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Assessment of Challenges Limiting the Use of Manure among Smallholder Farmers - A Comparative Study of Quzhou County of China and Kwara State of Nigeria

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Abstract
The intensive use and long-term dependence on chemical fertilizer may have negative effects on plant growth, the soil and the environment, but the application of manure could alleviate these problems. However, farmers encounter challenges in the utilization of manure. This study investigated the factors limiting the use of manure among small-holder farmers in Quzhou county of China and Kwara state of Nigeria. A structured questionnaire was used to gather information about challenges, level of use, perception about the use of manure and socio-economic characteristics from 120 small-holder from each of the study areas selected through a three-stage sampling technique. Data obtained were subjected to both descriptive and inferential statistics. The descriptive statistics used include mean, standard deviation, frequency and percentage while Pearson product moment correlation coefficient (PPMC) analysis was used to test the hypothesis of the study. Based on data collected, results shows that very few smallholder farmers (17.5%) apply manure on their farms in Quzhou County while majority of about (90%) farmers use manure in Kwara state. The study also found that majority of the farmers in the study areas were above the youthful and active age of 40years with 58.3% and 68% in kwara and Quzhou respectively. Also, vast majority of about 80% and 98% in Kwara and Quzhou respectively are smallholder farmers who farm on between 0.10 to 2ha farmland, average age of 50.2years. The result from the study further shows that the farmers have a favorable perception and a fair knowledge about the use of manure in the study areas. The leading challenges found in China were: that preference for chemical fertilizer, offensive odour, slow nutrient release, difficulty in transporting (due to bulkiness of manure), low nutrient content and lack of knowledge on how to use manure ranked 1st-6th respectively while stress of drying and composting, difficulty in transporting, lack of knowledge on how to use, slow nutrient release, low nutrient and lack of storage space were the leading challenges limiting the use of manure found among farmers in Kwara state of Nigeria ranked 1st to 6th respectively. Finally, the result of two hypothesis tested revealed that ownership of livestock and access to extension service have some significant effect on the level of use of manure among farmers in Quzhou County of China while only farm size have a significant effect on the use of manure among farmers in Kwara state, Nigeria and only level of education has a significant effect on the perception about the use of manure among the farmers in Quzhou county, China while Age, farm size, livestock ownership, access to extension service and Household size were found to have significant effect on the perception of farmers in Kwara state of Nigeria about manure. Based on the following findings, it was recommended that researchers should look into a way of reducing bulkiness of organic fertilizer for easy transportation and government should improve extension service delivery and training of farmers on handling, composting and application of manure.
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Introduction

The global population has been forecasted to reach 9 billion by the year 2050, and the demands on food production will also increase (Bedddington, 2010; Timan et al., 2011). Chemical fertilizers have been intensively applied to agricultural systems to achieve higher yields, especially in China. China is the largest consumer of mineral fertilizers in the world and nitrogen (N) fertilizer usage increased from 25.3 million tons in 2002 to 31.1 million in 2015 (FAO, 2019; Zhang et al., 2013). N is essential for plant growth, so its application influences crop yield by establishing and maintaining photosynthetic and sink capacities (Below, 2001; Tilman et al., 2002; Zhang et al., 40 2015). However, crop yield does not necessarily increase linearly with N fertilizer input (Gu et al., 2017; Yang et al., 2017; Zhou and Klaus, 2014; Li et al., 2019; Du et al., 2019). Excessive N fertilizer use has increased nitrogenous greenhouse gas emissions and intensified global warming (Reay et al., 2012). Zhang et al. (2013) reported that for every t of N fertilizer manufactured and used in China, there was an equivalent emission of 13.5

t of carbon dioxide (CO2), Which is dramatically higher than the equivalent emissions in Europe (9.7 t CO2).

The transition to environmentally friendly farming practices and products has recently become popular among farmers and consumers throughout the world(Chouichom and Yamao, 2011). Farming using natural fertilizers and manure is also gaining attention and acceptance; although slowly in many developing countries due to some socio-economic constraints that makes the utilization of manure difficult and stressful. Smallholder farmers occupy a very significant position in global food security and nutrition. Majority of farmers most especially in Asia and Africa are smallholders that are usually described as resource poor. They operate on small lands usually less than 1ha and depend mostly on family labor and most times lack access to mechanization and processing equipment. One of the major characteristics of production systems of smallholder farmers are widely known to be of old technologies, simple, low in returns, high seasonal labor fluctuations and women playing a vital role in production(Department of Agriculture Forestry and Fisheries, 2012).However, despite all these challenges, the contribution of smallholder farmers to global food production is significant as they are responsible for up to 50% of the worlds' cereal, 60% of the world's meat and 75% of the world's dairy production(Kremen, Iles and Bacon, 2012).

