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Environment and some adopted Agronomic Practices- Grassroots' participation in Osun and Ondo States of Nigeria

Abstract

The effects of adoption of improved sustainable agricultural practices in crops by grassroots' farmers were studied in Osun and Ondo States of Nigeria, among 30 large-scale commercial farmers in each state. Different types of sustainable practices namely organic agriculture, ORM; agri-horti-silviculture, AHS and combined polyculture and permaculture, CPP, common to farmers in the area were evaluated. Different parameters measured were plant population of trees, estimated number of pods, time of fruiting/maturity, number of cobs/maize/bunch/leaves and others alike. Simple correlation, regression analysis, percentiles and one way-ANOVA statistic were used for data analysis. The results revealed that there was a significant effect ($P < 0.05$) of the different sustainable practices on the yield of the crops planted. Root and stalk lodging, flower/fruits abortions were high especially in the CPP and AHS plots than ORM. There were stronger relationships between independent variables, different sustainable practices and yields of maize with higher R^2 value of 0.99. There was less than 5% awareness among farmers with such adoptable farm practices. Some diseases were not controllable as reported by 91.67% of the farmers. Also, 33.3% of the farmers concluded that tillage operations were delayed more than before and have negative impact on soil improvement.

write out ORM, AHS, CPP

RESULTS WERE NOT STATED PROPERLY. STATE THE SIGNIFICANT RESULTS AND GIVE A CONCLUSIVE STATEMENT

(**Key words**: environment, Grassroots, Osun and Ondo States, sustainable agriculture)

1. INTRODUCTION

One of the goals of the sustainable agriculture movement is to create farming systems that mitigate or eliminate environmental harms associated with industrial agriculture. Sustainable agriculture is part of a larger movement toward sustainable development, which recognizes that natural resources are finite, acknowledges limits on economic growth, and encourages equity in resource allocation [1]. It is an aspect of the economic and social development; it rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their needs. Sustainable agriculture integrates three main goals- environmental health, economic profitability and social and economic equity [2].

Sustainable agriculture is a model of social and economic organisation based on equitable and participatory vision of development which recognises the environment and natural resources as the foundation of economic activity. Agriculture is sustainable when it is ecologically sound, economically viable, socially just, culturally appropriate and based on a holistic scientific approach [3]. Among the various types of sustainable methods of agriculture are organic agriculture, crop rotation, cover crops, no-till and low-till farming, soil management/nutrient management, diversity, integrated pest management, rotational grazing, polyculture and monoculture, advanced biological farming, silvo-pasture and agro-forestry to mention a few [4].

Some agricultural systems among the above that were used in this study include the organic agriculture, agri-silvipasture and agri-horti-silviculture, and combination of

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polyculture and permaculture. The production system based on active agro-ecosystem management rather than on external input is organic agriculture. Agri-silvipasture is the combination of agri-silviculture and silvi-pastoral system. Under this system, farmers in dryland grow field crops and forest trees together up to a particular stage but in the later stage, the grasses are raised in place of field crops in the vacant space between the forest trees [5]. Agri-horti-silviculture is a system where fruit trees are grown along with crops and multipurpose tree species, it is highly diverse in vegetation with highest productivity. In this case, crops like rice, mustard, soybeans or vegetables may be grown in between banana or guava ([5]

In spite of the immense needs for high food security in Nigeria, some debilitating factors have been limiting production of both arable and permanent crops. Among these constraints are poor agronomic practices, ageing tree crops [6] and poor soil fertility [7]. Moreover, different problems posed threat to various adopted agronomic practices used by farmers, problems such as soil fertility, financial problems, illiteracy and lack of skill/expertise hands. However, the influence of agricultural practices integrating with the environment may help to solve some of these problems especially to replenish soil fertility.

