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Effect of COVID-19 adaptation strategies on arable crop farmers' output in the Umuahia agricultural zone of Abia State, Nigeria

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ABSTRACT

This study analyzed the effect of COVID-19 adaptation strategies on arable crop farmers' production in the Umuahia Agricultural Zone of Abia State, Nigeria. A multistage random sampling procedure was used to select seventy-two (72) arable crop farmers. Data for the study were collected through a structured questionnaire and analyzed using both descriptive and inferential statistics (using multiple regression and Z-test analyses). The results showed that arable crop farmers had a high perceived effect (= 2.5) of COVID-19 on arable crop production and a high utilization (= 2.4) of COVID-19 adaptation strategies. The mean farm output of arable crop farmers during and after the COVID-19 pandemic was 2112.871 kg/ha and 23222.282 kg/ha, respectively. Multiple regression analysis revealed that intensive use of organic manure (1.3898 coefficients), family labor (2.0466 coefficients), less cultivable farm land (0.18189 coefficients), and access to government aid (0.6994) all had an impact on the output of arable crop farmers in the study area. The Z-test result showed that there were no significant differences between the farm output of arable crop farmers during the 2112.87109 (SD = 3158.6590) and post-COVID-19 2322.2920 (1032.5310) pandemics. The study concluded that arable crop farmers had high utilization of COVID-19 adaptation strategies. The study therefore recommended the formulation of important policy as Nigeria moves from lockdown aimed at promoting economic recovery and measures to mitigate further spread to promote access of farmers to land, which can lead to increased farmer output in the study area.

Contribution/Originality: The findings from this research contribute to the knowledge of the effect of COVID-19 adaptation strategies on arable crop farmers' production in the Umuahia Agricultural Zone of Abia State, Nigeria.

1. INTRODUCTION

According to Ashagidigbi Waheed and Agboola Uthman (2019) Nigeria boasts a land area of approximately 91 million hectares, with 83 million of this total mass dedicated to cultivable arable crops like cassava and yam. These crops serve as the primary sources of dietary food energy for the majority of the population. Corona virus disease (COVID-19) became known worldwide in December 2019 when it was first identified in reported cases of patients with pneumonia admitted to hospitals in Wuhan, China (Africa Center for Disease Control Coronavirus Disease (COVID-19), 2021; World Health Organization, 2020). According to the National Bureau of Statistics (NBS) (2022) the agricultural sector in the first quarter of 2022 grew by 3.16 percent (year-on-year) in real terms, an increase of 0.88 percentage points from the corresponding period of 2021 and a decrease of 0.42 percentage points from the preceding quarter of the year. The Food and Agriculture Organisation (2020) reported that farmers in rural areas are particularly vulnerable to the impacts of disruptions caused by the COVID-19 pandemic. The disruptions in agricultural value chains caused by the pandemic, according to the Food and Agriculture Organisation (FAO) (2021) are exacerbating the existing challenges that farmers face when engaging in arable crop production.

Although arable crop farmers were excluded from direct restrictions imposed during the lockdown (Andam, Edeh, Oboh, Pauw, & Thurlow, 2020; Punch News, 2020) they were indirectly exposed to several challenges that affected the harvesting period of some crops, especially the highly perishable ones, due to timing and a shortage of labour that resulted in crop spoilage and losses of ready-to-harvest farm produce (Angelos & Nicole, 2020; Omekwe & Obayori, 2020). In addition, travel bans disrupted the distribution of farm inputs such as fertilizers, seeds, and agrochemicals, limiting and reducing agricultural yields (Obayori, Nchom, & Yusuf, 2020).

According to a Sasakawa online survey for Nigeria, about 88 percent of arable crop farmers surveyed were unable to access their farms, 83 percent were unable to receive extension services training, 71 percent were unable to obtain pre- and postharvest handling services, and 76 percent of agro-processors were unable to access raw materials due to limited market availability (Global Gender Gap Report (GGGR), 2020; Nchanji & Lutomia, 2021).

