroom market size is projected to increase by USD 13.88 billion from 2018 to 2022 (Niego et al., 2021). With such a market growth, mushroom nutraceuticals hold to be very promising in the years to come. By revenue, the global mushroom market was estimated at USD 46,107.9 million in 2020 and is expected to reach USD 95,253.3 million by 2028, growing at a CAGR of 9.5% from 2021 to 2028.

In Africa, mushroom consumption habit in many parts of African countries is well developed (Birhanu and Zerihun, 2012). In Eastern African countries including Ethiopia, productions of edible mushrooms are at a small scale and not satisfying the fast-growing demand locally and by the booming tourist industry (Sileshi, 2014). In Ethiopia, the current demand for fresh mushrooms by hotels and airlines is estimated at 460 tons and being catered mostly through imports because the production is much lower (Sileshi,2014). On the other hand, the global mushroom demand is more than 50 billion USD annually and is increasing every year by about 20%, hence there is also room for export markets. The demand for large-scale production in East Africa is apparent with a huge impact potential (Kivaisi et al., 2010).

In Ethiopia mushroom has been used as food by the inhabitants in Southwestern Ethiopia (Teferi et al., 2013; Semwal et al., 2014). Cultivation and exploration of mushrooms in Ethiopia have been reported scarcely. There are still some gaps in training and awareness programs of technology transfer to the farmers or local populace regarding mushroom utilization and cultivation (Teferi et al., 2013). A review of existing literature on mushroom studies of the country indicated that the fungal resource of the country is poorly studied, documented, and not properly utilized (Ayana, 2021). Even if the mushroom is abundant in the country, the practice of cultivation is very poor, and if present, it is mostly restricted to urban areas (Abate, 2014; Weldekiros et al., 2017). Because of insufficient production, large hotels and foreigners are used from supermarkets that are imported from abroad, so the production of mushrooms cannot support the consumers' demand (AUAB, 2015). However, since mushroom is an emerging business sector in Ethiopia, information is lacking all about the status of mushroom (Getachew et al., 2016).

To fulfill the demand for mushrooms, the country is importing it from different countries. The existing published works shows the trend of import and export of mushrooms in the country are lacking. To reduce mushroom imports by depreciating high foreign currency, the objectives of this research work are to 1) quantify the imported and exported quantities of mushrooms in Ethiopia, 2) assess the trends of import spending and income from exports3) to identify key mushroom suppliers to Ethiopia and mushroom

export destinations countries, and 4) provide policy intervention.

## MATERIALS AND METHODS

The data for this study were acquired from the Ethiopian Customs and Revenues Authority (ECRA) of import-export data within the periods of 1997–2020. The Ethiopian Customs Commission provided raw statistics on the international trade of mushrooms for the years 1997–2020 (ECC). The data used for this study consists of annual time series data of i) import value and volume, and ii) export value and volume of mushroom Ethiopia during the year 1997 to 2020. For the imported mushrooms, cost, insurance, and freight (CIF) values; while for the exported mushrooms, free on board (FOB) values were used in the analysis. We used conversion to the import-export value of the local currency (Birr) into US$, based on the exchange rate data obtained from the National Bank of Ethiopia (NBE) for the different months and years. The trend of mushroom import-export was computed using Excel (Microsoft Corp., Redmond, WA, USA). The trade balance was calculated by subtracting the imported quantities/expenditures to import from the exported quantities/incomes generated in the same years' time period. Overall, for the data analysis, descriptive statistical methods and inferential statistics, as well as the results, were presented through graphs and tables.

