

Constraints to liquid fertilizer usage in dry season vegetable production in the Southern Guinea Savannah Zone of Nigeria

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Abstract: *Despite the fact that liquid fertilizers have been around for more than a decade in Nigeria, not much has been documented on its usage in dry season vegetable production. Following the quest for smart farming practices to ensure the availability and affordability of good food, studies show that liquid fertilizer usage is associated with superior quality and quantity of crops. The shortage of literature on liquid fertilizer usage may have stemmed from its low usage. The low usage, on the other hand, may have been due to the challenges associated with its usage. This study identified the users of liquid fertilizers and assessed the severity of the constraints encountered in its usage. A three-stage random sampling procedure was used to select 309 vegetable farmers. Data was collected using a pre-tested and structured interview schedule. Data analysis was done using frequency counts, percentages, and Likert type scale. The results revealed a low level of usage of liquid fertilizer. Seven constraints to use were identified in the study. Lack of usage instructions ranked highest in terms of the severity, while the perceived low effectiveness of liquid fertilizer ranked the lowest among the constraints identified. The study, therefore, recommended that smaller units of the liquid fertilizer with labeled wrappers be made available to the farmers to reduce the complexity associated with its usage. Also, training of Extension officers and selling agents on up-to-date information on liquid fertilizer usage will help to ensure that the farmers have access to correct usage instructions.*

Keywords: *Soil fertility, Technology adoption, Challenges, Random sampling, Likert type scale, Usage instructions.*

Introduction

Low levels of fertilizer usage still abound in Nigeria. This is due to the relatively low level of availability and affordability of the fertilizer input (Liverpool-Taise et al., 2014). Consequently, vegetable productivity, like other food crops is far below what it could be. In the last decade, a lot of emphases have been placed on increasing fertilizer use in Nigeria as a way of increasing output of farmers to improve food security status. Several efforts have been made by the government in Nigeria to ensure the availability and affordability of fertilizer, with very little success.

Commercial liquid fertilizers were first introduced into the country in 2003, possibly as an alternative source of fertilizer to the scarce and expensive granular fertilizer. These liquid fertilizers are known to improve the quality and quantity of crops (Akanbi et al., 2007; Deore et al., 2010; Criollo et al., 2011). Thus, its ability to increase the nutritional content of food crops can address the problem of 'hidden hunger' that is so prevalent in many developing countries like Nigeria. Furthermore, because they come in liquid form, the nutrients are quickly absorbed by the plants which enable them to respond rapidly following application. Despite these attributes of liquid fertilizer, not much appears to have been documented on its usage in Nigeria. The dearth of literature on liquid fertilizer usage maybe as a result of low usage of the technology, which, in turn, may be due to the challenges encountered in its adoption by farmers.

Farming in Nigeria is dominated by small-scale farmers, and these farmers will typically adopt a new technology only when they are sure that it will increase their income to a reasonable extent, without it being too risky (Straub, 2009; Hochbaum, 2011). Thus, an in-

depth analysis of the constraints users of liquid fertilizer face will help put these challenges into better perspective so that a measure of their severity will be accessible to policymakers and fertilizer companies. Also, an analysis of the constraints faced in liquid fertilizer usage will help to identify and quantify the possible factors that may have contributed to farmers' lack of interest in the technology, with a view to removing such bottlenecks, or modifying the technology where possible. Furthermore, it is worthy of note that the gains in the usage of liquid fertilizer for dry season vegetable production may not be realized if they are not efficiently utilized due to the challenges the farmers face in its adoption. Thus, by not adequately identifying these challenges and finding solutions to them may make use of liquid fertilizer among dry season vegetable farmers undesirable, and deny the farmers and the general public the likely benefits of improved year-round vegetable production.

Objectives

In view of the preceding, the study set out explicitly to: (i) identify the users of liquid fertilizers; and (ii) identify the constraints faced by the dry season vegetable farmers in the use of liquid fertilizers; and (iii) measure the severity of the limitations identified.

Methodology

Study area

This study was carried out in the Southern Guinea Savannah Zone of Nigeria. It is the most luxuriant of the savannah vegetation belts in Nigeria. The area is characterized by low rainfall and extended dry periods of up to six months, and the soils are low in organic matter and chemical fertility.

