



Assessment of Factors that Limit Optimal Use of Organic Fertilizers in Subsistence Food Production in Vihiga County, Kenya

Mary J. Kipsat ^{a*}, D. O. Osewe ^a and Mose Phoebe Bwari ^a

^a *Department of Agricultural Economics and Rural Development, Maseno University, Kenya.*

Authors' contributions

This work was carried out in collaboration between all authors. Author MJK designed the study and wrote the first draft of the manuscript. Author DOO performed the statistical analysis and managed the literature searches. Author MPB edited the manuscript. All authors read and approved the final manuscript

Article Information

DOI: 10.9734/IJECC/2021/v11i1130545

Editor(s):

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<https://www.sdiarticle5.com/review-history/75715>

Original Research Article

Received 09 August 2021

Accepted 18 October 2021

Published 06 December 2021

ABSTRACT

In the face of skyrocketing prices of inorganic fertilizers, organic materials are considered the alternative sources of fertilizers. Research institutions have over the years succeeded in demonstrating high yield responses to recommended usage of organic fertilizers. Furthermore, organic fertilizer (biofertilizers) is a vital component of sustainable agriculture. The sound management of organic fertilization must attempt to ensure both an enhanced and safeguarded environment. Most Farmers in Vihiga County have adopted use of organic fertilizers. Despite this, crop yields remain low in farmers' fields due to low soil fertility and inability of farmers to optimally use organic fertilizers. Researchers often use optimal organic materials recording high yields in experimental and farm demonstration fields. Little or no research has been done to determine why farmers still record low yields despite a lot of extension outreaches to promote available organic matter technology packages in the study area. This paper reports findings of a study carried out to determine factors that limit optimal use of organic fertilizer by farmers in Vihiga County, Kenya. The objective of the study was to compare organic fertilizer usage in farmers' field with optimal

*Corresponding author: E-mail: mjkipsat@maseno.ac.ke;

(recommended) rates to determine if the usage were significantly different. This was aimed at providing advice based on empirical evidence to farmers on whether there is need to improve usages of organic fertilizer and to determine if low intensity of organic fertilizer was a possible cause of recorded low yields in farmers' fields. Purposive sampling was used to select farmers who were using organic fertilizer for soil fertility. A total of 120 farmers were selected to provide data needed for the study. Primary data was collected using questionnaires and data was analyzed using descriptive statistic (t-test). The results of the analysis indicated a significant difference in the usage between what farmers applied and what was recommended by research. Usages of organic fertilizer among the sampled farmers were much lower than the recommended levels explaining the low maize yields among farmers in the study area. The study rejected the hypothesis that the farmers' usages of organic fertilizer was not statistically significant different from that recommended by research institutions. This is because average usage of organic fertilizer of 320.3 kg/ha was significantly below those recommended by researcher of 5ton/ha (at 99% usage. Farmers must follow appropriate promoted technology recommendations. The study recommended promotion of organic fertilizer. Farmers should be sensitized on the need to bridge the gap between the current and the recommended usage for them to realize the benefits of organic fertilizer.

Keywords: Usage; organic fertilizers; subsistence food production; Kenya.

1. INTRODUCTION

Declining soil fertility is the fundamental biophysical root cause for the declining percapita food production in Kenya [1]. Organic fertilizers, if used in the right amounts can be as effective as chemical fertilizers. They are required in large amounts (5 tons/ha) to meet plant nutrient requirements [2]. Organic fertilizer is often applied by broadcasting and hoeing or raking it into the top soil. Chemical fertilizers contain soluble mineral salts that plant roots can absorb quickly explaining why they are needed in small amounts (50 kg/ha). High chemical fertilizer prices however have resulted in many farmers not adopting recommendations for major soil types and individual crops in Kenya's representative soils [3,4].

Small scale farmers in Kenya often apply suboptimal usages of inorganic fertilizers making it hard for farmers to achieve potential yields of hybrid crop varieties [5]. [6] noted chemical fertilizer use as low as 5% of recommended usages. [6] proposed that other forms of solving food insecurity problems other than exclusive use of chemical fertilizers be put in place. According to [7] fertilizers are a recurring cost of production that must be paid for by increased crop yields. [8] noted that non-conventional fertilizer use in soil fertility management ought to be promoted since it is environmentally friendly and more cost effective than conventional fertilizers. [9] advocated exclusive use of organic inputs for soil fertility as a logical alternative to expensive fertilizers in Africa. Organic matter rich in carbon and poor in nitrogen enriches soil in

humus and are applied in substantial amounts of up to 5.5 tons/ha [9].