The forecast of mushroom trade was also estimated using Autoregressive Integrated Moving Average (ARIMA) model. The ARIMA is expressed as AR: (p=degree of the autoregressive part); I: (d=degree of the difference involved), and MA: (q=degree of the mean part). The ARIMA model was developed in the 1970s by George Box and Gwilym Jenkins to describe changes in the time series using a mathematical approach also known as a BOX- Pierce model. Box and Pierce refer to the set of procedures for identifying, fitting, and checking ARIMA models with time-series data. Forecasts follow from the form of fitted model (Box and Pierce, 1970). The ARIMA model is expressed as follows:

1. Autoregressive model: AR (p) is the general form:

$$"Yt = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} +---+ \beta pYt\text{-}p + \varepsilon_{t---(1)"}$$

Where, Yt = Response (dependent) variable at time t

Yt-1,Yt-2,Yt-3---------,Yt-p = Response variable at time lags t-1, t-2,------,t-p respectively

$\beta_0$, $\beta_1$, $\beta_2$ ---------- $\beta p$ = Coefficients to be estimated $\varepsilon_t$ =Error term at time t

2. Moving average model: MA (q) which has the general form:

$$Yt = \mu + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} --- \theta q\ \varepsilon_{t-q----(2)}$$

Where; Yt = Response (dependent) variable at time t

$\mu$= Constant mean of the process

$\theta_1$, $\theta_2$, ---------- $\theta q$= Coefficients to be estimated

$\varepsilon_t$ =Error term at time t

$\varepsilon_{t-1}$,$\varepsilon_{t-2}$,--------$\varepsilon_{t-q}$= Errors in previous periods that are incorporated in the response Yt

3. Mixed Autoregressive Integrated Moving Average (ARIMA) Model: ARIMA (p, d, q) which has the general form:

$$Yt = \beta_0 + \beta_1 Yt\text{-}1 + \beta_2 Yt\text{-}2 +---+ \beta pYt\text{-}p + \varepsilon_t - \theta_1\ \varepsilon_{t-1} - \theta_2\ \varepsilon_{t-2} --- \theta q \varepsilon_{t-q---(3)}$$

Determine whether the series is stationary or not by considering the graph of the Partial Correlation function (ACF). If a graph of ACF of the time series values either cuts off fairly quickly or dies down fairly quickly, then the time series should be considered stationary. If a graph of ACF dies down extremely slowly then the time series is non-stationary. If the series is not stationary, it can be transformed data to a stationary series by differencing. The graph of the autocorrelation function (ACF) and the Partial Correlation function (PACF) was used to determine the model.

## RESULTS AND DISCUSSION

### Import-export trend and status of mushrooms in Ethiopia

World mushroom production has gradually increased from 0.30 million tons to 3.41 million tons over the last 50 years from 1965 to 2015 (Singh et al., 2017). Resultantly, the world trade trend shows that the mushroom export/import has also continuously increased during the period. The import quantities and expenditure of mushrooms in Ethiopia are presented in Figure 1 between the years of 1997 – 2020. Accordingly, the country imported a total and an average of 2,118.9 and 88.3 tonnes of mushrooms per year. On the other hand, the estimated result shows that the country has exported a total of 87 tonnes of mushrooms with a yearly average of 5.1 tonnes (Table). From such quantities of exports, the country earned a total income of about $188,262.7 and on average $11,074 per year. Regarding the expenditure, the country spent $3,700,786.05 for mushroom import. This result suggests that the quantity of imported mushrooms is greater than export by 89% in the country. This revealed that the country is heavily dependent on imported mushrooms which leads to an imbalance between import and export of mushroom trade. The finding implies on the export front, till, Ethiopian contribution to the world mushroom trade was almost negligible compared to import.

The findings indicated that Ethiopia spent millions of $ to import mushrooms. This result is comparable with previous empirical pieces of evidence that showed the demand for fresh mushrooms exceeds the supply (Sileshi, 2014). As a result, the existing few fresh mushroom producers for example in Addis Ababa could not meet the demand of the market. Due to this, many supermarkets imported a huge amount of chemically preserved mushrooms from different countries (Sileshi, 2014). On the export side, Ethiopia began exporting mushrooms in 2004 but did not export any from 2009 to 2013 for unexplained reasons (see Table 1). The only highest quantities of mushrooms exported from Ethiopia and incomes were generated in 2006 (Table 1). Studies in the past stated that even if the mushroom is produced in Ethiopia, there are challenges that affect the commercial mushroom production; such as lack of capital investment to start up, diseases, lack of physical materials, lack of training and experience, lack of support from governments and other bodies (Gebretsadkan, 2015; Sileshi, 2014). To achieve sustainable production and marketing of mushrooms should require considerable investments to develop a contemporary mushroom farm (Raut, 2019). The expenses of imported mushroom results indicated that the total spent of import is about US$ 3,700,786 as well as yearly expenditure was US$ 154,199 from different countries. The expenses to import mushroom in Ethiopia was much higher than the income generated from the export of mushroom into the country.