Then, how could each of the aforementioned practices contribute to sustainable development in farming? How have the grassroots' farmers adopted various techniques of these practices? How have those farmers who adopted them fairing? Does the environment contribute immensely toward this sustenance? Were these farmers aware of their adoption or were merely practicing what they do not know? It was hypothesized, therefore, that farmers' adoption of various sustenance practices and participation in the grassroots would have an impact on the yield of their crop, on the farming process and on the country. Accordingly, the objective of the study was to investigate the influence of different adopted sustainable practices in agriculture on the performance parameters of some agronomical crops. The research aimed to investigate the extent of usage of these adopted agricultural processes by the farmers and their effects on crops' yield and land improvements.

2. MATERIALS AND METHODS

The study was carried out in some villages surrounding Bagbe town, along Ore-Ondo Express road in Oke-Igbo Local Government Area (LGA) and Ondo East LGA of Ondo State of Nigeria and in some villages in three LGAs namely Boripe, Obokun and Ila in Osun State of Nigeria. The sites were selected based on the type of farming practices that were there and their sizes. The area is on $5^{o}43'$ E and $7^{o}14'$ N, it has clay loam, poorly drained and had 300 mm-350 mm rainfall annually. The area was vast, opened to sun and not too prone to erosion. Three sustainable methods were used namely organic agriculture, agri-horti-silviculture and combined polyculture and permaculture. For the organic method, farmers plant maize two times in a year for three months-period each, it was tagged ORM. Other arable crops were also planted by the farmers and were not using any synthetic materials for their growth – they were purely organic. Cocoa trees planted not more than ten years ago was used for the polyculture/permaculture, tagged CPP and the plantain agri-horti-silvicultured with rice was the third method, tagged AHS. The AHS in some farms had some cocoa trees planted as inter-planted with.

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Sixty-six farms were visited in all; twenty-two farms were selected for the cocoa trees, CPP; twenty-two farms planted with plantain and rice, AHS were selected and another twenty-two farms selected for ORM. Each of the farms had at least three acres each. Questionnaires were drawn based on the variables namely climatic effects on yield, planting seasons and crop quality, possibilities for land improvement by these various adopted methods, effects of the adopted processes on some crop failure causative parameters and others.

The questionnaires consisted of two sections A and B. Section A contains 11 questions on the personal information of the respondent while section B consists of 41 questions based on the needed research procedures. They were validated by other experts in different fields like agronomist, one educational evaluator, and one environmentalist. Data were analysed using descriptive and analyses like simple correlation, regression analysis, percentiles and one way-ANOVA.

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3. RESULTS AND DISCUSSION

3.1 Farmers' Statuses and Activities

Table 1 revealed that women that adopted the above agricultural practices are less than one-fifth of the number of men. None of them had ever received any aid from either government or non-governmental organisation (NGO) while the same percentage rejected any innovation brought to them by their colleagues. The most striking observation was in the issue of their awareness of these adopted processes, there were as low as less than 5% awareness among them of such adoptable farm practices for good farm operations. This could be as a result of their level of secular or professional education in their jobs of their comparative interest despite higher percentage (54.55) having more than 2 ha of land. Also, farmers engaging in other activities are more than 70%, many of them were into artisanship works in their villages; government's attitude toward farming and farmers may be the cause. Also, female farmers were less than 20%. All these may affect food security in the country if left unaddressed. Government and NGOs should increase level of awareness among women to participate more in farming, should encourage farmers to make farming full-time and to help in the needs for trainings and orientations for them.

RESULTS ARE BEST PRESENTED WITH LITERATURE SUPPORT

3.2 Yield of Crops under each Adopted Agricultural Processes

3.2.1 Sizes of Farms versus Yield

Significant effect was not observed between all the adopted practices and yields of each of the crop. There were statistical differences among the mean values of the adopted processes and the yield of different crops. In the study, highest mean value for the yield obtained from CPP was 19.5±14.85 (Table 2) and this was 8.3% increased over the value obtained for AHS and 44.44% increased over ORM. The correlation coefficients among the CPP, AHS and ORM with their crops' yield in each case were 0.893, 0.982 and 0.792 respectively. These were high and depict stronger relationship between the sustainable adopted processes used by the farmers and yields of crop they harvested. Farmers interviewed on their farms agreed that they had higher yield than some other farmers not using CPP, AHS on their farms,

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although, most were not aware of the adopted processes. They attributed their increase yield to divine providence.

