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Journal of Stored Products and Postharvest Research

ARTICLES

Research Articles

Full Length Research Paper

Post-harvest losses and welfare of tomato farmers in Ogbomosho, Osun state, Nigeria

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Crop losses, especially along the post-harvest food supply chain, have been identified as one of the major causes of food shortage problems in most developing countries and in Nigeria in particular. Vegetable farmers such as those that grow tomatoes often record great amount of produce loss which translates to a waste of resources, a reduction in their income and ultimately their welfare. This study examined the effects of post-harvest losses on the welfare of 107 tomato farmers in Ogbomosho selected through a multi-stage sampling procedure. The analytical tools used in the study include descriptive statistics, gross margin analysis, Ordinary Least Square (OLS) and regression model. Results revealed that majority of the tomato farmers were male, married and had no formal education. The average gross margin values of ₦3, 229.45 and ₦72, 905.80 were obtained with and without post-harvest losses for the tomato farmers respectively. This implied a 95.5% post-harvest loss incurred by the farmers. Household size and the total value of post-harvest losses were found to significantly affect the per-capita income and hence welfare of the tomato farmers negatively. The study recommends that farmers engaged in tomato production be adequately trained on post-harvest crop handling techniques. In addition, priority should be given to investment in post-harvest processing technologies and establishment of processing industries especially in the production areas.

Key words: Post-harvest loss, tomato, welfare, farmers, Nigeria.

INTRODUCTION

Global efforts in the fight against hunger to raise farmers' income and improve food security especially in the world's poorest countries should give priority to the issue of crop losses (FAO, 2010). This is due to the adverse effects of crop losses on food quality, environment and generally on economic development. Crop losses indicate a waste of productive agricultural resources such as land, water, labour, managerial skills and other inputs that could have been channelled into more viable ends.

Roughly, about one-third of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tons per year (FAO, 2011). In addition, 30 to 40% of the food crops produced in the world is never consumed as a result of damage, rotting as well as pest and diseases which affect crops after harvest (Meena et al., 2009). As a consequence, post-harvest losses have thus been identified as one of the determinants of food problem in most developing countries.

Tomato, a relatively short duration crop, is one of the most important vegetables worldwide (Shankara et al., 2005; Seisuke and Neelima, 2008). It is high yielding and economically attractive, hence, the area under cultivation is increasing daily. For instance, world tomato production in 2001 was about 105 million tons of fresh fruit from an estimated 3.9 million hectares (FAO, 2005). In Nigeria, tomato accounts for about 18% of the average daily consumption of vegetables (Babalola et al., 2010). This makes it a very important food crop to an average Nigerian. In 2008, 1,701,000 tons of tomato was produced. As a result, Nigeria became the 13th largest producer of tomato in the world (FAO, 2010). It is grown in the South-western part of the country in small holdings under rain-fed conditions and in the North under irrigation systems (Ayandiji et al., 2011) and consumed both in fresh and in paste form. However, because of its highly perishable nature, many problems are encountered in its production. These problems include diseases, nematodes, insect pests, high flower drop, all these resulting in low yield and poor quality fruits. These, coupled with poor post-harvest handling as a result of lack of storage facilities, good road network, good marketing channel amongst others, brings to the fore the need for efficient harvesting, handling, transportation and marketing techniques to curb postharvest losses in tomato production.

Poor post-harvest handling of perishable farm produce by the farmers can be traced to the negligence on the part of some farmers when rotten fruits are mixed with healthy ones. This tends to have a multiplying effect of rot on the healthy fruits. Also, fruits and vegetables vegetables which include tomatoes produced in rural areas are hardly taken to the market either due to lack of access to nearby markets or inadequate market information by these farmers. Since the farmers have little or no capacity to process their produce and coupled with the fact that there are no modern storage facilities, their products are prone to damages and post-harvest losses (Kader, 2005). Even when the farmers decide to take their produce to the market, they are often constrained by problems of transportation such as poor road network and inefficient mode of conveying their produce to the market. In Nigeria, this includes the use of dilapidated trucks. All these problems together reduce the quality of the farmers' products and force them to sell the rotten tomatoes (popularly known as *esa* among the Yoruba) at ridiculously low prices. This in-turn reduces their income and ultimately their welfare as they are not able to afford other basic necessities of life.

However, one of the country's agricultural policy thrust specifies that farmers be encouraged to use simple but effective on-farm, off-farm storage facilities and agro-processing technology in order to add value to farm produce and increase their shelf life. In line with this, the Nigerian Stored Products Research Institute (NSPRI) together with Food and Agriculture Organization (FAO) developed techniques for the storage of fruit and vegetables especially tomatoes. Many of the techniques would require high-energy sources like refrigeration which are not available and affordable to the local farmers. These techniques could help increase the shelf-life of the crops and make them stay longer before they are sold.