Table 1. Trends of imported-export mushrooms (1997-2020)

| Year | Volume import (tonne) | Value import ($US) | Volume export (tonne) | Value export ($US) |
|---|---|---|---|---|
| 1997 | 6,895.00 | 11,025.49 | 0 | 0 |
| 1998 | 27,464.00 | 2,367.45 | 0 | 0 |
| 1999 | 5,735.00 | 10,686.84 | 0 | 0 |
| 2000 | 10,499.00 | 14,035.96 | 0 | 0 |
| 2001 | 66,011.00 | 51,738.09 | 0 | 0 |
| 2002 | 9,644.00 | 11,713.6 | 0 | 0 |
| 2003 | 24,706.00 | 25,721.21 | 0 | 0 |
| 2004 | 35,853.00 | 33,969 | 2,373.00 | 66,348.02 |
| 2005 | 43,563.56 | 47,778.49 | 2,005.00 | 2,005.00 |
| 2006 | 47,005.76 | 78,171.74 | 63,963.00 | 93,140.84 |
| 2007 | 55,355.06 | 181,712.53 | 300.00 | 665.93 |
| 2008 | 121,555.23 | 222,787.50 | 17,956.50 | 25,312.19 |
| 2009 | 70,170.92 | 130,481.88 | 350.00 | 387.32 |
| 2010 | 72,793.65 | 19,4915.01 | 4.00 | 138.58 |

| | | | | |
|---|---|---|---|---|
| 2011 | 75,339.53 | 163,966.13 | 48.00 | 249.46 |
| 2012 | 99,547.46 | 284,266.14 | 5.00 | 15.39 |
| 2013 | 10,6002.46 | 217,595.03 | 0 | 0 |
| 2014 | 188,128.68 | 455,459.11 | 0 | 0 |
| 2015 | 134,322.41 | 290,534.32 | 0 | 0 |
| 2016 | 166,159.01 | 258,751.69 | 0 | 0 |
| 2017 | 172,546.07 | 262488.90 | 0 | 0 |
| 2018 | 154,273.28 | 208,356.77 | 0 | 0 |
| 2019 | 271,440.48 | 329,599.69 | 0 | 0 |
| 2020 | 153,919.06 | 212,663.47 | 0 | 0 |
| Total | 2,118,929.62 | 3,700,786.05 | 87,004.50 | 188,262.72 |
| Average | 88,288.73 | 154,199.42 | 3,625.19 | 7,844.28 |

The trend analysis result for the relative quantities and expenditure of imported mushrooms is also presented in Figure 1 from 1997-2020. The estimated result indicated that the average yearly quantities and expenditure trends of imported mushrooms are 53 % and 44%, respectively.