Feeding over 6 billion people-and over 9 billion by 2050-will require a wide range of creative, sustainable agricultural systems which not only provide food, but also but also factor in the economic value of nature-based services such as organic fertilizer that underpin agriculture [8]. Animal manure and plant materials are bulky and are needed in large amounts because of their low nutrient content, difficulties in preparation, lack of constant supply due to low livestock numbers and high labor demands for collection, storage, transportation and application in fields [9,10]. They contain from 1- 4% N (10-40g N/kg) on a dry weight basis, while inorganic fertilizers contain from 20-46% N (200-460 g N/kg) [2]. To haul 100 kg N needed for a 4 ton/ha maize crop, it would take 0.217 tons of urea or 20 tons of leaf biomass [10, 2]. Organic inputs are low suppliers of P due to their low P concentration [2,11]. Technically feasible yields have been obtained under research conditions. However, crop yields are still low in farmers' fields. The purpose of this study was to compare usages of organic fertilizer with the research recommendations. The study postulated that usages of organic fertilizer were not significantly different from recommended usages.

2. METHODOLOGY

The study was carried out in Emuhaya, Sabatia and Luanda divisions of Vihiga County (Fig. 1). The County's warm and humid climate supports growing of most crops. However, the soils are of

low fertility, limited water-holding capacity and are prone to erosion due to their sandy texture, high land use intensity and heavy rainstorms. The low agricultural productivity in Vihiga County has resulted in food insecurity. Crop yields have continued to decline despite the existence of already developed technologies that farmers could use to improve soil fertility.

The population was divided into three sampling units represented by the three selected divisions, selected based on agro-ecological zonation. Purposive sampling was used to select respondents according to recommendations by Kothari and Garg [12]. Farmer's willingness to participate in the study determined whether the purposively selected farmers provided data or not. Data was collected from at least two farms from each sub-location in which a total of 80 respondents were interviewed. A household was the enumeration unit and was defined as a decision-making unit at farm usage.

The target population sampled was the set of resource poor farmers who used organic fertilizer in subsistence maize and bean production in the study area. This study recognized the role maize

and bean production play in meeting food needs of residents in Vihiga County.

Ten trained agriculture staff/field extension workers familiar with the local language and customs served as enumerators, orally administering questionnaires during data collection exercise. Questionnaires were pre-tested with a random sample of 8 farmers in Tiriki Division of Vihiga County. Information concerning households was provided by heads of selected household.

Primary data on usage of organic fertilizer in sampled farms was obtained from selected farmers. Information on the recommended usags of organic fertilizer that was needed for optimal crop yields was obtained from research publications in libraries of institutions such as KARI, ICRAF, KEFRI, UNEP, Moi University and NGOs such as ABLH.

Farmers' usage was postulated not to be statistically different from recommended usages. Data collected was subjected to t-test to compare the difference between mean of use usages and that recommended by researchers.