Based on the above assertion, it appears there is a paucity of information and empirical evidence about the effect of the COVID-19 pandemic on arable crop output and the adaptation strategies employed by farmers to curb the menace in Umuahia Agricultural Zone of Abia State, Nigeria.

1.1. Specific Objectives were to

i. Ascertain farmers' perceived effect of the COVID-19 Pandemic on arable crop production;
ii. Assess adaptation strategies employed by arable farmers to mitigate the effects of the COVID-19 lock down, and
iii. Estimate the output of arable crop farmers during and after the pandemic in the study area.

1.2. Hypotheses of the Study

The following hypotheses were tested:

HO_1: There is no significant relationship between strategies adopted by farmers during the COVID – 19 pandemic and their arable crop output.

HO_2: There is no significant difference between the output of arable crop farmers during and after the COVID-19 pandemic in the study area.

2. METHODS

2.1. Study Area

The Umuahia Agricultural Zone of Abia State, Nigeria, served as the study's location. The zone comprises seven blocks: Umuahia North, Umuahia South, Ibeku, Isiala Ngwa North, Ohuhu South, and Ohuhu North. The state is located in Nigeria's southeast agro-ecological zone. The zone lies between Latitudes 5o 5287961N and Longitudes 7° 4897325E coordinates of Umuahia zonal office Library Avenue Umuahia (Abia State Agricultural Development Programme (ASADP), 2015). The majority of the people in the rural communities of Umuahia Agricultural Zone are predominantly arable farmers, while others are civil servants (Abia State Agricultural Development Programme (ASADP), 2015).

2.2. Sample Size and Data Analysis

The study employed a multistage random sampling procedure to select the blocks, circles, and arable crop farmers. The study randomly selected the first six (6) agricultural blocks that make up the Umuahia agricultural zone, namely Umuahia North, Umuahia South, Ohuhu North, Ohuhu South, Ikwuano, and Isiala Ngwa blocks. In the second stage, we adopted the simple random sampling technique to select three (3) circles each from the agricultural blocks, resulting in a total of eighteen (18) circles. In the fourth stage, we selected four (4) respondents, resulting in a sample size of seventy-two (72) arable crop farmers for the study.

Data from the study were analyzed with descriptive statistics (frequency counts, percentages, and mean scores) and inferential statistics (multiple regression and Z-test analyses). Specifically, all the objectives were realized using descriptive statistics, while hypotheses 1 and 2 were tested using multiple regression and Z-test analyses, respectively.

2.3. Measurement of Variables

In order to ascertain farmers' perceived effect of the COVID-19 pandemic on arable crop production, this was measured and rated on a 4-point Likert rating scale of Strongly Agree = 4, Agree = 4, Disagree = 2, and Strongly Disagree = 1. Based on fourteen (14) perceived item statements, respondents mean scores were computed for each perceived effect of COVID-19 by adding the weights of 4+3+2+1 = 10/4 = 2.5. The following decision rules were used: The mean scores are between 1.00 and 1.50: no effect, 1.51 and 2.00: low effect, 2.1 and 2.49: moderate effect, and above 2.5: high effect.

To assess adaptation strategies utilized by arable farmers to cope with the effects of COVID-19 lockdown, this was measured and rated on a 3-point Likert-type scale of Always = 3, rarely = 2, and Never = 1. Based on the fourteen (14) available adaptation strategies, respondents' mean scores were computed for each available adaptation strategy. A midpoint was obtained by adding 3+2+1 = 6/3 = 2.0. The following decision rules were used: The mean score is between: below 1.00 = no utilization, 1.00–1.49 = low utilization, 1.50–1.99 = moderate utilization, and 2.0 and above = high utilization.

In estimating the output of arable crop farmers during and after the pandemic, the respondents were asked how many bags of arable crops they harvested before and after the COVID-19 pandemic and were converted to kilogram, and the cost of each bag was derived in monetary terms (Naira).

2.4. Model Specifications

Hypothesis 1 was tested using multiple regression analysis at a 95% confidence level. The four functional forms of regression models, viz., linear, semi-log, exponential, and Cobb-Douglas, were tried. The best fit was chosen as the lead equation based on its conformity with econometric and statistical criteria such as the magnitude of R^2, F-ratio, and number of significant variables.

