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Analysis of Resource-Use Efficiency in Tomato Production in Jere, Borno State, Nigeria

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Abstract
The study investigated the resource use efficiency of dry season tomato production among small scale farmers in Lake Alau of Jere Local Government Area of Borno state. Primary data for the study was collected using structured questionnaires and oral interviews from 60 tomato farmers. Four villages notable for tomato production were purposively selected, and from each village, 15 farmers were randomly selected. The data collected were analyzed using production function analysis. The results of the double-log production function showed that seed, herbicides, fertilizer and farm size were positively related to the output and it is significant at 1% while labour was negatively related. And the farmers were inefficient in the use of all resources, with inputs being over-utilised. This may be due to the severe nature of land fragmentation occurring around Maiduguri and Jere, being among the few relatively secure areas in the state. The study suggests that introduction of modern methods like greenhouse cultivation of tomatoes coupled with drip irrigation systems, will enable year-round cultivation and allow farmers to optimize resource use.
Keywords: Resource-use, efficiency, production function, agribusiness, Jere, tomato

1. Introduction

Tomato (*Lycopersicon esculentum*) is an important vegetable crop grown in many parts of the world, contributing significantly to income security and the nutritive diet of many households. According to Mofeke *et al.,* (2003), vegetable crop constitute 30 to 50% of iron and vitamin A in resource poor diet. Vegetable crops including tomato are widely cultivated in many parts of Nigeria, particularly by small scale farmers (Adeolu and Taiwo, 2009). Denton and Swarup (1983) and Anon (1989) observed that tomato production in the northern states as in other parts of the country is done during the dry season, while its production is scarce during the rainy season because of high disease incidence associated with growing tomatoes and preference of tomato producers for growing food crops during the rainy season. This is why most tomato produced is irrigated. However, the spread of irrigation farming is still relatively low in Nigeria and Africa as whole. In Africa, irrigated area is estimated at 6% of total cultivated area, compared with 37% for Asia and 14% for Latin America (FAO, 2009). Svendsen and Sangi (2009) observed that more than two-third of existing irrigated area is concentrated in five countries namely, Egypt, Madagascar, Morocco, South Africa and Sudan. Given that irrigated crop yield more than double of rain fed yields in Africa (Liangzhi *et al.,* 2010) it is important to invest on irrigation development with particular focus on location and technologies with greatest potential for irrigation. The effort of the federal government of Nigeria with support of World Bank and the African Development Fund to develop irrigation system in the country started with the approval of the implementation of the National Fadama Development Project in 1992 (World Bank, 1992) followed by second National Fadama Development project between 2004 and 2010, and the third National Fadama Development Project (2008-2016). Small scale irrigation systems have gone a long way to support dry season crop farming all over the country. Dry season production of vegetable is common along the banks of rivers that cut across cities and towns in many states of the country. According to FAO (2016), while Nigeria accounted for 10.8% of global area harvested in 2014, it accounted for only 1.3% of world production that year. This is a clear reflection of the country's underperformance in productivity. Average yield of tomatoes per hectare was below 4MT in that year, placing in 164th in the World. In the same year, the highest global yield of around 500MT was achieved by The Netherlands. One of the reasons for this low yield in Nigeria is poor fruit set resulting from temperatures that are generally above optimum range for good fruit set (Simon and Sobulo, 1974). Another is that most of the small scale producers lack the knowledge and resources to adopt improved agronomic practices that will boost their yield and address existing and new threats to productivity such as pests and diseases (IFAD, 2013). To make matters worse, half of what is grown is even wasted before getting to the market because of the poor infrastructure- the logistics challenge of getting farm to fork. Because of this, more than half of what the country consumes is imported (Alawode, 2015), contributing to a rampaging foreign exchange leakage. Kalu (2013) attributed this situation to socio-economic constraints surrounding the key actors in the tomato value chain, institutional weakness and declining agricultural research. This situation has serious implications for local or multinational conglomerates that have made or are planning to make investments in domestic tomato processing, because enhancing agricultural productivity is identified as one of core pillars of agribusiness in Africa (Staatz, 2011). For example, Nascon Allied Industries Plc stated in its annual report for 2016 that it had to close down its palm

oil refinery and tomato paste manufacturing plant because Crude Palm Oil (CPO) and triple tomato concentrate have both remained on the restricted items list. It claimed that despite all efforts, they were unable to secure the raw materials locally, in sufficient quantity to run the refinery and production plant efficiently.

Therefore research information on the resource use efficiency of dry season tomato production among small scale farmers will contribute to addressing the challenges being encountered in the tomato value chain.

The objective of the study was to determine the resource use efficiency of dry season tomato production among small scale farmers in Lake Alau area of Jere local government area of Borno state.