Manure has been used for centuries as a fertilizer in agriculture and has been found to be a valuable resource that if well-handled and applied can improve soil qualities and supply nutrients to plants. The use of organic manures alongside inorganic fertilizers often lead to increased soil organic matter (SOM), soil structure, water holding capacity and improved nutrient cycling and helps to maintain soil nutrient status, cat-ion exchange capacity (CEC) and soil's biological activity (Saha *et al.*, 2008).But due to economic advancement and the need to produce more food to feed the ever increasing population of the world, there is a drastic continual increase in the use of chemical fertilizers world over. As a result, farmers now depends more on inorganic fertilizers because its quick release nature but this has not been helpful in so many ways. According to (FAO, 2006), the application of organic materials in agriculture has contributed immensely in converting poor fragile land of the world into staple productive ecological zones. In many cases, the use of organic fertilizer has been resulting into doubling of yields which makes an important contribution to increasing the food security of a region(Park *et al.*, 2008).

In order to efficiently use the nutrients in manure and to prevent water pollution caused by run-off or leaching of excess nutrients, it is important that land application of manure be based on crop nutrient needs. Since farms have increased in size and since specialization has caused concentration of livestock production in recent years, many farmers lack the amount of land required applying manure based on either nitrogen or phosphorus needs (Ribaudo, et al.). If livestock production is to continue in its current form, there is a need for crop farmers to use manure as an alternative or in supplement to commercial fertilizers in order to efficiently utilize nutrients in manure without degrading water quality. If crop farmers are not willing to accept manure for use as a fertilizer as a result of challenges associated with its use, then livestock farmers will face an ever-increasing problem of how to dispose of the animal waste produced on their farms which will in turn lead to many environmental issues. While alternative uses of manure are being studied, land application will remain important.(Núñez and McCann, 2004).

The use of Nitrogen based fertilizers have increased rapidly in China during the last two decades, as a response to the increasing demand for food by the rapidly growing human population(Wang *et al.*, 2007). The increasing use of N and P fertilizers and the neglect of manure and wastes as valuable resources of nutrients and soil organic matter(Ju *et al.*, 2005;Yang, 2006) have contributed to unbalanced fertilization, low fertilizer use efficiency, and to eutrophication of surface waters and contamination of the environment(Zhihong, 1996;Cai *et al.*, 2002;Bao *et al.*, 2006;Ju *et al.*, 2006). Wheeler (2008) identified a number of the problems which farmers faced in the use of organic manure. The problem includes slow effect of organic fertilizer, labor intensive, limited sources of manure, higher cost of organic fertilizer, storage of manures, and emergence of weeds and unfavorable smell of most of organic fertilizers. Lack of skills and technical knowhow are also constraints in the use of organic fertilizers identified by Pornpratansombat (2010). Other major constraints to increased adoption of the organic fertilizer include technological challenges, policies for quality control of organic products, and lack of or inadequate access to extension service that provide technical advice.

Many factors limiting the use of organic manure have been reported by various studies in Africa and other parts of the world. A study in south Africa by (Odhiambo and Magandini, 2015) found that transportation was the major constraint regarding manure use and that the main source of farm yard manure was from neighboring pens/kraal. This is contrary to the findings of (Alimi et al.,2006) in a similar study conducted in Nigeria which found that the major challenges facing farmers in using organic fertilizers are the doubtful efficacy and its offensive odor. If crop farmers are not willing to accept manure for use as a fertilizer, then livestock farmers will face an ever-increasing problem of how to dispose of the animal waste produced on their farms and this will consequently result to an environmental challenge(Núñez and McCann, 2004). While alternative uses of manure are being studied, land application will remain important. It is known fact that the use of manure alone cannot sustain food productivity but it provides an environmentally friendly alternative of improving soil nutrients and properties.

While China has been able to achieve high productivity in crop production over the years with the use of high chemical fertilizer which has resulted with some significant negative agronomic and environmental problems,

Nigeria on the other hand is suffering low productivity due to low nutrient input. The low use of chemical fertilizer which is low among Nigerian farmers can be attributed to the low local production capacity and high poverty rate among farmers while opposite is the case in China where local production of chemical fertilizer is higher making it affordable and available to farmers. The livestock industry in china has witnessed an impressive increase in numbers and this increase has resulted into availability of manure in the country. The quantity of manure generated by China's livestock industry has increased significantly as a result of the rapid increases in livestock numbers(Galvan et al., 2016). The quantity of manure generated increased by at least fourfold between 1980 and 2005, to an annual estimated total of 3060 million tons (Mt, fresh weight of manure) in 2005(Chadwick *et al.*, 2015).

Despite the numerous advantages associated with the use of manure and its abundance in china, the application of chemical fertilizers in 2010 was over 90percent. As a result, soil acidification is a major problem in soils of intensive Chinese agricultural systems(Galvan et al., 2016). Two nationwide surveys showed that soil pH declined significantly ($P < 0.001$) from the 1980s to the 2000s in the major Chinese crop-production areas (Guo *et al.*, 2010). As a result of low economic power among smallholders farmers in Nigeria coupled with the high cost and low availability of fertilizers needed in crop production, manure seems to be a cheap alternative source of plant nutrient. Meanwhile, in order to improve the use of manure among farmers, understanding the many factors and challenges farmers face in making use of this resource will contribute greatly to solving the problems. Given the aforementioned problems, it is critical and necessary to assess the factors limiting the use of organic manure by smallholder farmers, this will provide valuable information for designing appropriate strategies and policy measures that will address such constraints, promote an increase in the use of organic fertilizers and consequently improve crop yield and better soil quality. The general objective of this study is therefore to comparatively assess factors limiting the use of organic manure among small-holder farmers in Quzhou county of China and Kwara state of Nigeria.