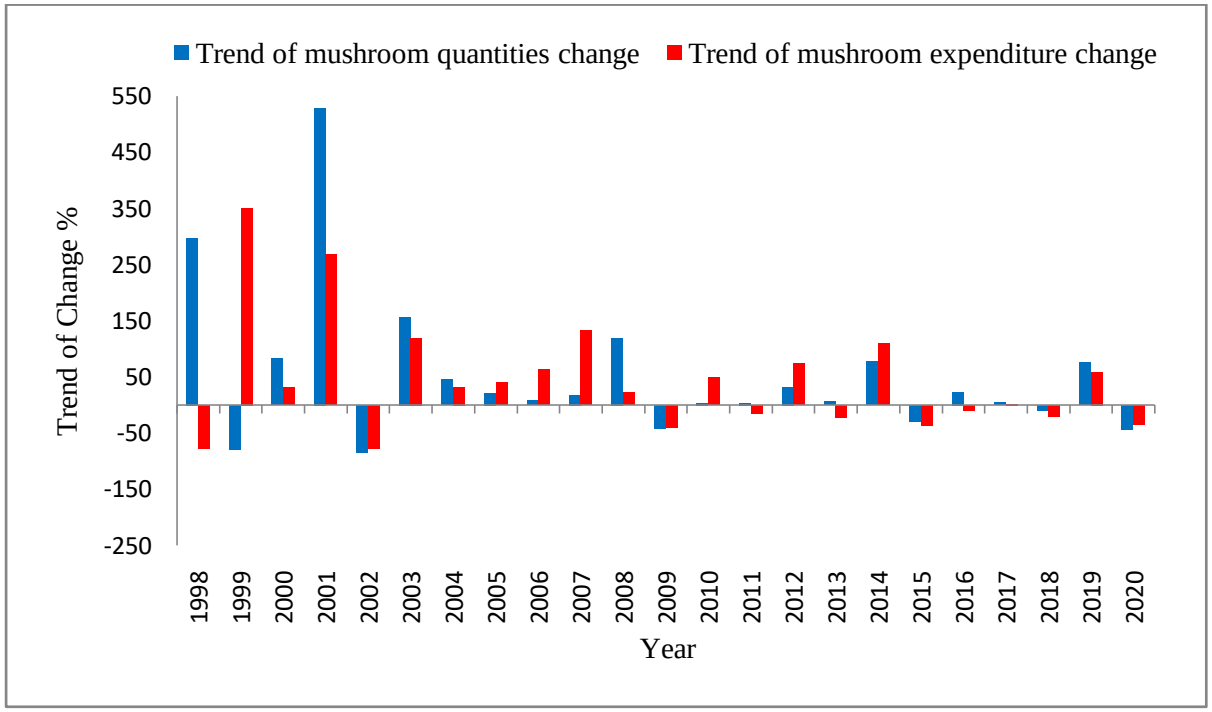


Figure 1. Trend of percentage change on the quantities and relative expenditure of mushroom in Ethiopia (1997 - 2020)

The trade balance of both import mushroom quantity and expenditure revealed that the import and export quantity is not balanced (Table 2). The findings indicated that most of the years the imported quantity of mushrooms was higher than exported quantities which is a trade deficit. Overall, the trade balance result showed that on average the quantities of mushrooms exported from Ethiopia were much less than imported by 84.7 tonnes. Likewise, the yearly average income from the export is much less than the expenditure of imports by US$ 146,355. The existence of a trade gap in mushroom when customers are increasingly looking for high-quality products (Raut, 2019). In general, the incomes generated from the export of mushrooms were much less than the expenditure of import by 92.8%. This suggests that the country has to give due attention to reducing the expenditure from the import by expanding commercial farms of mushrooms in the country through diversification of livelihoods and income generating activities (Sileshi, 2014). Evidence showed that existing market demand and supply of mushrooms in the local market is at a rudimentary

stage due to inefficient production and poor quality of the products (Sileshi, 2014; Getachew et al., 2016).

Table 2. Balance of Mushroom Trade in Ethiopia (1997-2020)

| Year | Volume (tonne) | Value ($US |
|---|---|---|
| 1997 | -6,895.00 | -11,025.49 |
| 1998 | -27,464.00 | -2,367.45 |
| 1999 | -5,735.00 | -10,686.84 |
| 2000 | -10,499.00 | -14,035.96 |
| 2001 | -66,011.00 | -51,738.09 |
| 2002 | -9,644.00 | -11,713.6 |
| 2003 | -24,706.00 | -25,721.21 |
| 2004 | -33,480.00 | 32,379.02 |
| 2005 | -41,558.56 | -45,773.49 |
| 2006 | 16,957.24 | 14,969.1 |
| 2007 | -55,055.06 | -181,046.6 |
| 2008 | -103,598.73 | -197,475.3 |
| 2009 | -69,820.92 | -130,094.6 |
| 2010 | -72,789.65 | -194,776.4 |
| 2011 | -75,291.53 | -163,716.7 |
| 2012 | -99,542.46 | -284,250.8 |
| 2013 | -106,002.46 | -217,595.00 |
| 2014 | -188,128.68 | -455,459.1 |
| 2015 | -134,322.41 | -290,534.3 |
| 2016 | -166,159.01 | -258,751.7 |
| 2017 | -172,546.07 | -262,488.9 |
| 2018 | -154,273.28 | -208,356.8 |
| 2019 | -271,440.48 | -329,599.7 |
| 2020 | -153,919.06 | -212,663.5 |
| **Total** | **-84,663.55** | **-146,355.1** |
| **Average** | **-84.664** | **-146,355** |