2. Methodology

2.1 The Study Area

Jere local government area of Borno state, Nigeria has an area of 868km^2(square kilometres) and a population of 211,204 (NPC, 2006). It is located in the Sudan savannah zone within latitude 11^{0}N and 12^{0}N, longitude 13^{0}E and 14^{0}E, with annual rainfall of between 500mm-650mm. The rainfall last for about 4-5 months per season. The soil of the area is generally sandy loam with pocket of black soil mass usually found along the basin. The vegetation of the area varies from grasses to low shrubs clotted with trees. As tomato is mainly produced during the dry season, it is irrigated

2.2 Data Collection and Sampling Techniques

Both primary data and secondary information were used for the study. Primary data was obtained through the use of structured questionnaires. Secondary data were obtained from published sources. The list of farmers registered with the Tomato Growers Association of the area served as a sampling frame for the study. Multi-stage sampling technique was used in obtaining samples for the study. First stage involves a purposive selection of four villages (Ngafete, Awaisa, Usmanti and Yuti) because of their importance in tomato production. Second stage involved a random selection of fifteen (15) tomato farmers in each of the villages selected which give rise to the total number of 60 respondents. Selected farmers were interviewed after the 2016/2017 harvest.

2.3 Method of data analysis

The production function analysis was used to obtain the parameters for the measurement of resource use efficiency of the tomato farmers. Four functional forms were tried and the lead equation was selected based on economic, econometric and statistical criteria including the signs and magnitude of the coefficient, the magnitude of R2, F-statistics (Umoh and Yusuf, 1999; Gujarati, 1999). The functional forms experimented with were: linear, Double Log, Semi-log and Exponential. The implicit function can be presented as:

$Y = f(X_1, X_2, X_3, X_4, X_5, Ui)$, (Olayide and Heady, 1982; Olukosi and Ogungbile, 2005)

Where

Y = Output of tomato (kg)
X_1 = Quantity of seed
X_2 = Farm size (Ha)
X_3 = Herbicide (liter)
X_4 = Fertilizer (kg)
X_5 = labour (standard man-days)
Ui = Error term

Determining Economic Efficiency of Resources Use

The following ratio was used to estimate relative efficiency of resource use (k), following Goni *et al.* (2007).

k = MVP/MFC

Where:

K = a constant
MFC = Cost of one unit of a particular resource
MVP = value added to vegetable output due to the use of an additional unit of input calculated by multiplying the marginal physical product of resource input used (MPP) by the price of output (Py) i.e. MPPxi x Py

Decision rule

If k = 1 Resource is efficiently utilized
k = >1 Resource is under-utilized
k = <1 Resource is over-utilized

Economic optimum takes places where MVP=MFC, otherwise i.e. if k 1, it suggests that resources are not efficiently utilized.

3. Results and Discussion

The influence of production inputs on vegetable output was determined with the aid of production function analysis. On the basis of *a priori* expectations, the statistical significance of the coefficients and the coefficient

of determination, the double logarithmic functional form was chosen. Table 1 contains the results of the production function analysis.

The results showed that the value of the R^2 is 0.8997 which shows that approximately 90% of the variations were explained by the selected independent variables. The coefficients from the double log functional form shows that seed used, herbicide, fertilizer and farm size were positively related to the output. While labour was negatively related. The table also indicated that the effect of the selected variables viz: seed, herbicide, fertilizer and farm size were significant at 1% ($p<0.01$). Taking the coefficients of the double-log function as direct elasticities, it then shows that a unit increase in seed, farm size, herbicide and fertilizer will lead to 26.9, 43.6 22.7 and 16.0 percent increase in tomato production in the study area respectively. While for labour, it shows that for every unit increase there will be a reduction in yield of tomato by12.8 percent.

Table 1: Estimated Coefficients of the Double Log Function

Variables	Coefficient	Coefficient	t	P
cons	0.1824574	0.5550961	0.33	0.744
seed	0.2686798*	0.0723171	3.72	0.000
Farm size	0.4355858*	0.0711903	6.12	0.000
herbicide	0.2269519*	0.0661148	3.43	0.001
fertilizer	0.1604776*	0.0559683	2.87	0.006
labour	-0.1282935 ^{NS}	0.1664318	-0.77	0.444
R-squared = 0.8997 Adj R-squared = 0.8905				

Source: Field survey, 2017.NB: *P<0.01; NS = Not Significant

Parameters of efficiency such as Marginal Value Product (MVP) and Marginal Factor Cost (MFC) were estimated and presented in Table 2. The results revealed that the values of the efficiency scores were less than unity (1) for all the resources used. This implies that all the resources used were over-utilized.

Table 2: Estimates of Efficiency Parameters

Resource	APP	MPP	MVP	MFC	Efficiency Score
Seed	8.967	0.26868	8.060	8000	0.0010
Farm Size	2.317	0.43559	13.068	10000	0.0013
Herbicde	3.033	0.22695	6.809	1000	0.0068
Fertilizer	125	0.16048	4.814	120	0.0401
Labour	23.317	0.12829	3.849	500	0.0077

Source: Field Survey, 2017

4. Conclusion

Findings from this study revealed that tomato production in area was inefficient. This may be due to the severe nature of land fragmentation occurring around Maiduguri and Jere, being among the few relatively secure areas in the state ravaged by the *Boko Haram* insurgency. A number of studies have highlighted the inverse relationship between land fragmentation and productivity (Okezie et al, 2012) and resource use efficiency (Bizimana et al, 2004 and Niroula and Thapa, 2007). One way through which the efficiency of the farmers can be improved is for research institutions, extension services and the large conglomerates venturing into vertically integrated agribusiness to introduce modern methods like greenhouse cultivation of tomato. Coupled with drip irrigation systems, this will enable year-round cultivation and allow farmers to optimize resource use. Research into the relationship between land fragmentation and productivity and resource use efficiency in the area is also recommended.

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