Sampling technique

Two states, Kwara and Niger States, were randomly selected from the six states in the Southern Guinea Savannah Zone. Locations where dry season vegetable production was predominantly carried out were identified using the 2012 Crop Area Yield Survey (CAYS) manual from both states' Agricultural Development Project (ADPs). Twenty-five percent of the identified locations in each of the States were randomly selected from the 33 locations identified in Kwara State and 35 identified in Niger State. This gave a total of eight and nine locations in Kwara and Niger States respectively. Next, the different farmer groups in each of the selected locations were identified with the help of the Extension Officers in charge of each of the selected locations. A minimum of two different farmer groups was identified in each of the locations. A list of all dry season vegetable farmers was obtained from the leader of each of the groups. From those lists, another list was compiled to give the total number of vegetable farmers in that location irrespective of the group they belong. From the compiled list, twenty-five percent of the listed vegetable farmers were randomly selected from each location to give a sample size of 160 vegetable farmers for Kwara State and 157 vegetable farmers for Niger State. Thus, a total of 317 vegetable farmers were interviewed for the study. Data for only 309 farmers were eventually useful for analysis due to insufficient information given by eight respondents.

Method of data collection

Data for the study were collected between February 2014 and April 2015 using a structured interview schedule that involved vegetable farmers. Focus Group Discussion (FGD) was also organized with the local leaders of the vegetable farmer groups to supplement the data obtained from the interview schedule. Some of the constraints included in the survey instruments were identified from the literature that had to do with challenges small-scale farmers encounter in the adoption of new technologies. The farmers were asked to rate the problems they faced in the use of liquid fertilizer in dry season vegetable production on a 5 point numerical rating scale of *extremely severe problem =5, severe problem =4, moderately severe problem = 3, mild problem= 2 and not severe at all= 1*. Vegetable farmers were expected to tick against each constraint listed according to the degree of severity. The farmers were also asked to state and rate any other additional constraints encountered, that

was not included in the instrument. The survey instrument was subjected to review by experts in the Department of Agricultural Extension and Rural Development, University of Ilorin to establish its validity. To ensure reliability, pretesting was done with 30 dry season vegetable farmers who were not included in the sample. Internal consistency approach using Cronbach's alpha was adopted, and data analysis was done using the SPSS software. An alpha value of 0.816 indicated a reliable scale.

Analytical techniques

Descriptive statistics which include measures of central tendencies such as frequency distribution and percentages were used to identify the users of liquid fertilizers, and describe the socio-demographic/economic characteristics of the vegetable farmers. A box plot analysis was used to measure the level of severity of the constraints faced by the vegetable farmers in the usage of liquid fertilizer. The users of liquid fertilizer were asked to rate on a scale of five (most severe problem) to one (not a problem at all) the severity of the challenges they encountered in the usage of liquid fertilizers. These values were then plotted using the box plot.

Results and discussion

This section presents the empirical results of the data analysis done for the study.

Identification of liquid fertilizer users in the study

The results for the users of liquid fertilizers are shown in Table 1.

Table 1: Distribution of dry season vegetable farmers based on liquid fertilizer usage

Categories of fertilizer usage	Frequency	Percentage
Liquid only	44	14.20
Liquid with non-liquid	43	13.90
Non-liquid only	222	71.90
Total	309	100.00

Source: Field survey, 2015.

Less than one-third of the farmers used liquid fertilizers (Table 1). The low level of usage of the technology was primarily because the technology was not yet widely known in the study area. More than 45 percent of the non-users of the liquid fertilizer attested to the fact that they had never heard about the technology. The majority of those who had never heard about the liquid fertilizer technology were those who stayed in locations that were farther from the city centers. The low level of knowledge of the technology is a significant challenge for the adoption of the technology because innovations must be widely known to be adopted.

The socio-demographic characteristics of the vegetable farmers.

The socio-demographic characteristics are described based on usage or non-usage of liquid fertilizer. The results are presented in Table 2.

Table 2: Socio-demographic characteristics of the farmers

Characteristics	Users of liquid fertilizers (n = 87)	Non-users of liquid fertilizers (n=222)
Sex		
Male	72 (82.76)	150 (67.57)
Female	15 (17.24)	72 (32.43)
Age of farmers (years)		
≤ 30	4 (4.60)	12 (5.41)
31- 40	20 (23.00)	35 (15.76)
41-50	42 (48.28)	97 (43.69)
51-60	19 (21.84)	59 (26.58)
> 60	2 (2.30)	19 (8.56)
Mean	45.15	47.20
Household size		
1 – 5	34 (39.08)	116 (52.25)

6 -10	42 (48.28)	96 (43.24)
11 – 15	10 (11.49)	9 (4.05)
> 15	1 (1.15)	1 (0.45)
Mean	6	6

Source: Field survey, 2015. Figures in parenthesis are percentages

From Table 2, well over half of the respondents were male for both the user and non-user groups. Overall, vegetable production in the study was male-dominated. The males accounted for 72 percent of total respondents. The modal age range for both groups was the 41-50 years. Mean age for the study was 47 years which was the same as that for the non-users, while it was 45 years for the users. This means that users of liquid fertilizer were relatively younger than the non-users and so may have been more willing to try out the innovation. This is so because older farmers are usually more conservative than their younger counterparts who are more open to new technologies (Daudu et al., 2009). The minimum age recorded for the study was 25 years while 68 years was the maximum. Eighty-eight percent of the respondents were married and had household sizes that ranged from one to ten persons, with a mean of six persons.