To meet the general objective, the study will focus on the following specific objectives:

- To determine the socio-economic factors that influences the use of organic manure among smallholder farmers.
- To identify challenges and limiting factors with regards the use of organic manure
- To assess the extent of use of organic manure among smallholder farmers
- To investigate the perception and level of knowledge among smallholder farmers about organic manure

This study tested for the following hypotheses:

H_1: there is a significant relationship between some selected socio-economic characteristics of respondents and the level of use of organic manure.

H_2: there is a significant relationship between perception about organic manure and level of use of organic manure.

MATERIALS AND METHOD

Description of the study area

As a comparative study, this study was conducted in two different and separate location, Quzhou County of China and Kwara state of Nigeria.

Quzhou is a typical agricultural county (114°50′ 22.3′ ′ E–115°13′ 27.4′ ′ E, 36°35′ 43′ ′ N–36°57′ N) situated about the Centre of the North China Plain (NCP) which is a region with intensively managed cereal production systems, producing 38% of agricultural products in China. Rotation of winter wheat (Triticum aestivum L.) and summer maize (Zea mays L.) is the dominant cropping system(Shen *et al.*, 2016). Quzhou County is also a host community to one of the Science and Technology Backyards experimental stations of China Agricultural University in which new agricultural technologies are developed and demonstrated. It has a total population of 433,000 and arable land of 66,700 ha, with 93,074 farming families living in 342 villages within 10 townships, Per capita arable land is about 0.15 ha; per capita, net agricultural income was US$944 in 2008 in rural households which is far below the US$2,290 in urban households(of Statistics of China, 2015).

Kwara state is located between longitudes 4º-6º East of Greenwich Meridian and between latitudes 8º-10º north of the Equator and it covers a land area of about 32,500 km2. Kwara state has two main climate seasons, dry and wet. The natural vegetation comprises of wooded and rain forest savannah, with annual rain falls ranging between 1,000 to 1,500 mm while the average temperature lies between 30°C and 35°C (FOS, 1995). Kwara State has about 36,820 hectares of farmland. According to the 2006 census reports, the population of Kwara state stood at 2.37 million consisting of mostly the Yoruba, Nupe and Baruba ethnic groups (NPC, 2007).

Population of the study

The population for this study was all small holder crop farmers in Quzhou county of China and Kwara state of Nigeria.

Sampling procedure and sample size

Data for this study was obtained through a multiple stage sampling technique at the two study areas. In the first stage, Quzhou County was selected due to its prominence in farming. In the second stage, two (2) STB villages (Wangzhuang and Fuzhuang STB villages) were purposively selected. In the third stage with the help of local Chinese students, sixty (60) smallholder farmers will be randomly selected from each of the two (2) villages to give a total sample size of one hundred and twenty (120) respondents.

While in kwara state, three (3) local government areas (LGA); namely: Asa, Ilorin east and Ilorin south were randomly selected out of the sixteen LGAs in the state. The second stage involved the purposive selection of two (2) communities known for arable farming in each of the local government previously selected. The third stage involved the random selection of twenty (20) arable farmers in each of the communities. This gave a total of one hundred and twenty (120) respondents that were selected for this study. Questionnaire was used to gather information from these respondents using an interview schedule format and observations by the researcher on the field.

Instrument and data collection

The research was carried out in November 2020 following the pretest conducted one month earlier. An interview schedule through a structured questionnaire was used for this study as the instrument to gather information from respondents. The questionnaire focused and gather relevant information on areas such as: perception and level of awareness about manure, challenges and limiting factors of using manure, level of manure use and lastly socio-economic characteristic such as farm size, household size, age and farming experience of the farmers.

The interview schedules were composed of open-ended question, closed questions and some likert scaled questions as well. The modified interview schedule includes 18 statements of opinions regarding organic fertilizer use. The received responses were scored on a five (5) and three (3) point Likert scale ranging from "strongly agree (5)" to "strongly disagree (1)" and from "very severe (3)" to "Not severe (1)" respectively. The questionnaire was translated to the local language and administered to the respondents with the help of two Chinese partner attached to the researcher to bridge the communication gap that exist in china. While experienced extension officers were used in administering the questionnaire in Kwara state, Nigeria.