The four functional forms are expressed as follows:

i. Linear Function

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + e_i \quad \ldots\ldots\ldots.. (1)$$

ii. Semi – log function

$$Y = L_n\beta_0 + \beta_1 L_n X_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n + X_5 \beta_6 L_n X_6 + e_i \quad \ldots\ldots\ldots \quad (2)$$

iii. Exponential function

$$LnY = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + e_i \quad \ldots\ldots\ldots\ldots\ldots.. \quad (3)$$

iv. Cobb Douglas Function

$$LnY = L_n\beta_0 + \beta_1 L_n X_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n X_5 + \beta_6 L_n X_6 + e_i \quad \ldots\ldots\ldots. \quad (4)$$

Where;

Y = Output from arable crop production (Difference in Kg harvested during COVID-19 pandemic).

β_1 = Intensive use of organic manure (Mean scores).

β_2 = Use of family labour in rice production activities (Mean scores).

β_3 = Reduction of cultivable farm land (Mean scores).

β_4 = Access to government palliatives (Mean scores).

β_5 = Reverting to the use of medicinal herbs for disease control (Mean scores).

β_6 = Harvesting of non-timber forest products from the wild (Mean scores).

ei= Error term.

Hypothesis 2: There is no significant difference between the output of arable farmers during and after the pandemic in the study area.

These hypotheses were tested using Z–test analysis.

The model for Z-test analysis of comparison is specified, thus:

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \qquad (5)$$

$n_1 + n_2$ - 2 degrees of freedom.

Where,

Z = "Z" statistic.

$\bar{X}_1$ = Sample mean of output of arable crop farmers during COVID – 19 pandemic.

$\bar{X}_2$ = Sample mean of output of arable crop farmers post COVID – 19 pandemic.

σ^2_1 = Standard deviation of output of arable crop farmers during COVID – 19 pandemic.

σ^2_2 = Standard deviation of output of arable crop farmers post COVID – 19 pandemic.

n_1 = Sample size for arable crop farmers during COVID – 19 pandemic.

n_2= Sample size for arable crop farmers post COVID – 19 pandemic.

3. RESULTS AND DISCUSSION

3.1. Perceived Effect of the COVID-19 Pandemic on Arable Crop Production

The result in Table 1 showed that farmers had a high perceived effect ($\bar{X}$ = 2.5) of COVID-19 on arable crop output in the study area. This suggests that the global pandemic has an effect on farmers' output, income, and disruptions in farmers' household food security, access to, and transportation of farm inputs. This result corroborates with the findings of Uğur and Buruklar (2022) as they reported that smal- scale farmers are very vulnerable to economic and environmental shocks leading to low output due to the high cost of labor. In the same vein, Angelos and Nicole (2020) affirmed that the evidence reported in various studies indicates that COVID-19 disease impacts a country's economy.

Table 1. Mean frequency distribution of perceived effect of COVID-19 on arable crop output in the study area.

Perceived effect of COVID -19	SA	A	D	SD	Total	Mean	Decision
The COVID-19 pandemic has a negative effect on household food security	60(240)	10(30)	2(4)	0(0)	274	3.8	High effect
Reduction in crop output due to arable crop losses	71(284)	1(3)	0(0)	0(0)	287	3.9	High effect
Reduction in income realized from sales of crops	72(288)	0(0)	0(0)	0(0)	288	4.0	High effect
Non-access to farm inputs such as improved seeds and agrochemicals	65(260)	7(21)	0(0)	0(0)	281	3.9	High effect
Non-availability of social safety nets to cater for stable food supply to farm families	24(96)	46(138)	2(4)	0(0)	238	3.3	High effect

