Impact of Purdue Improved Cowpea Storage (PICS) Bag on the Profitability of Cowpea Storage in Kontagora Local Government Area of Niger State

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Abstract

The study examined the impact of Purdue Improved Cowpea Storage (PICS) Bag on the Profitability of Cowpea Storage in Kontagora Local Government Area of Niger State, Nigeria. Data were collected using a structured questionnaire. Descriptive statistics, multiple regression, independent t-test and farm budgeting models were employed for data analysis. Results of the descriptive analysis revealed that cowpea storage in the study area was gender bias given that majority (94.2%) of the respondents were men. About (98.3%) had one form of formal education or the other, while (76.7%) had above 15 years farming experience. Results from the Cobb Douglas regression model indicated that among socio-economic factors such as age, household size and years of experience, only age have a significant positive impact on the profitability of cowpea storage using PICS bag (p<0.097). The profitability analysis puts the average net revenue for chemical and PICS bags users at ₦48,210 and ₦82,730 per hectare, respectively. The difference in profit was statistically significant (P< 0.00), implying that PICS bags usage was more profitable and had an impact on cowpea storage in the study area. Against this background, it was recommended that Niger State Government, through the Extension Component of the State Agricultural Mechanization and Development Authority (NAMDA) promote efficient use of improved storage technology (PICS bag) amongst cowpea farmers in the study area with the view to ensuring profitable and sustainable cowpea production.

Keywords: Cowpea, PICS bag, Profitability, Impact, Farm Budgeting, Niger State.

1. Introduction

Cowpea (*Vigna unguculata [L.] Walp*) is the most important economically and nutritionally indigenous African legume crop, grown by millions of small-scale farmers [1]. Cowpea is rich in protein and constitutes a staple food for people in rural and urban areas, [2]. It is used for family consumption as well as sold in the local market for much needed cash. About 95% of global production reported in FAOSTAT is in West Central Africa, with Nigeria being the largest producer and consumer of cowpea, producing 3.4 million tons in 2017 [3]. Niger produces 14%, Burkina Faso produces 6%, and Nigeria produces up to 66%. Both areas planted to cowpea and production has expanded in the last decade, with production now averaging over 3 million MT annually. Cowpea is also an important cash crop in the region with potential for entering commerce. In the late 1990s, official cowpea trade accounted for over 300,000 metric tons of cowpea per year within the Nigerian Cowpea Grain shed [4]. In Nigeria, the crop is grown as a component of mixed cropping system with very little grown as a sole crop because of production problems; the most important of which are insect pests. However, the post-harvest grain storage is a recurrent constraint for increased cowpea production in Africa because of the risk of losses by bruchids [5].

Cowpea bruchids (*Collosobruchus spp.*) are the most common and widespread insect pests in storage. It is a field-to-store pest; adult beetles lay eggs on pods (in the field) or on seeds (in storage). After hatching, the larvae develop within seeds and eat up the cotyledon, thereby causing extensive damage. Adults emerge from the seeds through characteristics holes made by the larva [6]. Adults are 2 to 3.5 mm long.

According to Murdock [7], damage by insect pest on cowpea can be as high as 80-100% if not effectively controlled. As a result, a freshly threshed store of cowpea with only a small initial bruchid infestation can within two or three months be rendered inedible and worthless in the market. Farmers use a variety of commercial and traditional methods to control bruchids, many of which have restricted value because of cost, labor and potential toxicity. For instance, insecticides can be used to control cowpea weevils, but poor farmers often do not have access to these insecticides and when they do, they often misuse them resulting in health and environmental problems. Ash is also used for cowpea storage, but only for small quantities due to labor requirement and because many people consider ash as "dirty" and refuse to eat food stored in ash. Farmers and traders have an economic motive for storage because cowpea prices often double or triple from harvest time when it is sold at low price

to few months before next harvest when it is sold at an exorbitant price.