**The extent of mushroom import-export in Ethiopia with different countries**

The import data of mushrooms shows that Ethiopia imported from 29 countries in the years of 1997 – 2020 as well as exported to 12 countries from 2004-2020. This implies that Ethiopia is involved within a few countries for the export and many for import mushrooms. The major mushroom importer countries to Ethiopia are presented in Figure 2 between the years 1997-2020. Among importer countries, United Arab Emirates are the dominant which accounts 53%, followed by the Netherlands (24%), Italy (10%), China (6%), Belgium (3%), Djibouti (2%), Malaysia (1.0%) and Turkey (1.0%). The result indicates that European countries are the major suppliers of mushrooms while mushroom import with African countries was limited. The result indicated that most of the expenses mushroom was spent to import from the United Arab Emirates followed by China. This could further show that the United Arab Emirates was the main supplier for most of the mushrooms to Ethiopia. Similarly, most of the expense for mushroom importation was spent in Asian and European countries which could be related to the differences in the price tag of the imported mushroom or the quality of the product they supplied. Ethiopia imported mushrooms in the years of 1997–2020 only in a few African countries such as limited only Djibouti. This could further show that the trade linkage in mushroom between Ethiopia and other African countries is poor and limited only to very few countries.

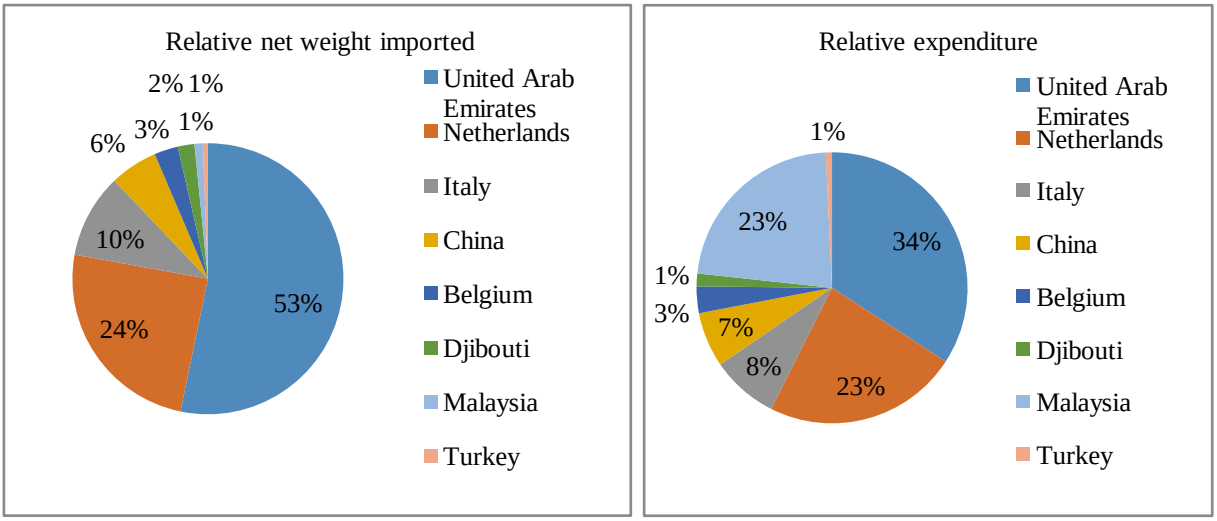


Figure 2. The share of major countries importing mushrooms to Ethiopia (1997 - 2020)