Perceived effect of COVID -19	SA	A	D	SD	Total	Mean	Decision
Scarcity of farm labour due to restrictions on movement during the pandemic	6(24)	47(141)	19(38)	0(0)	203	2.8	High effect
Death of members due to poor access to health care services, thereby affecting family labour	35(140)	35(105)	2(4)	0(0)	247	3.4	High effect
Extension visits were hampered, leading to a reduced transfer of technologies	70(280)	2(6)	0(0)	0(0)	280	3.8	High effect
No access to the market, thus affecting the sales of farm produce	71(284)	1(3)	0(0)	0(0)	287	3.9	High effect
Effect of high production costs on arable crop members	16(64)	6(18)	49(98)	1(1)	181	2.5	High effect
The effects of the pandemic caused the closure of my arable crop farm	20(80)	32(96)	19(38)	1(1)	215	2.9	High effect
The pandemic resulted in not meeting pertinent family needs	25(100)	46(138)	1(2)	0(0)	240	3.3	High effect
The lockdown and delay in public transportation led to huge losses in perishable farm produce	25(100)	46(138)	1(2)	0(0)	239	3.3	High effect
It has led to incapacitation and reduced days/Hours	10(40)	50(150)	12(24)	0(0)	214	2.9	High effect
Total mean ($\bar{X}$)						47.7	
Grand mean ($\bar{X}$)						2.5	High effect

Values in parentheses are nominal Likert values multiplied by frequencies.

3.2. Adaptation Strategies Utilized by Arable Crop Farmers to Cope with the Effects of the COVID– 19 Pandemic

The result in Table 2 showed that arable crop farmers had high utilization of COVID-19 adaptation strategies available to them in the study area. The result corroborates the findings of Bolarin, Komolafe, and Ajiboye (2022); Orimoloye and Ololade (2021) and Orimoloye, Belle, Olusola, Busayo, and Ololade (2021) as they utilized these adaptation strategies to cope with the effect of the COVID-19 pandemic on crop production activities.

Table 2. Mean frequency distribution of the adaptation strategies utilized by arable crop farmers in coping with the effect of COVID-19 pandemic in the study area.

Adaptation strategies	Always	Rarely	Never	Total	Mean	Decision
Intensive use of organic manure	33(132)	39(78)	0(0)	210	2.9	High utilization
Sales of rice at the farm gate	72(216)	0(0)	0(0)	216	3.0	High utilization
Use of family labor	71(213)	2(4)	0(0)	217	3.0	High utilization
Reduction of cultivable farm land	62(186)	10(20)	0(0)	206	2.8	High utilization
Access to government palliatives	32(96)	40(80)	0(0)	176	2.4	High utilization
Use of phones for extension advice	71(213)	1(2)	0(0)	215	2.9	High utilization
Sale of household assets	72 (216)	0(0)	0(0)	216	3.0	High utilization
Hawking of farm produce within neighborhood	70 (210)	2(4)	0(0)	214	2.9	High utilization
Engagement in non-farm activity	71(213)	1 (2)	0(0)	215	2.9	High utilization
Borrowing money for family upkeep	71(213)	1 (2)	0(0)	215	2.9	High utilization
Reduced food consumption	71(213)	1 (2)	0(0)	215	2.9	High utilization
Harvesting of non-timber forest products	56(168)	16 (32)	0(0)	200	2.7	High utilization
Reverting to the use of medicinal herbs for disease control	64(192)	1 (2)	7 (7)	201	2.7	High utilization
Engaging in the manufacture and sale of face masks	70(210)	1 (2)	1 (1)	213	2.9	High utilization
Total mean ($\bar{X}$)					34.0	
Grand mean ($\bar{X}$)					2.4	High utilization

Values in parentheses are nominal Likert values multiplied by frequencies.

3.3. Output of Arable Crop Farmers During and After the COVID 19 Pandemic

The results in Table 3 showed that the mean farm output of the arable crop farmers during and after the COVID-19 pandemic was 2112.871 kg/ha and 23222.282 kg/ha, respectively. The result is in tandem with the findings of Dev (2020) and Gong (2018) who reported that the COVID-19 pandemic affected farmers output due to the unavailability of labor and restrictions on farming inputs and resources.

Table 3. Mean frequency distribution of output of arable crop farmers during and post COVID-19 pandemic in the study area in the study area.