The socioeconomic characteristics of the farmers are presented in Table 3.

Table 3: Socio-economic characteristic of the vegetable farmers.

Characteristics	Users of liquid fertilizers (n = 87)	Non-users of liquid fertilizers (n=222)
Form of education		
No formal	22 (25.29)	96 (43.25)
Formal	65 (74.71)	126 (46.75)
Farm size (hectares)		
0.01-1.00	65 (74.71)	192 (86.49)
1.01-2.00	15 (17.24)	17 (7.66)
2.01-3.00	4 (4.60)	10 (4.50)
> 3.0	3 (3.45)	3 (1.35)
Mean	0.76	0.63
Membership of vegetable association		
Yes	15 (17.24)	74 (33.37)
No	72 (82.76)	148 (66.67)
Average monthly income from dry season vegetable production		
<€50,000	46 (52.87)	166 (74.77)
€50,000 – €100,000	17 (19.54)	28 (12.61)
€100,001 –€150,000	15 (17.24)	13 (5.86)
€150,001-€200,000	5 (5.57)	8 (3.60)
>€200,000	4 (4.60)	7 (3.15)
Mean	N68,811.69	N41,215.99
Average monthly income from other sources		
None	33 (37.93)	86(38.74)
<€5,000	11 (12.64)	72(32.43)
€5,000-€10,000	30 (34.48)	49(22.07)
€10,001-€15,000	6 (6.90)	8(3.60)
€15,001-€20,000	5 (5.57)	2(0.91)
>€20,000	2 (2.30)	5(2.25)

Note: €1 = ₦230

Source: Field survey, 2015. Figures in parenthesis are percentages

Majority of the vegetable farmers who used liquid fertilizer had one form of formal education. However, further analysis revealed that 81.6% of them had less than secondary school education, while 86.5% of the non-users had less than secondary school education. Maximum farm size recorded for the study was six hectares. Mean farm size for users was 0.76 hectares, while it was 0.63 hectares for non-users. This result shows that users of liquid fertilizer had relatively larger farm sizes. In all, more than 90 percent of farmers in both groups had less than two hectares of farmland, indicating that dry season vegetable production in the study area was dominated by small-scale farmers (World Bank, 2003). Belonging to an association that is directly related to one's occupation has been known over time to improve one's knowledge and skill regarding that occupation (Rajendran et al., 2015).

This is so because usually at scheduled meetings, ideas and personal experiences that can enhance one's work are shared. Sometimes also, these associations provide a platform for its members to have access to needed inputs on a timely basis and even at reduced costs. Table 3 revealed that about 29 percent of the vegetable farmers belonged to a vegetable association. Thus, the modal class for membership of vegetable association was those who did not belong to any vegetable growers association. The modal class for the average monthly income obtained in the study was the less than N50,000. This may mean that the farmers were not high earners. Nonetheless, the mean figure for the user group was relatively higher than their non-user counterpart. Further statistical analysis showed that the difference was significant at one percent ($t\text{-cal} = 4.078$; $p = 0.001$). About 61 percent of the vegetable farmers had other sources of income apart from vegetable production. It is, however, worth mentioning that about 82 percent of those who had other sources of income got their income from trading, commercial bike riding, food vending, tailoring, bricklaying, carpentry, and other menial jobs. This may be attributed to the fact that most of the vegetable farmers had a low level of education. The mean amount of average monthly income from these other sources recorded was ₦8,450 with a minimum of ₦1,500 and a maximum of ₦50,000. Majority of the vegetable farmers got between ₦5,000 and ₦10,000 monthly from these sources. Further analysis shows that 80 percent of these vegetable farmers had just one source of income, while the remaining of them had two or three sources.