On the other hand, the major mushroom export destination countries and relative income from the export are presented in Table1. Ethiopia started to export mushrooms in 2004.The finding indicates that the export quantity accounts for 85.7 %, 2.5%, 2%, 2%, 2%, 1.8%, 1.6%, 1.6% to Yemen, Italy, Sudan, Djibouti, United Arab Emirates, Netherlands, and United Kingdom, respectively. Likewise, about 64.4 %, 1%, 0.9%, 0.4%, and 28.8 % of mushroom income was gained from Yemen, Saudi Arabia, Italy, Sudan, and the United Kingdom, correspondingly. This result indicates that Yemen was the major destination country for the exported mushrooms of Ethiopia.

Table 3. Major export destination countries of mushroom from Ethiopia (2004– 2020)

| Countries | Relative net weight export | Relative income from export |
|---|---|---|
| Yemen | 86% | 66% |
| Saudi Arabia | 2% | 1% |
| Italy | 2% | 1% |
| Sudan | 2% | 1% |
| Djibouti | 2% | 1% |
| United Arab Emirates | 2% | 1% |
| Netherlands | 2% | 1% |
| United Kingdom | 2% | |

**Forecasted Mushroom Trade**

The forecast of mushroom trade is analyzed from 2021 to 2040, for 20 years (Figure 6). The import and export value, the time series, ACF, and PACF plots of the first-difference time series are also presented in the result. The first difference in time series is stationary, as can be seen from the time series plot (constant mean and approximately constant variance. The ACF and PACF plots in the spending and income case illustrate that the model would be appropriate for the first-differenced data. The best models are chosen from among the competing models based on the minimum value of the root mean square error (RMSE), mean absolute error (MAE), mean absolute percentage error (MAPE), maximum coefficient of determination (R2), and, of course, the significance of the models' coefficients. The autocorrelation function (ACF) and partial autocorrelation function (PACF) of the residuals are used to perform diagnostic checks on the best-fit models (Figure 4).

