RELATIVE PROFITABILITY OF SOLE AND MIXED CROPPING ENTERPRISES 
IN THE CENTRAL NIGER DELTA OF NIGERIA 
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ABSTRACT 
The Study is based on field data collected from a sample of 100 farmers and farm households 
drawn from 3 of the 8 local government areas (LGAs) in Bayelsa State, Nigeria. The data was 
collected for a period of 15 months during the 2000/2001 cropping season using the cost-route 
methodology. A customised budgetary model was used in analysing the data so collected. The 
results indicate that crop farming enterprises in the area are generally profitable though average 
returns per hectare of land employed in mixed cropping (₦88,500.16) was relatively higher than 
that of sole cropping (₦50,532.81). It has been argued that in terms of returns to the factor 
endowment of resource poor farmers in the area, mixed cropping is more advantageous than sole 
cropping. Granting that cultivable land is a limiting factor in the Niger Delta area of Nigeria 
relative to other parts of the country, mixed and double cropping stand out as viable strategies for 
agricultural growth and development in the area. It has been recommended that agricultural 
extension packages in the area should henceforth be packaged in a manner as to promote mixed 
and double cropping among farmers in the area with appropriate production, processing, and 
marketing incentives. 

INTRODUCTION 
The three conventional cropping systems 
practised in the world are sole cropping, mixed 
cropping and inter-cropping. Sole cropping is 
practised when a farm is planted with only one 
crop throughout a given cropping or farming 
season. This system of cropping is common 
among large commercial farms particularly in 
Europe, Australia and America. In mixed 
cropping, a major crop say plantain, cassava 
or yam with one or more supplementary crops 
are planted on a farm in a given cropping or 
farming season. This system of cropping is 
common among small-scale farmers in Africa, 
Asia, and Latin America. Lastly, inter-cropping 
is practised when two or more crops are planted 
together on a farm either in pure stands or in 
alternate rows (Allison-Oguru, 2004). 

Multiple or mixed cropping and inter-
cropping are therefore known traditional 
cropping systems practised in most parts of 
Africa, Asia and Central America (Rapenbruck, 
et al., 1976; Beets, 1982; Francis, 1986). For 
example, Nji et al. (1987) and Peter et al. (1994) 
have reported the practice of multiple cropping 
and inter-cropping among peasant farmers in 
Cameroon and other parts of Africa. These 
practices are said to have prevailed over the years 
because of some benefits which peasant farmers 
have continued to derive from these cropping 
systems. Hoof (1987) and Reijtjes (1992) have 
observed that in most multiple cropping systems 
developed by small-holder farmers in the tropics, 
productivity in terms of harvestable products per 
land area is higher than under sole cropping. 
Steiner (1984) and Francis (1986) have also 
reported yield increases ranging between 20% 
and 60%. 

The relevant questions that readily come 
to mind are: what are the other advantages 
associated with multiple or mixed cropping and 
inter-cropping? Do these advantages translate to 
higher monetary returns i.e. could it be that 
multiple or mixed cropping enterprises are 
relatively more profitable than sole cropping 
enterprises? If multiple or mixed cropping and 
inter-cropping are so advantageous, how come 
that even in tropical Africa some farmers still 
practice sole cropping? This paper sets out to 
address these questions in an empirical manner.

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and to recommend among the three conventional cropping systems the one that is most suited to the factor endowments of the Niger Delta in general and Bayelsa State in particular.

MATERIAL AND METHODS

Sources and Types of Data Used for the Study: Data for this study were obtained from the farm and farm household levels. Data collected from the farm level include: farm size, crop mixtures cultivated, quantities and values of physical, biological and chemical inputs employed in farm production, quantity and quality of farm labour employed, quantity and value of farm output produced, etc. From the farm household level were collected the following information: household size and composition, household food consumption, etc.

Sampling and Method of Data Collection: A 3-stage sampling technique was employed in drawing the sample for this study. The first stage involved the deliberate selection of 3 out of the 8 local government areas (LGAs) in Bayelsa State based on preponderance of crop farming activities. The local government areas sampled are Ogbia, Sagbama, and Yenagoa. In each of the LGAs selected from a list of communities obtained from the respective LGA Secretariats. In each community so sampled, 5 farm households were randomly selected for initial study out of which 100 were finally chosen, on the basis of willingness to participate in the study, for in-depth study.

With the aid of trained enumerators drawn from the Agricultural Projects and Extension Services Bayelsa Department of Shell Petroleum Development Company of Nigeria Limited (SPDC), the Bayelsa State Agricultural Development Programme, and the Bayelsa State Ministry of Agriculture, data concerning the week activities of the 100 selected farmers and farm households were collected using the cost-route procedure for a period of 15 months in the 2000/2001 farming season.