COVID – 19 pandemic	During	Percentage	Post	Percentage
Output Kg/ha	Frequency		Frequency (n=72)	
600 – 1600	41	56.94	20	22.77
1700 – 2600	23	31.94	24	33.33
2700 – 3600	3	4.16	22	30.55
3700 – 4600	2	2.77	3	4.16
4700 – 5600	2	2.77	3	4.16
5700 – 6600	1	1.38	-	-
Mean ($\bar{X}$)	72	2112.871	72	2322.282

3.4. Relationship between Selected Strategies Adopted by Farmers During COVID – 19 Pandemic and their Arable Crop Output

The results in Table 4 showed the regression estimates of strategies adopted by farmers during the COVID – 19 pandemic on arable crop output in the study area. Among the four functional forms estimated, the double-log functional form was chosen as the lead equation based on a high R^2 value, the number of significant factors, and agreement with a priori expectations. The F-value was highly significant at the 1% level, indicating a regression of best fit. The R^2 value of 0.6046 showed that 60.46% of the variability in arable crop output was explained by the independent variables. The study found that four of the six variables they looked at—heavy use of organic manure, family labor in arable crop production, less farmland that can be farmed, and access to government aid—were important enough to talk about.

The coefficient for the intensive use of organic manure (1.3898) showed a positive and highly significant correlation with the arable crop output in the study area, with a probability of 1%. This implied that an increase in intensive use of organic manure led to an increase in arable crop output during the COVID-19 pandemic periods. This was expected and in line with Singh (2020) study, which noted that during the pandemic all markets were closed due to lockdown; hence, farmers were not able to access farming inputs (such as fertilizers), leaving them with alternatives to the use of organic manure. On the other hand, Rosenberg, Cooke, and Walljasper (2020) contended that the pandemic impacted production costs, characterizing this impact as a high cost of production material supply, a shortage of inputs, and limitations on the importation of certain goods like inorganic fertilizer.

The coefficient for the use of family labor in arable crop production activities (2.0466) was positive and significantly related to arable crop output at the 10.0% level of probability. This was an indication that increases in the use of family labor in arable crop production activities led to an increase in arable crop output during COVID-19 pandemic periods. The result was expected, as during the pandemic, mobility poses a risk for both the sustainability of agricultural production and the protection of public health. We restricted the recruitment of farm labor from other cities for farm activities to lower the risk of infection (cases) in production areas, which significantly increased the reliance on family labor. In line with the findings, Uğur and Buruklar (2022) noted the negative effects of the Covid-19 pandemic on agricultural laborers and activities. Singh (2020) also in corroboration with the findings, noted that because of the fear of spreading COVID-19 infection in agricultural work, especially during the time of harvesting, preparation, and sowing the field, where more labor is required in the field and more people gather together in the same field, it is very difficult to follow the social distancing during this period. It is appropriate to employ family members as laborers, as they reside in the same area, thereby mitigating the spread of infection. Menon and Schmidt-Vogt (2022) also emphasized that the common economic impacts of the pandemic on farming systems were the increase in labor costs and the decrease in prices for agricultural products, contributing to the use of household labor as an alternative. However, in contradiction, Ergun (2019) and Demir (2018) observed that 50% of tea producers and 5% of hazelnut producers, respectively, live in a city different from where their land is located and only visit the land during the harvesting period. In this case, only the producers, not the hired labor, were able to move.

The coefficient for reduction of cultivable farm land (0.18189) was also found to be highly significant at the 1% level and negatively related to arable crop output in the study during COVID – 19 Pandemic periods. The study during COVID-19 pandemic periods found the coefficient for reduction of cultivable farm land (0.18189) to be highly significant at the 1% level and negatively related to arable crop output. This indicated that a reduction in cultivable farm land increased arable crop outputs in the study during COVID-19 pandemic periods. This may explain why arable crop farmers manage small-farm holdings more efficiently and effectively than large landholdings. In corroboration with the study, Mokumako (2021) reported that the lockdown prompted farming households to relocate to nearby farms, increasing the amount of time they spent on the farm. As a result, farmers took care of their farms themselves and completed several farm tasks that they had previously been unable to do due to inadequate labor resources. Access to government palliatives (0.6994) was both negative and significant at the 10% level of probability. This showed that any increase in access to government palliatives reduced the arable crop outputs in the study during COVID-19 pandemic periods. This contradicted a previous expectation, as the palliative measures were designed to mitigate the impact of the lockdown imposed to contain the COVID-19 pandemic, not to decrease the production of arable crops. Therefore, this could be attributed to the relaxation of certain farmers and farming households during the pandemic, as they relied on government-provided palliative measures for survival. Isaac (2020) argued that the palliative measures shared during the pandemic were primarily for the most vulnerable members of the community or society, including the farmers. The hypothesis, which states that there is no significant relationship between selected strategies adopted by farmers during the COVID-19 pandemic and their arable crop output, is hereby rejected.