However, the non-availability of these facilities to local farmers implies that farmers will always have to sell at reduced prices as they cannot keep the highly perishable products for an extended period of time. This has grave implications on the income of farmers and could consequently result into a rapid decline in their welfare. Also, it is distressing to note that while many resources are being devoted to planting crops, irrigation, fertilizer application and crop protection measures for increased productivity, little is being done to minimize post-harvest losses. A reduction in post-harvest food loss could guarantee increase in food availability thereby reducing the need for food importation and consequently impact positively on the welfare of farmers (Adesina, 2012). This is pertinent if the country is to meet its goal of food self-sufficiency by 2015. Most of the available studies on post-harvest losses in Nigeria were carried out using the urban markets as case studies (Adeoye et al., 2009). The near neglect of the farmers who constitute the upstream sector of agricultural production and who are most affected by post-harvest losses in terms of decreased market efficiency, severe reduction in income and consequently loss of welfare, therefore justifies the need for this study. This study apart from examining the value of loss and returns accruing to the tomato farmers, also seeks to know the extent to which post-harvest losses affect the welfare of the farmers in question.

MATERIALS AND METHODS

This study was carried out in Ogbomosho area of Oyo state. The choice of this area was premised on the fact that tomato is one of the major crops produced in the area. Ogbomosho, an ancient Yoruba city founded in the mid-17th century is located in the South Western part of Oyo State, Nigeria. The area is situated on Latitude 8.133°N and on Longitude 4.250°E of the equator. The two major seasons are dry and rainy seasons with an average temperature of 27°C. Located at an elevation of 342 m above sea level, the predominant vegetation zone in Ogbomosho is derived savannah with mean annual rainfall of 1.247 mm. Employing 3.2% growth rate from 2006 census figures, the 2011 estimated population for the Local Government is 1,200,000 persons. The area is densely populated with 536 people per km^2. Their major occupation is farming while notable crops grown include cassava, tomatoes and maize.

Primary data used for the study were obtained from 115 randomly selected tomato producers. Sample information were collected on variables such as socio-economic characteristics of respondents including: gender, household size, access to credit, educational level, years of experience, mode of transportation of farm produce, scale of operation, labour used, and working hours per day. Finally, information on prices of output as well as fixed and variable costs incurred in the production of tomatoes were obtained

from the respondents. However, owing to incomplete questionnaire information, data from 107 respondents were used for analysis in this study. Data were analyzed using descriptive statistics, gross margin and the ordinary least squares regression analysis. Descriptive statistics such as frequency distribution, percentages and mean were used in analyzing the socio-economic characteristics of respondents and the constraints faced by the farmers, while gross margin analysis was used to estimate the profit made by the tomato farmers in Ogbomosho. The gross profit of a business is estimated as the difference between the total sales and the variable cost incurred.

GM = TR – TVC

Where: GM = Gross Margin, TR = Total Revenue, TVC = Total Variable Cost, TR = Value of output (amount realized from the sale of tomatoes). This was obtained by multiplying the quantity of tomatoes sold by the unit selling price. TVC = Cost of all inputs (Pre – harvest and harvest labour wage, transportation costs and other input costs).

The gross profit margin was obtained by dividing the gross profit by sales. The gross profit margin is given as:

$$\text{Gross profit margin} = \frac{\text{Sales} - \text{Variable cost}}{\text{Sales}}$$

Gross profit margin is particularly useful in evaluating the profitability of tomato production amongst the farmers in Ogbomosho. This is because many of the farmers' practice subsistence farming which often times involve a small amount of fixed capital.

Ordinary least square model

The ordinary least square model was used to examine the effects of post-harvest losses on the welfare of tomato farmers in Ogbomosho, Osun state, Nigeria. The model is stated as follows:

$$y_i = \alpha + \beta x_i + \varepsilon_i.$$

Where: y_i= Dependent variable, α = Constant term, β = Regression Coefficients, ε_i= Error term.
The model is explicitly stated as:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \text{---------} + \beta_{11} X_{11} + \varepsilon_i$$

Where:
Y= Per Capita income (in Naira), X_1=Market participation rate, X_2=Marital Status (Married=1, otherwise=0), X_3= Years of formal education, X_4=Gender (Male=1, otherwise=0), X_5= Age (Years), X_6= Size of Farmland (in Hectares), X_7= Farming Experience (in years), X_8= Time spent on the farm (in Hours), X_9= Primary Occupation (Farming=1, otherwise=0), X_{10}= Household size, X_{11}= Value of Post-harvest losses (in Naira), ε = error term.
The market participation rate was defined as the ratio of the value of the total quantity of tomatoes sold to the price value of the total harvested tomato for the planting season. That is,

$$MPR = \frac{\text{Value of tomatoes sold}}{\text{Value of total tomatoes harvested}}$$