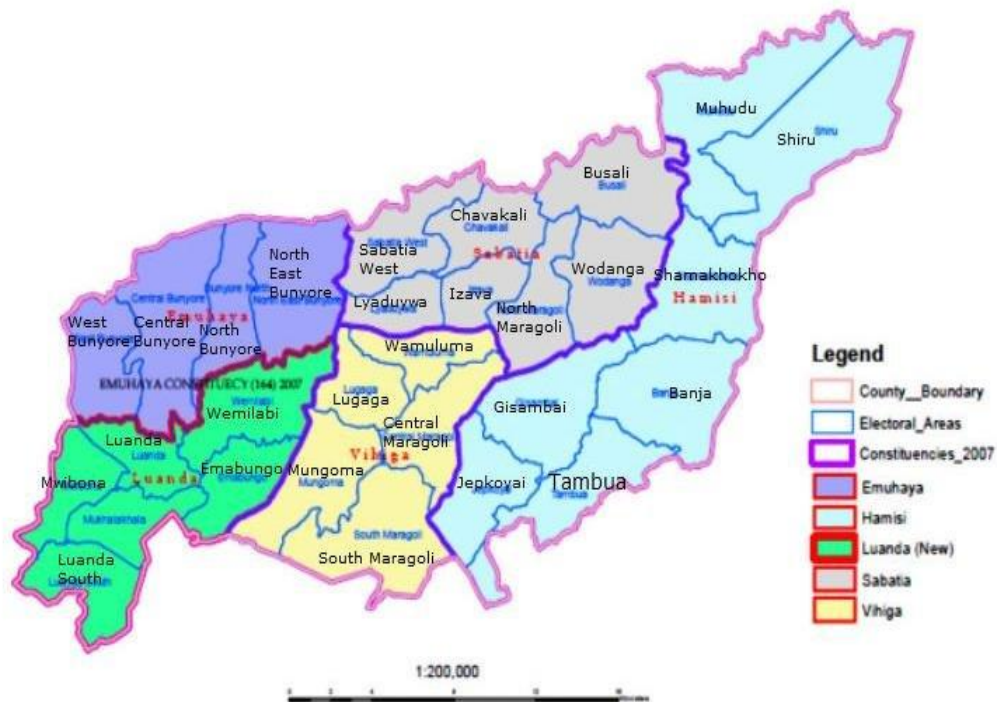


Fig. 1. Map of Vihiga county showing study sites

3. RESULTS AND DISCUSSION

This chapter provides the analysis of use usages of organic fertilizer on maize and bean intercrop production in the study area. The results of the analysis showed that a majority (76%) of the farmers interviewed in the study used organic fertilizer for soil fertility improvement. When a random sample of farmers who had adopted use of organic fertilizer for soil fertility in the study area was taken, it was shown that majority of them used sub optimal usage (less than 5 tons/ha) of the manure resulting in low crop yields. This could have been due to Offensive odor and transportation problems as demonstrated by Aderinoye-Abdulwahab and Salami [10]. Applications of manure-based commercial organic fertilizers (COFs) which have been harmlessly disposed still resulted in general increases intercrop production. Table 1 shows summary statistics of results of the survey of organic fertilizer use usages among farmers.

From the study, the average usage of organic fertilizer by farmers was 0.32 tons/ha while recommended usage was 5tons/ha. The high variances of means revealed the big gap between actual usage of organic fertilizer and that recommended by research for optimal crop yields. The actual distribution of usage of use of organic fertilize among the farmers interviewed has positive skewness and is leptokurtic. This means that a majority of the sampled farmers used suboptimal usage of organic fertilizer.

Table 2 shows the results of the t-test done to test the hypothesis that difference between the usage of organic fertilizer in farmers' fields and that recommended by research did not differ significantly from zero. The postulated hypothesis means that organic fertilizer usages by farmers did not differ significantly from that recommended by research institutions for optimal plant growth in the study area. As can be seen from table below the hypothesis was rejected.

A test of difference of means showed that usage of use of organic fertilizer was significantly below 5 tons/ha recommended by research [13,1,14] at 99.9% confidence usage ($p < 4.91E-48$). The conclusion is thus that farmers interviewed used usages of organic fertilizer that were far below rates recommended by research as needed to get optimal crop yields. It was observed that farmers failed to gather enough manure, which affected amount used on crops. Offensive odor and transportation problems were among the prominent limitations as suggested by Aderinoye-Abdulwahab, S.A and Salami, S.T [10] and Mughivisha, Olowoyo and Mzimba [15] This translated into poor crop yields in farmers' fields, explaining why there were low yields among farmers who were using organic fertilizer as opined by [16,17,18]. From study findings it was concluded that adoption of a technology should not in itself be used as a measure of success in helping farmers out of food insecurity.

Table 1. Usage statistics of organic fertilizer in farmers' fields and experimentals

Category of Farms	Mean	Standard error	Sample Variance	Standard Deviation	Kurtosis	Skewness
Farmers' Fields (kg/ha)	320.3	21.48	32303.9	179.73	1.466	1.085
Recommended Use Usages (kg/ha)	5000	130.33	1189050	1090.44	-0.144	-0.780

Source: Data Analysis in this Study (2016)

Table 2. T-test analysis of recommended and farmers' usages of organic fertilizer

Population Sample/ Statistic	Farmers' Use Usages of Organic fertilizer	Recommended Usage of Organic fertilizer
Mean kg/ ha	320.3	5000.26
Known Variance	32303.95	1189050
7Hypothesized Mean Difference	0	
t-Statistics	-35.43	
P(T<=t) one tail	4.91E-48	
T Critical one-tail	1.666	

Source: Data Analysis in this Study (2016)

4. CONCLUSION

The study rejected the hypothesis that the farmers' usages of organic fertilizer was not statistically significant different from that recommended by research institutions. This is because average use usages of manure of 320.3 kg/ha was significantly below those recommended by researcher of 5ton/ha (at 99% usage).

Farmers must follow appropriate promoted technology use recommendations. From the findings it is recommended that extension agents should shift focus from promoting use of improved technologies to ensuring that the technologies are adopted in recommended usage by research. An econometric analysis is also recommended to look at the factors affecting the use levels of organic manure by the farmers

ACKNOWLEDGEMENTS

The Deputy Vice Chancellor of Maseno University for provided the financial support which formed the basis of this work

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:

The peer review history for this paper can be accessed here:
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