The main purpose of storage is to even out fluctuations in market supply, both from one season to the next and from one year to the next, by taking the produce off the market in surplus seasons, and releasing it back into the market in lean seasons, this in turn checks out fluctuations in market prices. However, during storage, insect pests pose a significant threat to the shelf life of the stored grain. Species like *Bruchidius atrolineatus* and *collosobruchus maculatus*, (commonly known as cowpea weevils, or bruchids) carry out their life cycle within grain, and their presence makes the crop unfit for human or animal consumption and affect the market value [8]. The need to ascertain and proffer solutions for cowpea storage loses in Kontagora Local Government Area brought about this study.

Based on this, the research will provide answers to the following research questions:

i.   What are the socio-economic characteristics of cowpea farmers in the study area?
ii.   What are the socio-economic factors impacting profitability on PICS bag storage?
iii.   Is the use of Pics bag profitable for storage in the study area?
iv.   What are the constraints faced by cowpea farmers in the study area?

2. Materials and Methods
2.1 Study Area
The study was carried out in Kontagora LGA of Niger State, North central Nigeria and is part of the Kontagora Emirate. The LGA hosts a number of towns and villages, which include Kontagora, Alala, Udara, Kawo, Tungan Wawa etc. The estimated population of Kontagora LGA is put at 151,968 inhabitants of whom 77,782 are Male and 74,186 are Females [9] with the vast majority of the area's population made up of Kambari ethnic group. Kontagora LGA hosts the popular Kontagora River with the average temperature of the area put at 31^{0C}. The area witnesses about two major seasons which are the dry and the rainy seasons which last for six or more months while the average wind speed of the area is 11km/h and a Latitude of 10^0 24' 11.48" N and Longitude of 5^0 28' 14.88" E respectively.

Agriculture is a key economic activity in Kontagora LGA with the area known for the cultivation of a number of crops such as Sorghum, Millet, Cowpea, Tobacco, Rice etc. The area hosts a few industries, which include a plastic manufacturing plant. Trade also flourishes in Kontagora LGA with the area hosting a number of markets, which attract thousands of buyers and sellers on a daily basis, and it is rich in mineral resources all of which could be tapped for industrial purposes.

2.2 Sampling Procedure and Sample Size
A multi stage sampling method was employed for the study. The first stage is the purposive selection of Kontagora LGA, it is chosen based on the prevalence of cowpea farming. The second stage involved random selection of six (6) villages from the Local Government Area; this is due to the concentration of cowpea farmers in the area. The selected villages are; Kontagora, Kawo, Tungan wawa, Yangalu, Tungan gari, Mai lehe. The third stage involved the use of Random sampling techniques to select Twenty (20) respondents each from the selected villages. The sample size for the study therefore constituted 120 cowpea farmers.

2.3 Data Collection
Primary data were used for the study. The primary data were collected using a structured questionnaire with the aid of oral interview. The questionnaire was therefore, issued to three (3) set of respondents, and they were:

I.   Those not storing at all and sell immediately after harvest.
II.   Those using traditional method for storage e.g., chemicals.
III.   Those using PICS bag for storage.

2.4 Analytical Technique
Descriptive statistics, Cobb Douglas regression model and Farm Budgeting were used to achieve the stated objectives of the study;

2.4.1 Farm Budgeting Model
For more convenient expression of economic concepts and relationships [10], the following abbreviations of terms are used:
NI= net income.
TR =total return.
TC= total costs.
FC= fixed costs.
VC =variable costs.
Δ change in any of the above, for example.
ΔNI =change in net income.
R= rate of return.

For the sake of simplicity, we assume that the main objective of a sorghum grower was to maximize the net income derived from his crop.

Net income (NI), generated during cowpea storage, is the amount of money which is left when total costs (TC) are subtracted from the total return (TR):

NI = TR – TC………………………………..(1)

Total returns (TR) correspond to the value of stored cowpea.

Total costs (TC) include the costs of all inputs, such as cowpea grains harvested per Kg, PICS bag, pesticides, labor and capital.

For purposes of PBA, total costs can be separated into two groups: fixed costs (FC) and variable costs (VC):

TC = FC + VC:…………………………………….(2)

Fixed costs (FC)

When a new technology is compared against a farmer's present technology, fixed costs (FC) are those that do not vary between the technologies.