RESULTS AND DISCUSSION

Table 1 presents the socio-economic characteristics of the respondents. More than three-quarters of the respondents were males while females accounted for the remaining 24.3%. This implies that tomato farming is dominated by male farmers and could be attributed to the cultural setting of the area in which land is mainly allocated to males while females are deprived of direct land ownership. More than half (52.3%) of the respondents were below 41 years of age with the mean age of all the interviewed farmers being 31 years, implying that a good number of the farmers in the area are in their economic active age. Also, more than half of the interviewed farmers were married and had household sizes of between 7 and 12 members. The mean average household size stood at 8 while about 52.3% of the respondents had between 1 and 10 years of farming experience. With respect to the educational status of the respondents, more than three-fifths (67.3%) of the farmers had no formal education while only 2.8% had tertiary education. This result agrees with the findings of Ayandiji (2011) who discovered that only 2.2% of citrus farmers had tertiary education but contrasts with it in the percentage of farmers who had formal education (66.7%). With only about 3.7% of the farmers cultivating less than 1 ha and about three-fifths (60.6%) between 1 and 10 ha, results showed that the production of tomatoes in this study area is rather on a large scale. Unfortunately, owing to the lack of storage and processing facilities, coupled with the inefficient mode of packaging and transportation, post harvest losses in this area is inevitable. Further, the main mode of transportation of produce to the point of sale is the use of 'pick-up' vans employed by more than four-fifths of the farmers while other forms of transportation which include the use of car and motorcycle were used mainly by the small scale producers. This corroborates the findings of Muhammad et al. (2012) in which the main mode of transportation employed by fruits and vegetable farmers in Garun Mallam Local Government Area of Kano State, Nigeria was found to be the use of open pick-ups.

The major post-harvest constraints reported by respondents in the study area as presented in Table 2 include the lack of storage facilities, long distance to market, poor transportation network, pests and diseases and lack of access to credit facilities while the least reported constraint was theft of produce. This is consistent with the findings of Seid et al. (2013) and Basappa et al. (2007) who found inadequate storage facilities, inadequate transport facilities, pests and diseases to be significant factors contributing to post-harvest losses of maize and commercial horticultural crops respectively. Lack of storage facilities was reported as a major constraint by all the farmers. As a result, farmers' are usually forced to take their produce to the market directly from the farm. This results most times into

Table 1. Socio-economic characteristics of respondents.

Variable		Frequency	Percentage
Sex	Male	81	75.7
	Female	26	24.3
Age	<21	14	13.1
	21-40	42	39.2
	41-50	45	42.1
	>50	6	5.6
Marital status	Single	25	13.1
	Married	58	39.2
	Separated/Divorced	13	42.1
	Widowed	11	5.6
Household size	1-6	35	32.7
	7-12	58	54.2
	>12	14	13.1
Farming experience	1-10	56	52.3
	11-20	50	46.8
	>20	1	0.9
Educational status	No Formal Education (NFE)	72	67.3
	Primary	23	21.5
	Secondary	9	8.4
	Tertiary	3	2.8
Farm size	<1ha	4	3.7
	1-5	35	32.7
	6-10	30	28.0
	>10	38	32.5
Mode of transportation	Motorcycle	15	14.0
	Van pick-up	89	83.2
	Car	3	2.8
	Total	107	100.0

Source: Field survey, 2012.

a glut in the market and consequently increased incidence of post-harvest losses. The long distance to market coupled with the poor transport network were also major constraints reported by all and about 99.1% of the farmers respectively. This could be as a result of the fact that the longer the distance from the farm to the market, the higher the transportation costs that will be incurred. Some farmers, because of their inability to pay the transportation costs, harvest their produce and sell as much as they can at the farm gate. Whatever is left is utilized by the household while the remaining is left to rot. For instance, the distance from *iluju* and *tewure* (which were part of the communities sampled), to Central Ogbomosho where the middle-men from Ilorin buy in bulk, is about 50 km. Apart from the high transportation costs, the perishable nature and high moisture content of tomatoes account for a sizeable amount of post-harvest losses during transportation. This could be attributed mainly to the inefficient packaging of the produce during transportation as the produce are usually packed in baskets which are heaped on top of one another. Also, pests and disease infestation as well as lack of access to credit were major constraints faced by almost all (99.1%) and about 95.3% of the farmers respectively. Lack of credit access was mainly due to the inability of the farmers to meet the requirements of credit institutions for

Table 2. Post-harvest constraints encountered by the farmers.