Table 4: Farmer's sources of information on liquid fertilizer

Characteristics	Frequency	Percentages
Source of 1st contact with liquid fertilizer		
Extension agents	10	11.49
Fellow farmers	28	32.18
Sales agent/Agro dealers	49	56.33
Total	87	100.0
The primary source of information on liquid fertilizer		
Extension agents	4	4.60
Fellow farmers	29	33.33
Sales agent/agro-dealers	52	59.77
Internet	2	2.30
Total	87	100.00

Source: Field Survey, 2015

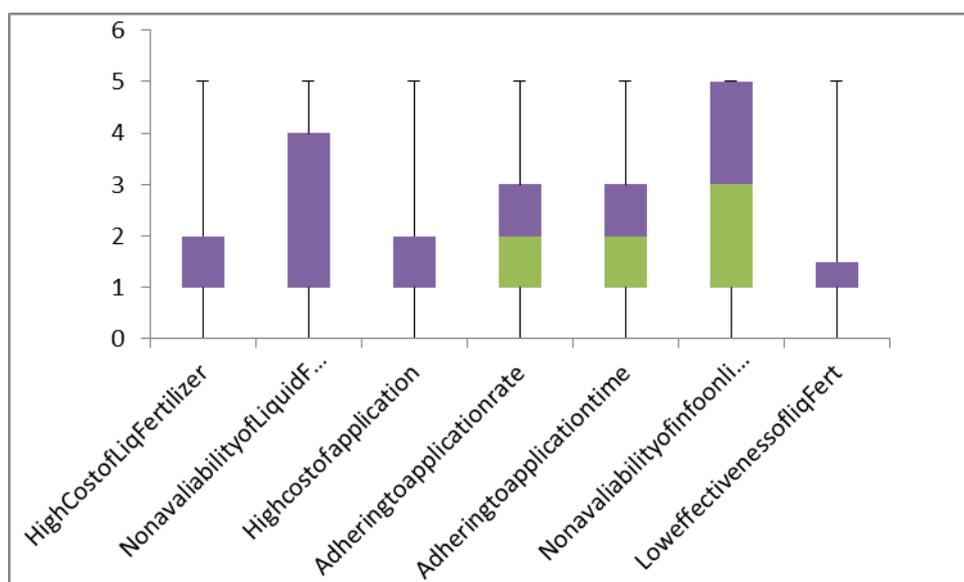
Table 4 shows the sources of information about liquid fertilizer, as stated by farmers. About 56 percent of the users of liquid fertilizer had their first contact with liquid fertilizer through sales agents. Thirty-two percent of them were introduced to liquid fertilizer by their fellow farmers. This means that they saw their colleagues using the liquid fertilizers and they inquired about them. The rest of them were introduced by extension agents. Access to extension services can be of tremendous help in boosting the efficiency of the farmers and also influence individual decisions of the farmers. Almost half of the vegetable farmers had no access to extension service during the production year. The modal class for those who had access was 1-5 times for both groups. The mean number of extension contacts was four times for users of liquid fertilizers, while it was three times for non-users. The maximum number of extension contacted recorded for the study for the dry season production period was 12 times. More than half of the users of liquid fertilizer get their information on the usage of liquid fertilizer from sales agents or agro-dealers who sell the fertilizers to them. Others rely on their fellow farmers, extension agents, and the internet, in that order, for information. These results suggest that the sources of information on liquid fertilizer usage are quite important as this could to a large extent make or mar the experience individual farmers have,

and this, in turn, would serve as a source of information for other farmers to learn about the new technology.

The severity of constraints encountered in the use of liquid fertilizers

This section discusses the limitations encountered in the field by the vegetable farmers who use liquid fertilizer. These constraints include the high cost of liquid fertilizer, low availability of the liquid fertilizer, high cost of application, difficulty of adhering to application rate and time, lack of adequate instruction on usage of liquid fertilizer, and the perceived low effectiveness of the liquid fertilizer. These are shown in Figure 1.

Figure 1: Box plot distribution of vegetable farmers according to the severity of challenges faced in the usage of liquid fertilizer