Table 4. Regression estimates of selected strategies adopted by farmers during COVID – 19 pandemic on arable crop output.

Variables	Parameters	Linear	Exponential	Double log+	Semi-log
Constant	β_0	6803.7760 (0.68)	10.0544 (4.77)***	9.8485 (5.21)***	6649.646 (0.74)
Intensive use of organic manure	β_1	1795.42 (1.98)*	0.5600 (2.07)	1.3898 (2.12)*	4351.589 (2.06)*
Use of family labor in arable crop production activities	β_2	769.1264 (0.23)	-0.8305 (-2.79)**	-2.0466 (-2.84)**	1876.065 (0.23)
Reduction of cultivable farm land	β_3	-3105.063 (-2.51)*	-0.3306 (-4.66)***	-0.8189 (-4.06)***	-7629.179 (7.29)***
Access to government palliatives	β_4	-1724.977 (-4.22)**	-0.2821 (-1.38)	-0.6994 (-2.33)*	-4218.112 (-1.78)*
Harvesting non-timber forest products from the wild	β_5	152.9947 (0.15)	-0.0662 (-0.31)	-0.1701 (-0.33)	416.9555 (0.17)
Reverting to the use of medicinal herbs for disease control	β_6	450.5185 (0.59)	0.0751 (0.47)	0.1463 (0.51)	792.5084 (0.58)
F-calculated		10.39	11.30	11.40	10.29
R-squared		0.5669	0.5940	0.6046	0.5867
Adjusted R-squared		0.5444	0.5722	0.5829	0.5643

Note: * p≤ 0.10, ** p≤ 0.05 and ***p≤ 0.01. + = Lead equation.

3.5. Significant Difference Between Farm Output of Arable Crop Farmers During and After the COVID- 19 Pandemic

The results in Table 5 indicate significant differences between the farm output of arable crop farmers during and after the COVID-19 pandemic in the study area. The study showed the mean arable farm output during and after the COVID-19 pandemic was 2112.87109 (SD = 3158.6590) and 2322.2920 (1032.5310), with a Z-test of 0.5347 which was not significant. According to the Z-test result, we accept the null hypothesis that there were no significant differences between the farm output of arable crop farmers during and after the COVID-19 pandemic in the study area.

Table 5. Test of significant differences between farm output of arable crop farmer during and post COVID-19 pandemic.

Variables	Observations	Mean	Standard deviation	Z-value
During COVID – 19 pandemic	72	2112.8710	3158.6590	-0.5347
Post COVID – 19 pandemics	72	2322.2920	1032.5310	

Source: STATA result, 2023.

4. CONCLUSION AND RECOMMENDATIONS

The study concluded that arable crop farmers had a high perceived effect of the COVID-19 pandemic on arable crop production, high utilization of COVID-19 adaptation strategies, and higher output in the post-pandemic era. Intensive use of organic manure, using family labor, reducing cultivable farm land, and access to government aid were some of the adaptation strategies that affected the output of arable crop farmers. There were no significant differences in the output of arable crop farmers in the study area before and after the COVID-19 pandemic.

Therefore, the study urges Nigeria's policymakers, agriculturists, researchers, and development practitioners to remain focused on the post-effects of the COVID-19 pandemic. It also advocates for arable crop farmers to have easy access to land use, mechanization to reduce farm drudgery, access to fertilizer, and farm palliatives.

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