Table 1- Distribution of farmers by their farm activities, statuses and farm sizes

Variables	*Frequency*	*Percentage*
Age of farmers		
18-25 years	6	9.09
26-35 years	18	27.27
36-45 years	15	22.72
46-55 years	15	22.72
Above 55 years	12	18.18
Sex		
Male	57	86.36
Female	9	13.64
Level of Education		
No formal Education	18	27.27
Primary	27	40.91
Secondary	21	31.82
Higher Education	0	0
Farm Sizes		
Below 3 acres	0	0
1-2 ha	30	45.45
More than 2 ha	36	54.55

Source of your table and year

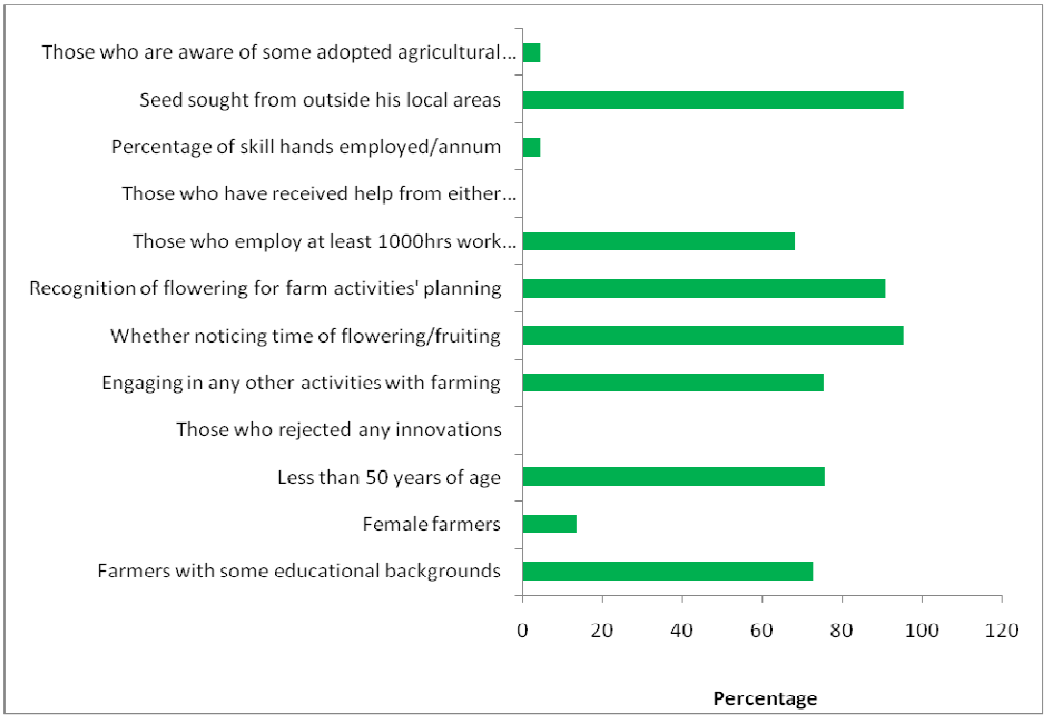

Figure 1- Statuses and activities of the Farmers

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Farmers' perception in the sizes of their farms in relation to their yield per hectare revealed ranking that the yield per ha for each of the crop and the adopted processes, CPP and AHS were at the same point, while ORM was the last. 90% of the farmers had strong belief that the amount of cocoa beans harvested per hectare could be rated to be at the same level with plantain that could be harvested within the same period.