Data analysis

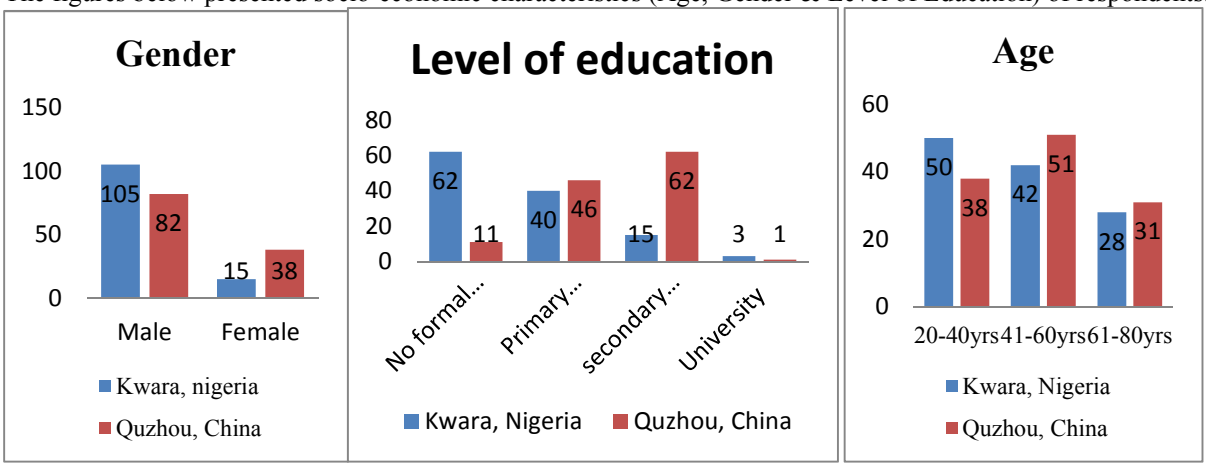
Data collected was analyzed using both descriptive and inferential statistics. The descriptive statistics included mean, standard deviation, frequency and percentage while the hypothesis was tested using Pearson Product Moment Correlation (PPMC) analysis.

Results and Discussions

Socio-economic characteristics

Age, Gender and Level of Education

The figures below presented socio-economic characteristics (Age, Gender & Level of Education) of respondents.



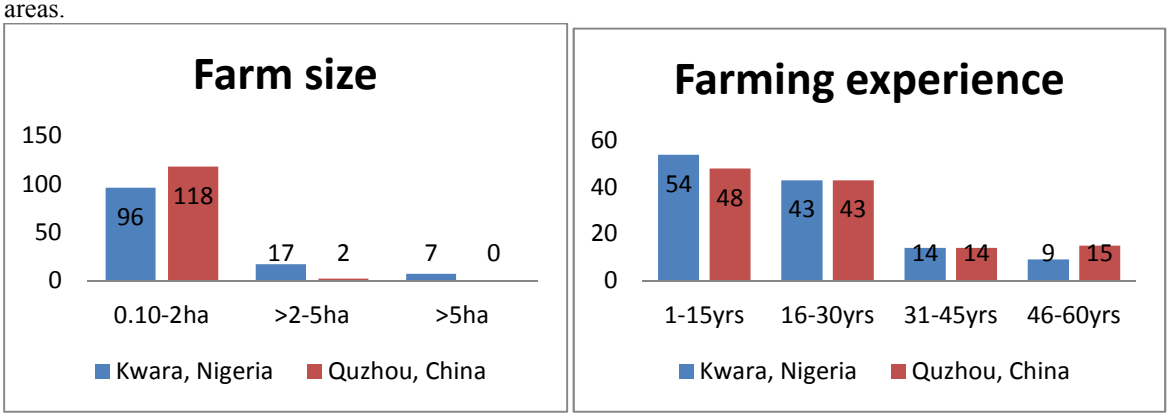
Source: Field survey, November 2020

Figures above shows result of socio-economic characteristics like gender, level of education and age of respondents. The result shows that majority of farmers in the study areas are of male gender with 88% and 68% male in kwara and Quzhou respectively. The result also shows a very low level of education (52%) with no formal education and only about 12% were educated up to the secondary level (minimum compulsory education level in Nigeria) in kwara state. This implies that farmers in Kwara are likely adhere to old method of agricultural practices than to venture into new innovations and thus, give preference to manure usage over of inorganic fertilizers. The

educational attainment of farmers in Quzhou, China was found to be higher with only (9%) with no formal education and over 50% having up to secondary school education. Regarding age of farmers, the study revealed a larger population of older generations among farmers in the two study areas with 58% and 68% above 40 years age bracket in Kwara and Quzhou respectively.

Farm size and Farming experience

The figures 8-10 below show the farm size and farming experience of smallholder farmers from the two study areas.