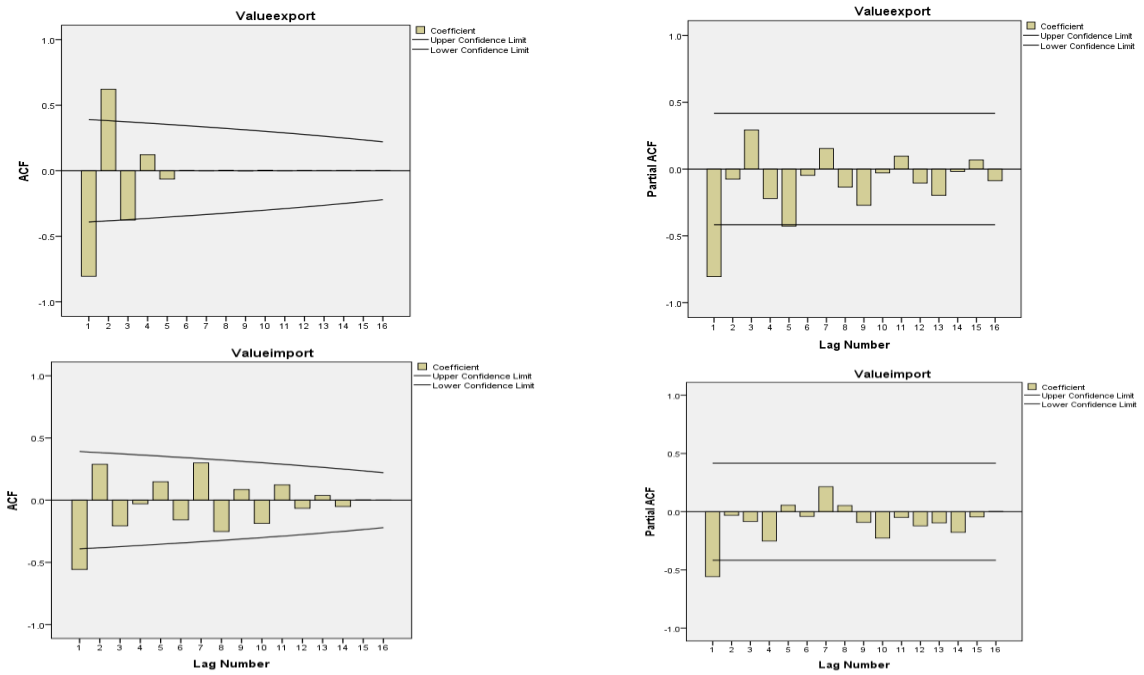


Figure 3. First difference plots of ACF and PACF for the import and export value of mushroom

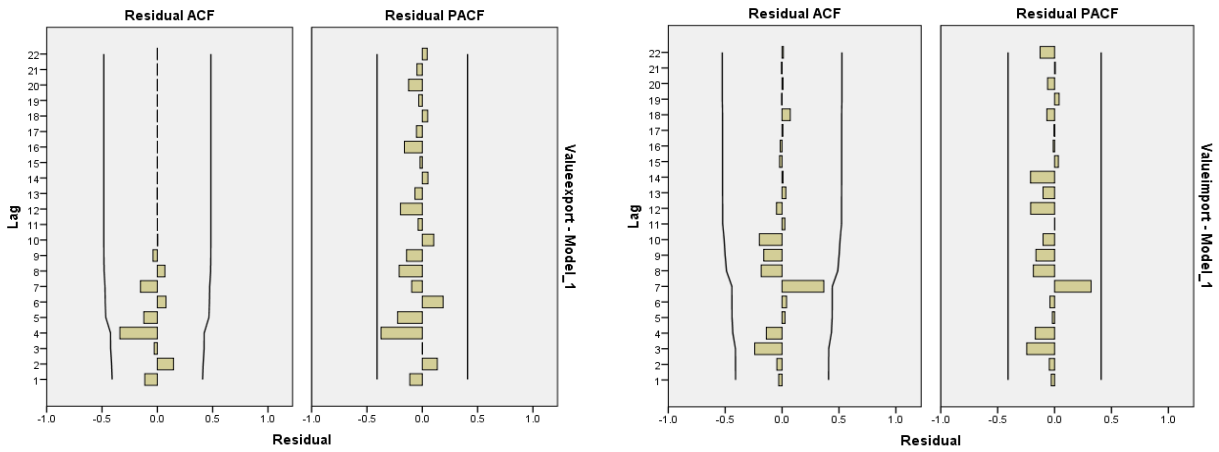


Figure 4. Residuals plots of ACF and PACF for the expense and income value of mushroom

The forecasted result based on the model of 1997–2020 indicated that in the years 2021–2040, the country's average yearly total expenses to import mushrooms will increase from the year 1997–2040 by 50%. An increase in future expenses to import mushrooms can be related to an increase in the volume of demand of mushrooms in the country in the coming future which could be related to a population increase.

The ARIMA model was used to forecast Ethiopia's annual import-export mushroom value figures 9 from 2021 to 2040. As a result, the ARIMA (1, 1, 0) and ARIMA (4, 1, 1) models for revenue and expense value are adequate for yearly forecasting in Tables 2 and 3. According to the study, the mushroom import has developed at a rapid pace, with yearly average growth rates as high as 3% during the forecast years. The predicated import of mushroom expense value will reach $7,567,946 from 2021-2040 and $483,528 as well as ($-8368.70) for income value by 2040, representing a 50% increase from 2021 to 2040. As presented in the graph, the predicting value of import is increasing; whereas export value will almost be negative.