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Table 2: Mean values for the effects of some adopted agricultural practices on crops' yield and soil conservation

Parameters	Adopted practices	Mean values
Yield (kg)	CPP	$19.50^{a} \pm 14.85$
	AHS	$18.00^{b} \pm 8.50$
	ORM	$13.50^{c} \pm 6.36$
Soil conservation	CPP	$18.23^{a} \pm 10.14$
	AHS	$16.04^{b} \pm 6.85$
	ORM	$14.23^{c} \pm 8.60$

Mean values with the same superscript(s) along same column for each factor are not statistically different at ($p \leq 0.05$)

3.2.2 Effects of Climate and diseases on the Crops' Yield

The farmers' responses revealed their perception of 66.7% reduction in farms' yield as at present when compared to eight to ten years before mainly due variations in global change in climate and the depth of diseases' infestations than before. Most of them could not differentiate between the level of the effects and each individual disease, but generally admitted that the effects were high on their crops' yield and quality. Also, there were no statistical differences between the adopted practices by farmers and the level of climatic influence on the yield of the crops planted. It can be surmised that climate affects their planting, harvesting and yields on the farm equally for all the adopted practices in the research as reported by the farmers, Table 3.

perception not properly measured

Table 3: Mean values for the climatic effects on yield for different adopted agricultural practices on crop production

Parameter	Adopted practices	Mean values
Climatic effects on yield	CPP	$22.00^{a} \pm 38.11$
	AHS	$22.00^{a} \pm 38.11$
	ORM	$22.00^{a} \pm 38.11$

Mean values with the same superscript(s) along same column are not statistically different at ($p \leq 0.05$)

The effects of disease on yields of crops under each treatment with two variables namely: at least 20% effect of such disease and at more than 20% effect of the disease on the yield was tested using pair t-test. It was observed that there were significant (P

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= 0.001 for CPP and AHS and 0.041 for ORM) effects of diseases on all the adopted processes on yields both at 20% and more than 20%. Farmers' perception was that there could have been increase in yield as cocoa leaves fair better and the fruits could have been more, but the reason was obvious, diseases. The yields' reduction was in the range 10% to 20% of their previous quantity according to the farmers. Many of the farmers agreed that these increase in crops' diseases, especially seemingly new and the old that were not easily controlled with their regular herbicides could be as a result of global climate change. These adopted processes if they can be practiced more may solve some of these problems.

However, some of these diseases were not controllable as reported by more than 50% farmers. Precisely, farmers in 91.67% of the farms visited said that a certain disease of cocoa trees is now more than what it was many years ago and that it was not controllable especially with all the insecticides, herbicides and others in the market. The disease affects the trunk of the tree and greatly reduces the flowering, fruiting and maturing of the few pods that were able to dare the disease. Other farmers also complained about the diseases as solutions were not coming. Further research may be conducted on this disease locally called 'Alemo' in Yoruba language to control/eradicate it.

3.2.3 Climate, Planting Seasons with Crops' Yield

Farmers gave responses on the period their planting time are delayed by the climatic variations on their farms. Based on 3 weeks, 4 weeks and more than 4 weeks delay to their planting season for some ten years ago, their answers varied. The regression analysis revealed stronger relationship between the differences in planting seasons and the adopted practices, R^2 values were 0.99 for each of CPP, AHS and ORM. Analysis of variance revealed significant differences ($P < 0.05$) among the adopted processes used by the farmers and the planting seasons' variations. Moreover, there were statistical differences among the mean values as shown in Table 4.

Table 4- Mean values (±SE) of the effects of different adopted practices on planting season' variations

Parameters	*Adopted practices*		
	CPP	**AHS**	**ORM**
At 3 weeks	1.00^{a}±0.02	0.333^{ab}±0.22	0.200^{c} ±0.12
At 4 weeks	1.00^{a}±0.02	0.667^{a}±0.22	0.300^{b} ±0.2
More than 4 weeks	0.016^{ac}±0.001	0.500^{ac}±0.01	0.891^{a} ±0.03

Mean values with the same superscript(s) along same column are not statistically different at ($p \leq 0.05$); SE – Standard Error

3.3 Adopted Processes and Soil Improvement

Farmers' responses on the extent of soil improvement as a result of using different adopted systems of farming on their farms based on perception for some period had varied answers. The regression analysis revealed stronger relationship between the differences in planting seasons and the adopted practices, with this, some of the farmers (33.3%) said that their tillage operations were delayed than before because of rainfall delay as a result of global climatic change and that this could have negative

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impact on their soil improvement. R^2 values were higher for each of CPP, AHS and ORM, Table 5. Analysis of variance revealed significant differences ($P < 0.05$) for CPP, AHS and ORM of their effects to improve the soil.