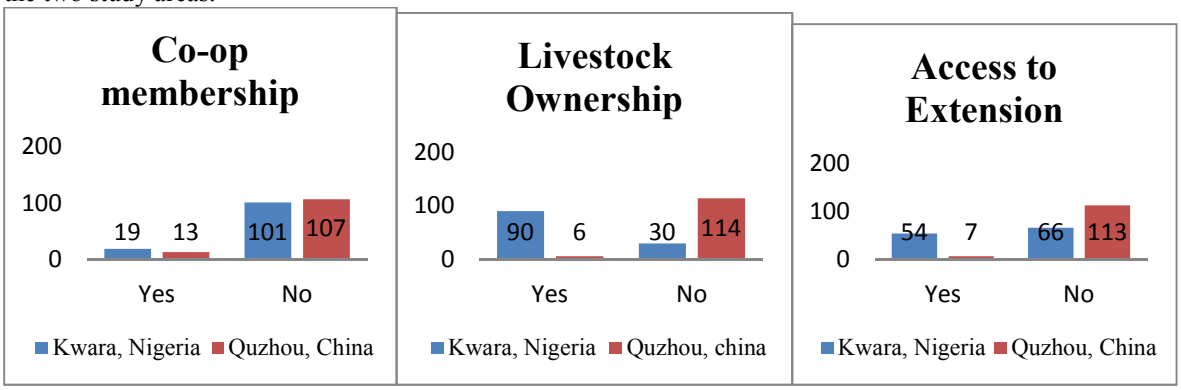


Source: Field survey, November 2020

Figures above shows result of socio-economic characteristics like farm size and farming experience among respondents. The results reveal that the average size of farm size among farmers in Kwara and Quzhou is 1.8ha and 0.85ha respectively. This shows that farmers in the study areas are majorly smallholders. Also, the result shows that the average farming experience is 23.82yrs and 26yrs in Quzhou and Kwara respectively, this signify a fairly high farming experience among the farmers which is an advantage because having a wide breadth of farming experience could aid better adoption and utilization of innovation and technology.

Co-op membership, Access to extension & Livestock ownership

The figures 11-13 below show the Co-op membership, access to extension service and livestock ownership from the two study areas.

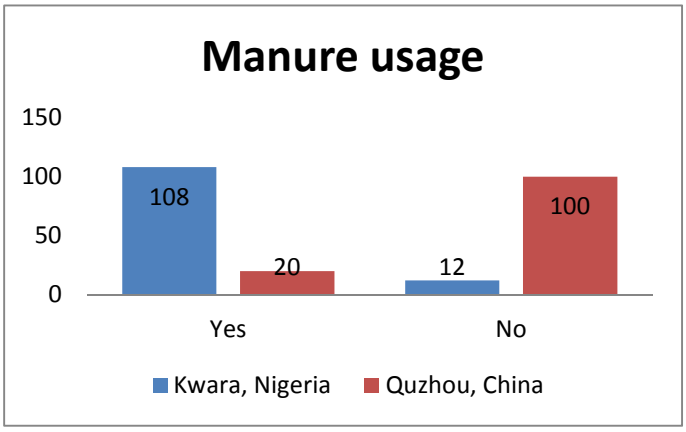


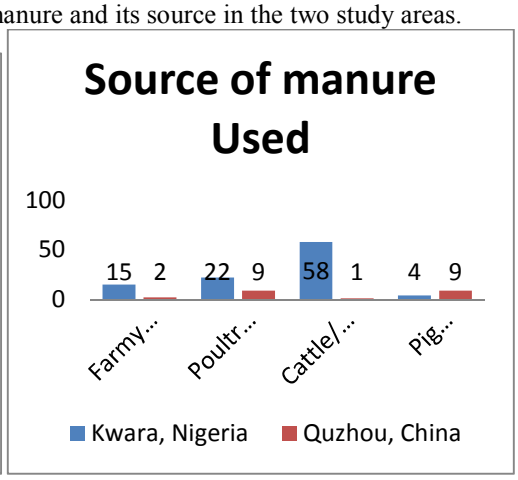
Source: Field survey, November 2020

The above figures shows results of level of co-op membership, livestock ownership and access to extension services among respondents in the study areas. The results show a very low membership of co-operative society among farmers in the two study area. It also shows that very few (5%) rear livestock and few (6%) have access to extension service about manure of in Quzhou while majority (75%) and close to half (45%) of respondents rear livestock and have access to extension services about manure in Kwara state respectively. According to Kassie et al. (2009) argued that farmers who have regular contact with agricultural experts are more likely to adopt agricultural technologies. Similarly, Ajewole (2010) claimed that the frequency of extension visits increased the possibility of commercial organic fertilizer adoption in Nigeria. Lastly, low level of livestock ownership among the farmers has been found by similar studies to influence the use of manure among farmers. Example is (Gelgo, 2016) who submitted that low livestock ownership could be the cause of low adoption rate of organic fertilizer

Level of manure use

Figure 9 & 10: Distribution of respondents based on usage of manure and its source in the two study areas.





Source: Field survey, November 2020

Figure above represent the result of level of use of manure in the two study area. The result of the study reveals that few (17%) of farmers in Quzhou County uses manure, while majority (90%) of farmers in Kwara state, Nigeria uses manure. This can be linked to the higher level of livestock ownership among farmers in Kwara state which provide an immediate source of manure and also factors such as availability and affordability of inorganic fertilizer in china whereas the opposite is the case in Nigeria while preference for chemical fertilizers among farmers in Quzhou due to its affordability and accessibility is also responsible for the low usage of manure. Figure 10 represent sources of manure in the two study area, it shows that cattle/sheep manure is the leading source of manure among respondents in kwara and pig manure is the leading source of manure in Quzhou. This is due to the high number of farmers keeping sheep as a livestock in kawara and the wider popularity of piggery in Quzhou.