Constraints	Frequency	Percentage
Lack of storage facilities	107	100
Long distance to market	107	100
Poor transport network	106	99.1
Pests/diseases	106	99.1
Lack of access to credit	102	95.3
Insufficient Working capital	66	61.7
Low Government support	58	54.2
Theft	36	33.6

Source: Field survey, 2012.

Table 3. Gross margin analysis result.

Analysis	Total variable cost (₦)	Total revenue (₦)	Gross margin (₦)	Average gross margin (₦)
Without Loss	1,655,029.00	9,455,950.00	7,800,921.00	72,905.80
With Loss	1,655,029.00	2,000,580.00	345,551.00	3,229.45

Source: Field survey, 2012.

obtaining loans. Other post-harvest constraints reported by the farmers include insufficient working capital and low government support.

Table 3 present the results of the gross margin analysis for evaluating the profitability of tomato production in Ogbomosho. The unit selling price was used to value the post-harvest losses incurred. The Gross margin after post-harvest loss of ₦345, 551.00 was much lower than the gross margin without loss of ₦7, 800,921.80. This implied a 95.5% post-harvest loss incurred by the farmers and showed the great extent to which post-harvest losses reduced the income of the farmers in Ogbomosho and consequently their welfare. This is in agreement with the findings of Babalola et al. (2010) and Ayandiji et al. (2011). The percentage gross profit margin without and with loss stood at about 82.5% and 17.3% respectively. The low percentage gross profit margin is an indication that the farmers retained a low percentage of each naira of sales, with little left over for other expenses and as net profit. This in-turn has negative welfare implications for the farmers.

One of the essential determinants of the welfare of the household, which requires that the quantity of tomatoes sold to tomatoes harvested be high, is the Market Participation Rate (MPR). As presented in Table 4, the positive relationship between MPR and per-capita income implies that farmers with high market participation rate fare better than those with lower participation rate. Similarly, the positive association between farm size and per-capita income implies that the larger the size of the farmland, the higher the output, per capita income and consequently, improved welfare of the farmers. This

corroborates the findings of Mujib et al. (2007) that the use of more land to cultivate tomato will result into more income and hence, increased household welfare. The amount of time spent daily on the farm also had a positive effect on per-capita income. Households in which their household heads were mainly engaged in tomato production had a higher level of welfare compared with households in which tomato production was not their primary occupation.

On the other hand, the value of post-harvest losses had a negative impact on the per- capita income and consequently welfare of the farmers'. The large expanse of land on which tomato was cultivated in this area which although increased productivity, also increased the chances of losses due to poor handling and packaging techniques as well as lack of proper processing and storage facilities. In addition, the negative relationship between household size and the per-capita income of the household implies that the smaller the household size, the higher the per-capita income of the farmers and ultimately a higher level of welfare.

CONCLUSION AND RECOMMENDATIONS

It is discouraging and counter-productive for farmers after channeling so much of their limited resources to production, to lose the harvested produce before it gets to the market or consumers due to factors beyond their control. This connotes a waste of productive resources as well as a significant reduction in expected income and consequently welfare of the farmers. The problem of

Table 4. Ordinary least squares regression result of the effects of post-harvest losses on the welfare of tomato farmers.

Variable	Coefficient	t-value
Market participation rate	62.185	1.73***
Marital Status	7.543	1.19
Formal Education	-5.294	-1.00
Gender	14.021	2.06**
Age	3.0123	0.64
Size of Farmland	1.634	2.39**
Experience	- 0.690	-0.87
Time spent on farm	3.101	-2.16**
Primary Occupation	25.162	4.19*
Household size	-5.618	-7.31*
Value of Post-Harvest loss	-0.002	-3.45*
Constant	164.270	4.78*

Source: Regression result, 2012. Level of significance at 1% is *, 5% is ** and 10% is ***, Number of observations = 107, $F_{(11,95)} = 11.15$, Prob> F = 0.000, R^2(Adjusted) = 0.5129.

post-harvest losses, which has long not been recognized as one of the major factors responsible for food insecurity in Nigeria, should be of utmost priority in any effort at achieving food self-sufficiency. The constraints encountered by the farmers also need to be effectively addressed. This could be through;

(i) The adequate training of farmers on post-harvest crop handling techniques as well as the provision of good storage facilities that could help prevent crop losses especially at the farm level.
(ii) The improvement of linkage roads and the resuscitation of the moribund Nigerian rail transportation system to help curb losses during transit to the market.
(iii) Investment in postharvest processing technologies and establishment of processing industries.

With respect to the welfare of the farmers, a reduction in post-harvest losses will lead to increased market participation, per-capita income and consequently improved welfare of the farmers. Farmers should also be enlightened on the benefit of small household size especially on its positive effect on per-capita income and household welfare. From the foregoing, it is obvious that the reduction in post-harvest losses is the key to improved welfare of the farmers, increased food availability and ultimately national food security.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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