Table 5: Effects of different adopted practices on farmers' perceived soil improvement

Parameters	*Adopted practices*		
	CPP	**AHS**	**ORM**
Mean values ±SE	1.00^{a}±0.02	0.387^{b}±0.747	0.500^{c} ±0.67
P-values (P<0.05)	0.0001	0.0001	0.0001
R^2	0.99	0.98	0.98

Mean values with the same superscript(s) along same row are not statistically different at ($p \leq 0.05$); SE – Standard Error

3.4 Adopted Processes, Climate and Yield/Quality/Crop Production-

3.4.1 Farmers' Perception of the effects on Root Lodging

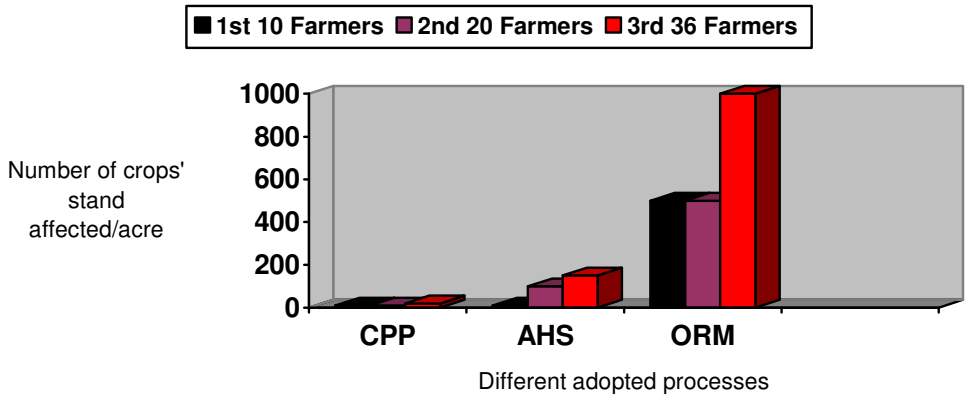

Figure 2: Farmers' perception of the effects of different adopted processes on root lodging (number of crop stands per acre)

Farmers' Perception of the effects on Stalk Lodging

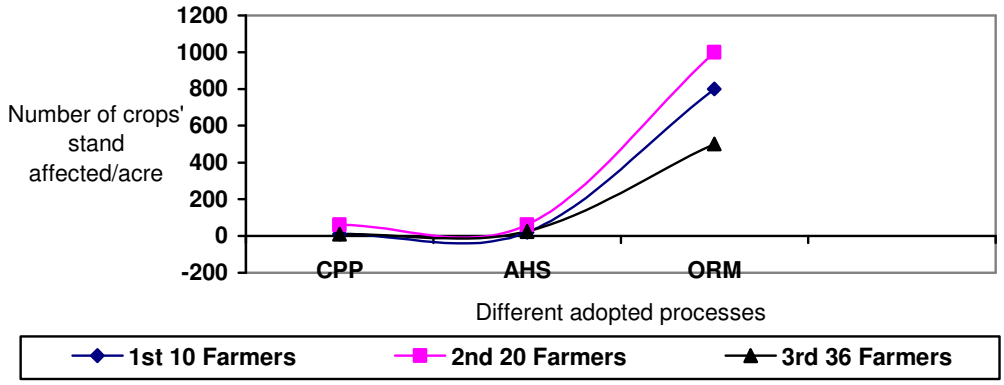

Figure 3: Farmers' perception of the effects of different adopted processes on stalk lodging (number of crop stands per acre)

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Although, planting seasons were delayed, each processes contributed to soil improvement. This supported good yield (if not because of crops' diseases) and increase income, which will reduced poverty of the farmers and add to nation's GDP. However, their soil's improvement effects vary as there were statistical differences among the mean values as shown in Table 5.