Table 4. Model statistics of forecasting

| Mushroom | Model | R-square | RMSE | MAPE | MAE |
|---|---|---|---|---|---|
| **Expense value** | ARIMA (1,1,1) | 0.683 | 73267.98 | 84.66 | 50109.06 |
| | ARIMA (0,1,1) | 0.673 | 72652.51 | 94.11 | 51961.24 |
| | **ARIMA (1,1,0)** | **0.683** | **71507.24** | **84.36** | **49922.00** |
| **Income Value** | ARIMA (1, 1, 1) | 0.232 | 21622.55 | 479.20 | 9453.85 |
| | ARIMA (1, 1, 0) | 0.230 | 21138.17 | 501.24 | 9394.25 |
| | ARIMA (0, 1, 1) | -0.101 | 25276.31 | 3021.15 | 11939.90 |
| | **ARIMA (4, 1, 1)** | **0.426** | **20277.06** | **2039.14** | **8772.22** |

Table 5. Coefficient estimates of ARIMA Model

| Mushroom | Model | | Coefficient | SD | t | sig |
|---|---|---|---|---|---|---|
| **Expense value** | ARIMA (1, 1, 1) | Constant | 11180.47 | 9594.38 | 1.165.26 | 0.258 |
| | | AR | -0.573 | 0.340 | -1.683 | 0.108 |
| | | MA | 0.030 | 0.400 | 0.074 | 0.941 |
| | ARIMA (0, 1, 1) | Constant | 12489.15 | 5850.55 | 2.135 | 0.045 |
| | | MA | 0.657 | 0.193 | 3.402 | 0.003 |
| | ARIMA (1, 1, 0) | Constant | 11159.92 | 9520.31 | 1.172 | 0.254 |
| | | AR | -0.593 | 0.186 | -3.183 | 0.004 |
| **Income Value** | ARIMA (1, 1, 1) | Constant | -2.6147 | 4052.21 | -0.000 | 0.99 |
| | | AR | -0.7570353 | 0.1884278 | -4.02 | 0.000 |
| | | MA | -0.0525057 | 0.4962161 | -0.11 | 0.916 |
| | ARIMA (1, 1, 0) | Constant | -19.71716 | 3699.44 | -0.01 | 0.996 |
| | | AR | -0.7756616 | -0.0990671 | -7.83 | 0.000 |
| | ARIMA (0, 1, 1) | Constant | -476.00 | 4063.11 | -0.12 | 0.907 |
| | | MA | -1.000549 | 67.2167 | -0.01 | 0.988 |
| | ARIMA (4, 1, 1) | Constant | -541.41 | 3631.48 | -0.15 | 0.881 |
| | | $AR_1$ | -0.0192551 | 0.6342473 | -0.03 | 0.976 |
| | | $AR_2$ | 0.7901978 | 0.1720887 | 4.59 | 0.000 |
| | | $AR_3$ | -0.073441 | 1.061907 | -0.07 | 0.945 |
| | | $AR_4$ | -0.4344119 | 0.2399861 | -1.81 | 0.070 |
| | | MA | -1.00007 | -388106 | -2.58 | 0.010 |

The global market was worth also approximately USD 241 billion in the year 2019 and is expected to bloom up to USD 373 billion by 2025 with a growth rate of 7.5% for medicinal mushrooms (Niego et al., 2021). The driving force of its market value increment is due to the health-promoting benefits of consuming mushrooms. On the other hand, the global edible mushrooms market is forecasted to grow at a high rate of 7.9% during 2020–2027 (Niego et al., 2021). Similarly, edible mushrooms had a global market value of USD 42.42 billion in the year 2018, USD 45.3 billion in 2020, and are forecasted to increase up to USD 62.19 billion in 2023, and USD 72.5 billion by 2027 (Niego et al., 2021).

## CONCLUSION

Even though Ethiopia has favorable climatic conditions with varied topography for the production of mushrooms the findings indicated that the country is heavily dependent on imported and preserved mushrooms. Ethiopia spent US$ 3,700,786 to import mushrooms in the years of 1997–2020 and gained $188,262.7 income from 2004-2020. The trade balance of the country shows a trade deficit. The forecasted result revealed that the country will spend $7,567,946 from 2021–2040. Thus, emphasis has to be given and works strongly on the expansion of mushroom-producing companies in the country. Government initiatives such as financial aid for new producers, the introduction of new technology, and efficient

packaging will help for developing the product faster by incorporating mushroom production in the agricultural and forest development strategy of the country.

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