Variable costs (VC)

On the other hand, are those that do vary between the technologies being evaluated, the variable costs are those associated with the storage technologies being evaluated (pesticide cost and Pics bag cost).

NI = TR – (FC + VC)……………………………(3)

Change in net income (ΔNI)

In deciding whether to adopt a new technology, a farmer wants to know whether it will increase his net income.

The increase (or change) in net income (Δ NI) is the difference between the change in total returns (ΔTR) and the change in fixed costs (ΔFC) and variable costs (ΔVC), according to formula

ΔNI = ΔTR – (ΔFC + ΔVC)

Fixed costs are, by definition, the same for all technologies:

ΔFC = 0

Thus, formula can be simplified to:

ΔNI = ΔTR - ΔVC:

By application of a new technology, a farmer expects an increase in net income.

Rate of return

In addition to change in net income, another criterion, the rate of return (R) is useful for evaluating the economics of adopting a new technology. R measures the increase in net income.

R = ΔNI/ΔVC:

In other words, (R) measures the net return on additional capital invested in a new technology, compared to the farmer's present one. If the new technology costs less than the farmer's present technology, it is not necessary to calculate the rate of return (R). If the alternative technology is more costly, the rate of return (R) must be higher than those of other possible investments, and high enough to cover risks associated with adoption.

3. Results and Discussion
3.1 Socio-Economic Characteristics of Respondents
In this section, the general socio-economic characteristics of cowpea farmers is provided. These includes gender, age, marital status, educational background, household size, occupation, farming experience, membership of association, years of membership of cooperative association and farm size (ha⁻¹).

3.1.1 Gender
Table 3.1 shows that overwhelming majority of the respondents were males constituting about 94.2% to females 5.8%. This means males engaged more in cowpea production than their female counterparts in the study area. However, the roles of the female gender may largely have been in areas of complimentary farm operations like harvesting and threshing. This result corroborates with Aliyu [11] who implies that gender is a significant factor in agriculture because of its vital role in determining farming activities, and this could influence the adaptive capacity to employ various cowpea storage methods.

Table 3. 1: Distribution of Cowpea Farmers According to Gender

Gender	Frequency	Percentage
Male	113	94.2
Female	7	5.8
Total	**120**	**100.0**

Source: Field Survey, 2020.

3.1.2 Age
The results indicates that 86.6% of the respondents were between 20–60 years old. The mean age of the farmers are 40 years, meaning they are still within their active age, agile and energetic. This result agrees with the findings of Hameed [12] that most farmers are within their active years and can positively contribute to agricultural production.

Table3.2: Distribution of Cowpea Farmers According to Age

Years	Frequency	Percentage
Less than 20	0	0
20 – 40	49	40.8
41 – 60	55	45.8
Above 60	16	13.3
Total	**120**	**100.0**

Source: Field Survey, 2020.

3.1.3 Occupation
Table 3 shows that most of the respondents (82.5%) are into farming, while 5.0%, 11.7% and 0.8% are into trading, civil servant and other occupation, respectively. This means that farming is the primary occupation of the people in the study area. Apart from farming, the people in the study area also partake in other secondary activities such as trading and civil service as a means of generation extra income.

Table 3. 3: Distribution of Cowpea Farmers According to Occupation

Occupation	Frequency	Percentage
Farming	99	82.5
Trading	6	5.0
Civil servant	14	11.7
Others	1	0.8
Total	**120**	**100.0**

Source: Field Survey, 2020.

3.2 Socio-Economic Factors Impacting Profitability of Cowpea Storage Using PICS Bag

The study examines the socio-economic factors impacting on profitability of cowpea storage in the study area.

The result of the Cobb-Douglass form of multiple regression reveals that age (0.097) is statistically significant and had a positive impact on the profitability of cowpea storage using PICS bag (p<0.10) while there is no significant relation between other socio-economic factors (such as Household size and Years of experience) and profitability of cowpea storage using Pics bag. This implies that age is the only socio-economic factor impacting profitability of cowpea storage using Pics bag in the study area.

Table 3.3: Socio-economic Factors influencing Profitability of Cowpea Storage using PICS Bags.