The numbers of cocoa trees affected by root lodging were low compare to others as revealed by 91% of the farmers. These were not expected by them but as the case could have been, it could be due to the age of their cocoa trees, a probable inference which many farmers did not agree with. Plantain trees also were affected by root lodging, not because of their age but could be because of their depth of planting during transplanting. Also, most farmers objected to this, saying that, it was because of soil degradation which is now becoming rampant in different farms, however, some of them ascribed this soil degradation to indiscriminate chemical usage on the soil. Thus, some of them discourage the use of synthetic materials, that is, conventional farming since their usage affect soil over a large area coverage to non-users' plots. At any case, climatic change has brought a lot of changes on the farm but these adopted processes if practice with much awareness than present may have positive effect on crop production.

There was significant effect ($P = 0.0001, 0.046$; at $P<0.05$) of the different adopted agricultural practices on the number of plant stands. The numbers of cocoa trees affected by stalk lodging were high (Figure 3) compare to others as revealed by 66.7% of the farmers. This was because cocoa trees were known to be hardy, not too tall and could therefore capable of resisting stalk damage as a result of wind. Plantain trees were affected by stalk lodging; this could be because of its trunk orientations and nature. Moreover, the linear and quadratic equations for the relationships between the effect of climate, planting seasons on the adopted processes researched into under stalk lodging established the fact that there were high relationship between them as their R^2 values were 0.77, 0.76 and 0.75 for the linear relationships for CPP, AHS and ORM respectively. The R^2 values were 0.99 for each of the CPP, AHS and ORM, revealing stronger correlation among them.

Farmers' Perception of the effects on Flowers/Fruits' Abortion.

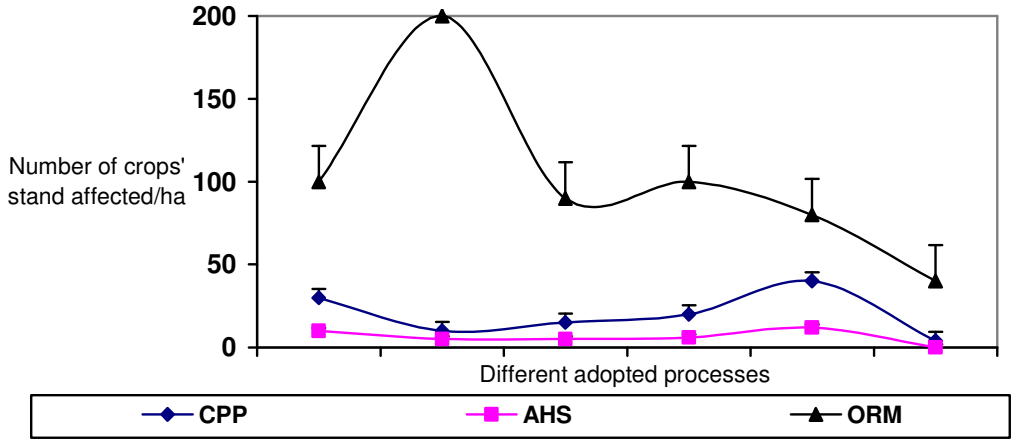

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Figure 4: Farmers' perception of the effects of different adopted processes on flowers/fruits' abortion (number of crop stands per ha)

There was significant effect (P = 0.001; at P<0.01) of the different adopted agricultural practices on the number of crops that had flowers/fruit abortion. Maize crops planted in ORM method were affected mostly by flower abortion compare to others as revealed by 50% of the farmers. Although, this was high but were relatively low compare to its number of stands per hectare when compare to other crops in their farms (0.75% abortion for maize per acre, 1.56% abortion for plantain per acre and 4.69% abortion cocoa per acre, Figure 4). Nevertheless, since some of the farmers said that they bought treated seeds from accredited seller, this phenomenon could be as a result of diseases or soil problems. Both cocoa and plantain trees were affected by flowers or fruits abortion and double the effects on maize. This could be because of the trunk-infestation with whitish-gum disease that does not allow flowers or fruits to come out from the trunk/stalk of cocoa trees. The reasons for the fewer plantain fruit abortion per acre could not be explained by the farmers or this research. Standard errors bars were shown for ORM and CPP but relatively minima for the AHS, Figure 4.