Factors and challenges limiting the use of manure

The results of factors and challenges limiting the use of manure among smallholder farmers in Quzhou County of china and kwara state of Nigeria are presented below:

Table 1: Severity of challenges/limiting factors affecting the use of manure among participants (Quzhou county, China)

Constraints	Very severe	Severe	Not severe	Mean	Rank
Preference for chemical fertilizer	57(47%)	48(40%)	15(12.5)	2.35	1st
Offensive odor	54(45%)	49(41%)	17(14%)	2.31	2nd
Slow nutrient release	46(38%)	62(52%)	12(10%)	2.28	3rd
Difficulty in transporting	53(44%)	45(38%)	22(18%)	2.26	4th
Low nutrient content	41(34%)	65(54%)	14(12%)	2.22	5th
Lack of knowledge on how to use manure	43(35%)	59(50%)	18(15%)	2.21	6th
Attracts insects and pests	35(29%)	63(53%)	22(18%)	2.11	7th
Stress of drying or composting	30(25%)	67(56%)	23(19%)	2.06	8th
Doubtful efficacy	25(21%)	73(61%)	22(18%)	2.02	9th
Availability of manure	29(25%)	63(53%)	28(22%)	2.01	10th
Problems of weed seeds in manure	30(25%)	60(50%)	30(25%)	2.00	11th
Lack of storage space	26(22%)	65(54%)	29(24%)	1.97	12th

Table 2: Severity of challenges/limiting factors affecting the use of manure among participants (Kwara state, Nigeria)

Constraints	Not Severe	Severe	Very Severe	Mean	Rank
Stress of drying or composting	Nil	7(5.8%)	113(94.2%)	2.9417	1st
Difficulty in transporting	Nil	11(9.2%)	109(90.8%)	2.9083	2nd
Lack of knowledge on how to use	2(1.7%)	10(8.3%)	108(90%)	2.8833	3rd
Slow nutrient release	4(3.3%)	14(11.7%)	102(85%)	2.8167	4th
Low nutrient content	4(3.3%)	21(17.5%)	95(79.2%)	2.7583	5th
Lack of storage space	2(1.7%)	28(23.3%)	90(75%)	2.7333	6th
Doubtful efficacy	6(5%)	28(23.3%)	86(71.7%)	2.6667	7th
Availability	Nil	43(35.8%)	77(64.2%)	2.6417	8th
Attracts insects and pests	15(12.5%)	68(56.7%)	37(30.8%)	2.1833	9th
Preference for inorganic fertilizer	28(23.3%)	45(37.5%)	47(39.2%)	2.1583	10th
Problem of weed seeds in manure	15(12.5%)	71(59.2%)	34(28.3%)	2.1583	10th
Offensive odour	30(25%)	51(42.5%)	39(32.5%)	2.075	12th

Field survey: November, 2021

The two table above revealed the severity of the challenges/limiting factors that affects the use of manure among smallholders farmers in Quzhou county of China and Kwara state, Nigeria. The challenges were ranked using the means score computed from the 3 point Likert scale type. The leading challenges found in China were: that preference for chemical fertilizer, offensive odour, slow nutrient release, difficulty in transporting (due to bulkiness of manure), low nutrient content and lack of knowledge on how to use manure ranked 1st-6th respectively while stress of drying and composting, difficulty in transporting, lack of knowledge on how to use, slow nutrient release, low nutrient and lack of storage space were the leading challenges limiting the use of manure found among farmers in Kwara state of Nigeria ranked 1st to 6th respectively. The two results are similar to the findings of similar study by (Odhiambo and Magandini, 2008) in south Africa, (Alimi *et al.*, 2006) and (Usman *et al.*, 2016) in Nigeria.

Perception and level of awareness about manure

Table 3: Distribution of participants based on their awareness and knowledge about the use of manure (Quzhou County, China)

Perception statement	strongly agree	Agree	Undecided	disagree	strongly disagree	Mean	Rank
Manure can improve crop yield	48(40%)	67(56%)	5(4%)	--------	---------	4.36	1st
Manure can improve water holding capacity of soil	43(36%)	66(55%)	11(9%)	---------	--------	4.27	2nd
Manure is not easy to handle like chemical fertilizer	36(30%)	77(64%)	3(3%)	2(1.5%)	2(1.5%)	4.19	3rd
Manure is a good source of plant nutrient	22(18%)	94(78%)	4(4%)	--------	--------	4.15	4th
Manure increase organic matter in soil	31(26%)	75(62%)	14(12%)	-----	-------	4.14	5th
Manure help improve soil structure	32(26%)	69(58%)	19(16%)	--------	-------	4.11	6th
Manure promotes activities of soil organisms	30(25%)	66(55%)	24(20%)	--------	-------	4.05	7th
Use of manure can ease soil preparation	27(23%)	58(48%)	27(22%)	8(7%)	--------	3.87	8th
Manure increases cost of production	21(17%)	72(60%)	18(15%)	7(6.5%)	2(1.5%)	3.86	9th
Use of manure pollutes farm and its environment	18(15%)	60(50%)	36(30%)	6(5%)	--------	3.75	10th
Handling of manure is dangerous to health	15(12%)	51(43%)	39(33%)	15(12%)	--------	3.55	11th

Table 4: Distribution of participants based on their perception and knowledge about the use of manure (Kwara state, Nigeria)