Variables	Coefficients	Standard Error	T-value	P-value
Constant	36284.771	19078.072	1.902	0.063**
Age	881.204	520.955	1.69*	0.097*
Household size	421.872	934.419	0.451	0.654NS
Years of experience	14.727	696.511	0.021	0.983NS
R Square	0.146			
Adjusted R Square	0.093			
F-value	2.785			

Computed from Field Survey Data, 2020 (*p<0.10%)

3.3 Profitability of Cowpea Storage

The study examines the profitability of cowpea storage using Net Revenue.

3.3.1 Profitability Analysis

The results from Table 3.4 shows that, there is no any significant difference (0.257N.S) in the price per bag between those using chemicals for storage (₦11,100) and those that uses PICS bags (₦11,000). Farmers that used PICS bags spent significantly more money (₦5,120.44) to procure PICS bags when compared to the amount (₦3,574.81) spent by their counterparts in the procurement of chemicals. However, the amount of money spent on labour by those using chemicals was significantly higher (₦196.20) than the amount spent on labour by those using PICS bag (₦102.65). Conversely, cost of PICS bag usage was significantly higher (₦5,223.09) than the cost of chemical usage (₦3,771.01).

Revenue realized before (₦105,136.05) and after (₦193,086.71) storage by farmers using PICS bags were significantly higher than the revenue realized before (₦86,876.62) and after (₦138,876.62) storage by farmers using chemicals.

At the end, the net revenue (₦82,730) accrued by farmers using PICS bag was significantly higher than the net revenue accrued by those using chemicals and the difference in profit was statistically significant (p,,<.000) at 1% level. The finding implies that there is significant impact of PICS bags on the profitability of cowpea storage in the study area. This conforms to the findings of Jokthan and Sanni [13] who observed that an increase in the income of users of PICS technology by about 48% for cowpea stored within 4-6 months period in Nigeria.

Table 3.5: Distribution of Average Cost and Return of Chemical versus PICS bag Cowpea Storage ha^{-1}

| Variables | Chemical | | Pics | | |
	Mean Value	Std. Dev.	Mean Value	Std. Dev.	P-value
Price/bag	11,100	694.131	11,000	776.129	0.257N.S
Cost of chemical & pics (ha^{-1})	3,574.81	4192.413	5,120.44	2506.750	0.026***
Cost of labour (ha^{-1})	196.20	247.5077	102.65	76.5845	0.010***
Cost of usage (ha^{-1})	3,771.01	4273.0474	5,223.09	2499.7085	0.038***
Revenue before storage (ha^{-1})	138,876.62	427300474	105,136.05	39,372.61	0.000***
Revenue after storage (ha^{-1})	138,876.62	427300474	193,086.71	71,677.15	0.000***
Net revenue	48,210	29146.0482	82,730	32258.2211	0.000***

Source: N.S = Not Significant, *** = Significant at p<0.01%

3.4 Constraints faced in using PICS bag for storage
Table 3.6 shows that majority of cowpea farmers (88.9%) using PICS bag for storage believe that it has no problem, 9.3% believe that the bag can be affected by rodents(rats), and 7.4% believe that the bag can be stolen. This shows the need to take proper care of the cowpea stores through provision of adequate security.

Table 3.6:

Response	Frequency*	Percentage
The bag can be stolen	4	7.4%
Rodents (rats) can affect it	5	9.3%
No problem	48	88.9%

Source: Field Survey, 2020, * Multiple response

4. Conclusions and Recommendation
The study revealed that cowpea farmers in the study area achieved absolute profitability in the use of different storage methods. It was found that cowpea storage in the study area using PICS bag is more profitable with a net revenue of (₦82,730) compared to their counterparts using chemicals (₦48,210). Thus, it could be concluded that cowpea storage using PICS bag is more profitable.

The study recommended that, Niger State Government, through the Extension Component of the State Agricultural Mechanization and Development Authority (NAMDA) should promote efficient use of improved storage technology (PICS bag) amongst cowpea farmers in the study area with the view to ensuring profitable, sustainable cowpea production.

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