Similarly, the linear and quadratic equations for the relationships between the effect of different adopted processes researched into under flowers/fruits' abortion revealed the fact that there were correlations and possible relationship among them. There were higher relationships between them as their R^2 values were 0.84, 0.80 and 0.63 for the quadratic relationship for CPP, AHS and ORM respectively.

3.5 Effects on Farmers' Income in the last five consecutive Farm years

Different farms had different income per acre and by extension per hectare according to the farmers' responses in the last five farm years. The reason could be the manner of handling of their works by various farmers or their soil or diseases. It could also be as a result of the middle-men tricks of cheat to the farmers that brought lower incomes. All the same, there were losses witnessed by most farmers in their incomes from their farm sales within the periods studied as given by them (Figure 5). The losses as shown in Figure 5 were as a result of effects of crop diseases coupled with actions of the middlemen. Government may do well to establish marketing board, this will also help government to know actual values of crops' yield in the country. Table 6 shows the linear and quadratic equations to depict the relationship between the adopted processes and the farmers' income at the period. The R^2 values were higher of the range 0.98 – 0.99, this no doubt revealed stronger relations between them and the linear equations depict the possibility of direct relationship between them.

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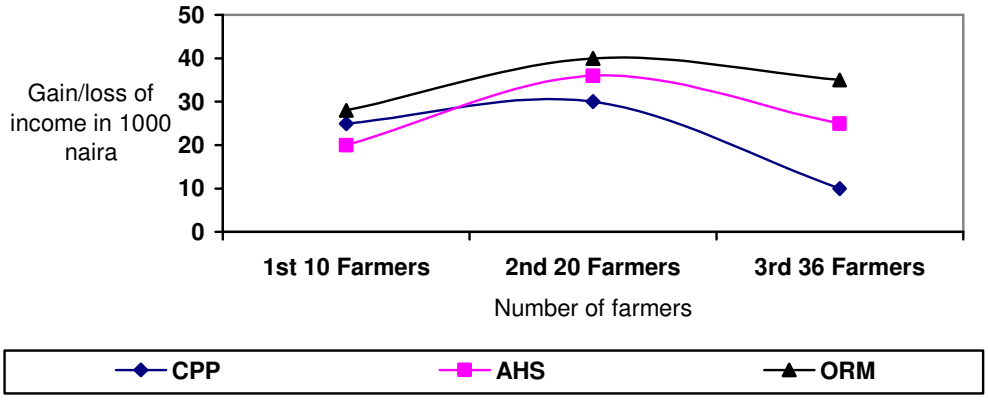

Figure 5: Farmers' responses of their gains/losses from different adopted processes in five consecutive farm years

Table 6. Regression analysis between adopted processes and farmers' income in five consecutive farm years

Adopted Processes	Linear model		Quadratic model	
	Regression equation	R^2	Regression equation	R^2
CPP	y = 1.5 x + 21.33	0.94	y = 6.5 x^2 - 24.5 x + 43	0.99
AHS	y = 5 x + 25.33	0.99	y = -x^2 + 9.0x + 22	0.99
ORM	y = 12.5 x - 11.667	0.98	y = -2.5 x^2 + 22.5 w - 10.0	0.99

x = gain/loss in income to the farmers; y = years

4. CONCLUSION

The following conclusions were arrived at:

1. There were stronger relationships between the sustainable adopted processes used by farmers and crops' yields. Climatic variations affect their planting, harvesting and yields on the farm equally for all the adopted practices.
2. There are some diseases that were not controllable as reported by farmers, described as white gum-like plaster on the stalk and disallow flower/fruits' emergency.
3. Tillage operations were delayed more than before, delays planting.

It was thereby concluded that the adopted systems by the farmers help to improve their farming operations, improve soil and provide income that affect their livelihood positively.

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