Source: Field survey, 2015

Figure 1 reveals that the major challenge faced by the users of liquid fertilizer was the lack of information on how to use the liquid fertilizer. More than half of the vegetable farmers (about 60%), sourced their information on liquid fertilizer at the point of purchase. These vegetable farmers usually buy their liquid fertilizer from Sales agents, Agro-dealers or Extension agents who usually do not have the adequate and correct information on the usage of these liquid fertilizers. The instructions on usage of liquid fertilizer intended to get to the users are written on the label wrapper on the one and four-liter containers of the liquid fertilizer. However, it was gathered during the Focus Group Discussion (FGD) that most of the liquid fertilizer used by the farmers were the 250ml bottles which were usually sold for between ₦650 and ₦1200 (€1 = ₦230) depending on location and type. These 250ml bottles are filled from the four-liter containers that were packaged by the manufacturers themselves. The preference for the smaller bottle was due to its affordability per time. Unfortunately, the smaller bottles that were re-packaged by the agro-dealers and sales agents did not come with the label wrappers that contain the instructions on how to use the product. As such, the farmers had no access to usage instructions. Hence, not consciously including the information on how to use these liquid fertilizers may increase the complexity of the technology, and decrease the compatibility of the product with values, experiences, and needs of the farmers. This will in principle discourage the farmers from adopting even a simple innovation. Apart from increasing the complexity of the product, the absence of the label wrappers can also reduce the confidence the farmers have in the genuineness of the product since the liquid fertilizers had no brand names. Also, identification of the brand of liquid fertilizers posed a challenge to the researcher. Thus, identification was done based on color in the absence of the label wrappers.

The second most severe constraint faced by users of liquid fertilizer was the relatively low availability of the liquid fertilizer at the time when it was needed. This was because, at the time of the field survey, it was noted that the majority of the liquid fertilizer sales was by sales

agents and Extension officers. This means that the availability of the products depended on the availability of these sales and Extension agents. This constraint may have reduced the trial phase of the product, thus discouraging interested farmers from using it.

Inability to adhere to application time and rate ranked third and fourth respectively. These constraints were however considered not to be serious by more than 60 percent of the vegetable farmers. This was because a majority (70%) of the farmers claimed that they did fertilizer application any time of the day it was convenient for them. Ten percent preferred to do it in the evening while the remaining 20 percent applied the fertilizer in the morning. One often-cited advantage of using liquid fertilizer is that it can be done at any time of the day, irrespective of whether or not irrigation has just been done. The same could not be said for non-liquid fertilizers where its application was dependent on time during the day (morning or evening) and could only be applied just before or after rainfall or irrigation so that the fertilizer granules can dissolve (Fernandez, Sotiropoulos & Brown 2013). It is worth mentioning at this point that one of the liquid fertilizers used by the farmers in the study was time-of-day dependent and this may have been disruptive to the routines and schedules of the vegetable farmers. According to Dobbins, Cockerill, and Barnsley (2001), innovations that are disruptive to routine tasks even when they bring a large relative advantage might not be adopted because of added instability.

The high cost of the liquid fertilizer and the high cost of application ranked 5th and 6th respectively among the constraints the vegetable farmers faced in its usage. More than 60 percent of the users of liquid fertilizer in the study considered these constraints as not serious. Sometimes, the introduction of innovation may come with increased cost such that a benefit (positive consequences of the innovation) – cost (adverse effects) analysis puts the change into a better perspective as to whether or not to adopt the change. Evidence from literature seems to suggest that no additional cost is incurred in liquid fertilizer application. In some instances, the farmers even saved some money in its application because they often timed pesticide application to coincide with fertilizer application so that only one cost of labor for application was incurred for both fertilizer and pesticide application (Dittmar 2007). This means that the 12 percent of the respondents who cited the high cost of application of liquid fertilizer as a serious constraint were probably not able to combine pesticide and fertilizer application and so had to pay separate labor charges for both farm operations. This inability may have been due to lack of knowledge on the part of the farmers.

Perceived low effectiveness of the liquid fertilizer ranked the least among the constraints identified. The box plot was the shortest and this suggests that overall, the respondents had a high level of agreement with each other.

Conclusion and policy recommendations

The study concluded that there was low usage of liquid fertilizer by vegetable farmers in the Southern Guinea Savannah zone of Nigeria. This was, despite the potentials that exist in its usage as an alternative source of fertilizer in dry season vegetable production to increase the productivity of the vegetable farmers, and ensure sustained dry season vegetable production. Based on the findings, it was recommended that more advertising should be done to communicate the availability and benefits of liquid fertilizer as an alternative source to granular fertilizers. Also, manufacturers of the liquid fertilizers should consider the possibility of ensuring that smaller units of the product with labeled wrappers are supplied in the study area. This will reduce the complexity associated with the usage of the product and encourage the farmers to use it. Also, there should be the periodic training of the Extension Officers on the latest information concerning the usage of the liquid fertilizer. This will also foster the availability of correct information on the product. Since many of the users of liquid fertilizer source their information from agro-shop dealers and sales agent, efforts should be made to give these people periodic training alongside the Extension Officers. Also, these liquid fertilizers should be made more readily available to encourage the vegetable farmers to try it, which may lead to usage and, then, adoption.

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