Perceptions	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Mean	Rank
Organic manure is a good source of plant nutrient.	82(68.3%)	37(30.8%)	1(0.8%)	Nil	Nil	1.325	1st
Organic manure can improve water holding capacity of soil.	59(49.2%)	60(50%)	1(0.8%)	Nil	Nil	1.5167	3rd
Organic manure can increase crop yield.	77(64.2%)	41(34.2%)	2(1.7%)	Nil	Nil	1.375	2nd
Organic manure helps improve the soil structure.	53(44.2%)	63(52.5%)	3(2.5%)	1(0.8%)	Nil	1.6	4th
Organic manure can increase the organic matter in the soil.	51(42.5%)	61(50.8%)	8(6.7%)	Nil	Nil	1.6417	5th
Organic manure also promotes the activities of soil microbes.	17(14.2%)	72(60.0%)	31(25.8%)	Nil	Nil	2.1167	6th
Organic fertilizer use can ease soil preparation and plowing.	15(12.5%)	28(23.3%)	56(46.7%)	20(16.7%)	1(0.8%)	2.7	7th
Use of organic manure pollutes the farm and its environment.	2(1.7%)	24(20.0%)	10(8.3%)	66(55.0%)	18(15.0%)	3.6167	9th
Handling of organic manure is dangerous to health.	Nil	4(3.3%)	11(9.2%)	73(60.8%)	32(26.7%)	4.1083	10th
Use of organic manure does not reduce cost of production.	18(15.0%)	26(21.7%)	11(9.2%)	48(40.0%)	17(14.2%)	3.1667	8th
Organic manure is not easy to handle like chemical fertilizer	1(0.8%)	1(0.8%)	1(0.8%)	62(51.7%)	55(45.8%)	4.4083	11th

Source: Field survey, November 2021

Table 3 and 4 shows the farmers perception about the use of manure in the two study area. The perception was measured with statements on five point Likert type scale of strongly agree which was assigned values of five (5) to strongly agree and value of one (1) to strongly disagree. The respondents indicated their responses to 11 statements on the rating scale provided. The result from the tables revealed that farmers in the two study area have a favorable perception and a fair knowledge about manure. This may be associated and linked to the appreciable level of education among respondents in Quzhou County and the long years of farming experience among farmers

in the two study areas. This result is in consonance to that of a similar study conducted by (Usman et al., 2016) in Nigeria.

Testing of hypothesis

H_1: Relationship between some selected socio-economic characteristics and the level of use of manure among participants.

- Table 8: Quzhou county, China

Variables	r-value	p-value	Decision
Age	0.013	0.888	Not significant
Farm size	0.082	0.374	Not significant
Level of Education	0.089	0.331	Not significant
Livestock ownership	0.297**	0.001	Significant
Access to extension service	0.260**	0.004	Significant

Source: Farmer's survey (November, 2021)

Correlation is significant at 0.01 (2 tailed)

Table 9: Kwara state, Nigeria

Variables	r-value	p-value	Decision
Age	0.023	0.799	Not significant
Farm size	-0.189**	0.039	Significant
Level of Education	-0.104	0.258	Not significant
Livestock ownership	0.150	0.102	Not significant
Access to extension service	0.171	0.062	Not significant

Source: Farmer's survey (November, 2021)

Correlation is significant at 0.01 (2 tailed)

Table 5 and 6 above represent the result of the Pearson Product Moment Correlation analysis of the hypothesis testing the relationship between some socio-economic characteristics of respondents and its effect on the level of manure use.

The results on the tables above showed that ownership of livestock (r = 0.297, p = 0.001) and access to extension service (r = 0.260, p = 0.004) have some level of significant effect on the level of use of manure among farmers in Quzhou County of China while only farm size (r = -0.189, p = 0.039) have a significant effect on the use of manure among farmers in Kwara state, Nigeria. The interpretation of this is that an improvement in livestock ownership, access to extension service and farm size will be accompanied with corresponding improvement in the use of manure among farmers and vice-versa. This is because livestock ownership provides an immediate source of manure and farmers who have better access to extension services are found to have higher adoption rate. This support the result of a study by Ajewole (2010) which claimed that the frequency of extension visits increased the possibility of commercial organic fertilizer adoption in Nigeria and a study in Ethiopia by (Gelgo, 2016) who found that no to low level of livestock ownership to be a cause for no or low use of manure because they do not own enough livestock which may provide them manure.

H_2: Relationship between some selected socio-economic characteristics and the perception about the use of manure.

- Table 10: Quzhou county, China

Variables	r-value	p-value	Decision
Age	0.125	0.888	Not significant
Farm size	0.071	0.374	Not significant
Livestock ownership	0.010	0.331	Not significant
Access to extension service	-0.015	0.001	Not significant
Level of Education	-0.284**	0.002	Significant

Source: Farmer's survey (November, 2021)

Correlation is significant at 0.01 (2 tailed)

Table 11: Kwara state, Nigeria

Variables	r-value	p-value	Decision
Age	-0.259**	0.004	Significant
Farm size	0.335**	0.000	Significant
Level of Education	0.104	0.257	Not significant
Livestock ownership	-0.048	0.603	Not significant
Access to extension service	-0.342**	0.000	Significant
Household size	0.220*	0.016	Significant

**Correlation is significant at 0.01(2-tailed)

*Correlation is significant at 0.05(2-tailed)

Table 7 and 8 above represent the result of the Pearson Product Moment Correlation analysis of the hypothesis testing the relationship between some socio-economic characteristics of respondents and its effect on the level of manure use.

The results on the table revealed that among all other socio-economic parameters tested, only the level of education (r = -0.284, p = 0.002) has a significant effect on the perception/knowledge about the use of manure

among the farmers in Quzhou county, China. While Age (r = -0.259, p = 0.004), Farm size (r = 0.335, p = 0.000), Livestock ownership (r = -0.048, p = 0.603), Access to extension service (r = 0.342, p = 0.000) and Household size (r = 0.220, p = 0.016) were found to have significant effect on the perception of farmers in Kwara state of Nigeria about manure. The implication of this is that educated farmers are more likely to have favorable perception and know the benefits of manure more than the less educated ones as they are likely to be aware and adopt innovation faster than their uneducated counterparts. The result also revealed that age (older farmers) having learnt from long term farming experience, farm size; owning a bigger farm, household size; having enlightened households and access to extension services increases the chances of knowing the importance of benefits of manure. This result is in line with the findings of Ajewole (2010).

CONCLUSION, SUMMARY AND RECOMMENDATIONS

Conclusion

If livestock production is to continue in its current form, there is a need for crop farmers to use more manure as an alternative or in supplement to commercial fertilizers in order to efficiently utilize nutrients in manure without degrading water quality. However, if crop farmers are not willing to accept manure for use as a fertilizer as a result of challenges and constraints associated with its use, then livestock farmers will face an ever-increasing problem of how to dispose of the animal waste produced on their farms which will in turn lead to many environmental issues that will affect all negatively. Therefore, in order to achieve this; we must find ways to understanding the challenges that farmers face in using manure which ultimately limits its usage as this will pave way for a sustainable and real time solutions to these problems.

Summary

The intensive use and long-term dependence on chemical fertilizer may have negative effects on plant growth, the soil and the environment, but the application of manure could alleviate these problems. However, farmers encounter challenges in the utilization of manure. This study investigated the factors limiting the use of manure among small-holder farmers in Quzhou county of China and Kwara state of Nigeria. A structured questionnaire was used to gather information about challenges, level of use, perception about the use of manure and socio-economic characteristics from 120 small-holder from each of the study areas selected through a three-stage sampling technique. Data obtained were subjected to both descriptive and inferential statistics. The descriptive statistics used include mean, standard deviation, frequency and percentage while Pearson product moment correlation coefficient (PPMC) analysis was used to test the hypothesis of the study.

Based on data collected, results shows that very few smallholder farmers (17.5%) apply manure on their farms in Quzhou County while majority of about (90%) farmers use manure in Kwara state. The study also found that majority of the farmers in the study areas were above the youthful and active age of 40years with 58.3% and 68% above 40 years in kwara and Quzhou respectively. Also, vast majority of about 80% and 98% in Kwara and Quzhou respectively are smallholder farmers who farm on between 0.85ha to 1.8ha farmland. The result from the study further shows that the farmers have a favorable perception and a fair knowledge about the use of manure in the study areas. The leading challenges found in China were: that preference for chemical fertilizer, offensive odour, slow nutrient release, difficulty in transporting (due to bulkiness of manure), low nutrient content and lack of knowledge on how to use manure ranked 1st-6th accordingly while stress of drying and composting, difficulty in transporting, lack of knowledge on how to use, slow nutrient release, low nutrient and lack of storage space were the leading challenges limiting the use of manure found among farmers in Kwara state of Nigeria ranked 1st to 6th accordingly. Finally, the result of two hypothesis tested revealed that ownership of livestock and access to extension service have some level of significant effect on the level of use of manure among farmers in Quzhou County of China while only farm size have a significant effect on the use of manure among farmers in Kwara state, Nigeria. Also, only level of education has a significant effect on the perception/knowledge about the use of manure among the farmers in Quzhou county, China while Age, farm size, livestock ownership, access to extension service and Household size were found to have significant effect on the perception of farmers in Kwara state of Nigeria about manure.

Recommendations

Based on the results and findings of this study, the following recommendations are made:

- Extension services to the farmers are not easily accessed by the farmers in the study areas. There is therefore need for the government to train more agricultural extension staff to cater for the majority of farmers.
- Enlightenment and training campaigns should be done through extension agent to sensitize, enlighten and train farmers in the study area about the potentials and benefit of using manure as this will stimulate the use of manure among farmers.
- Governments should improve in the provision of access roads in farming communities so as to ease the

movement of manure by crop farmers

- Improvement on training and retraining of farmers about best practice of handling, composting and application of manure. This will equip farmers with the required knowledge and encourage them to use manure.
- Farmers should be encouraged and sensitized on the benefits of belonging to co-operative groups and associations where they can put resources together to purchase and transport organic manure and other agro-inputs materials in a cheaper and easier way as a group rather than individually.
- Government should develop ways to promote Livestock ownership among farmers in the study area as this will not only serve as source of manure but also provide an additional source income and a mean of improving their livelihood.
- Researchers should work together with farmers towards developing technologies and strategies that will solve problems farmers face in using manure like bulkiness, odor, and stress involved in composting and application.
- Lastly, the government and other development partners should promote the commercialization and adoption of the organic fertilizer as this will serve as a way to utilize the manure to provide a sustainable source of plant nutrient to farmers.

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