Method of Data Analysis: The data for this study were analysed using the following customised budgetary model:

\[ \pi_{ij} = \sum_{j=1}^{n} P_{ij} Y_{ij} - TC_{ij} \] ............ (1)

where

\[ \pi_{ij} = \text{Net annual return (or Net farm income) from the } jth \text{ crop enterprise of the } ith \text{ farm household} \]

\[ P_{ij} = \text{Unit price of output of the } jth \text{ crop enterprise of the } ith \text{ farm household} \]

\[ Y_{ij} = \text{Output from the } jth \text{ crop enterprise of the } ith \text{ farm household} \]

\[ TC_{ij} = \text{Total costs of producing the recorded output level of the } jth \text{ crop enterprise by the } ith \text{ farm household} \]

\[ i = 1, 2, 3, \ldots 100 \]

\[ j = 1, 2, 3, \ldots 11 \]

But:

\[ TC_{ij} = \sum_{j=1}^{n} \sum_{i=1}^{m} d_{ij} X_{ij} - F_{ij} \] ............ (1)

where

\[ d_{ij} = \text{Unit price of the } ith \text{ farm input employed in the } jth \text{ crop enterprise} \]

\[ X_{ij} = \text{Level of the } ith \text{ farm input employed in the } jth \text{ crop enterprise by the } ith \text{ farm household} \]

\[ F_{ij} = \text{Fixed costs associated with the production of the recorded output level of the } jth \text{ crop enterprise by the } ith \text{ farm household} \]

Theoretically, profit is the return to the entrepreneur. In this study however, pij represents profit as well as some returns to the farmers management input which was not charged to the gross value of farm production. This is because in the study area, small-holder farmers were observed to perform the roles of both entrepreneurs, as well as operators and managers of their farm business.

RESULTS AND DISCUSSION

Crop Enterprises Surveyed: A total of 11 different crop enterprises were surveyed in the course of this study. Out of this number, 5 were
sole-cropping enterprises while the remaining 6 were mixed cropping enterprises. The distribution of these crop enterprises sampled are presented in Table 1.

Table 1. Distribution of Crop Enterprises Surveyed

<table>
<thead>
<tr>
<th>Crop Enterprise</th>
<th>Frequency</th>
<th>% Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swamp rice sole</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Plantain/cassava/vegetables</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Yam sole</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Cassava sole</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Plantain sole</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Plantain/sugar cane/vegetables</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Cassava/cocoyam/plantain</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Cassava/maize</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Plantain/yam/vegetables</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Plantain/cocoyam/vegetables</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Cocoyam sole</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Allison-Oguru (2004)

Relative Profitability of the Sole and Mixed Cropping Enterprise Surveyed: The results of the profitability analysis show that all the crop enterprises surveyed are profitable. In each case, gross value of production exceeds farm production costs thus yielding positive net annual returns. However, the results in Tables 2 and 3 generally indicate that the value of net annual returns are higher in the mixed cropping enterprises than the sole cropping enterprises.

Among the sole cropping enterprises, plantain sole yields the highest net annual returns per hectare of N76,331.00 followed by cassava, swamp rice, yam and cocoyam, in that order (Table 2). It can therefore be deduced that among the sole cropping enterprises, plantain is the most viable. This is arguably so because plantain is a delicacy and therefore a high value crop in the study area. In terms of net annual returns, mixed cropping yields the highest per hectare values, the most viable enterprise being plantain/yam/vegetables with a value of N1,12,523.25 followed by plantain/ sugarcane/ vegetables; plantain/cassava/vegetables; plantain/cocoyam/ vegetables; cassava/ cocoyam/plantain; and cassava/maize in that order (Table 3).

It can therefore be argued that in terms of returns per hectare, mixed cropping is preferable to sole cropping in the study area. These results are in agreement with the findings of Hoof (1987) and Rejntjes (1992) who also observed that in mixed cropping, productivity in terms of harvestable products per hectare is higher than in sole cropping given the same level of management.

If mixed cropping is so profitable relative to sole cropping, how come that crop farmers in the area still cultivate certain crops solely? One reason that can be adduced is that most of the farmers practising sole cropping in the area have access to a larger amount of cultivable land. For example, a total of 10.2ha of land was devoted to sole cropping of five crops giving an average of 2.04 ha per crop. Conversely, only

Table 2. Profitability status of the sole cropping enterprises surveyed

<table>
<thead>
<tr>
<th>Crop Enterprise</th>
<th>Hectare cultivated</th>
<th>Profitability Measures</th>
<th>Profitability Measures</th>
<th>Profitability Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Costs ($)</td>
<td>Value of Production ($)</td>
<td>Net Annual Return ($)</td>
<td></td>
</tr>
<tr>
<td>Plantain</td>
<td>2.5</td>
<td>127,422.12</td>
<td>312,000.00</td>
<td>184,577.88</td>
</tr>
<tr>
<td>Yam</td>
<td>1.8</td>
<td>109,525.24</td>
<td>193,600.00</td>
<td>74,074.76</td>
</tr>
<tr>
<td>Swamp Rice</td>
<td>2.4</td>
<td>103,505.86</td>
<td>211,200.00</td>
<td>107,694.14</td>
</tr>
<tr>
<td>Cocoyam</td>
<td>0.8</td>
<td>62,860.43</td>
<td>83,200.00</td>
<td>20,339.57</td>
</tr>
<tr>
<td>Cassava</td>
<td>2.7</td>
<td>117,763.50</td>
<td>280,800.00</td>
<td>163,030.50</td>
</tr>
<tr>
<td>Total</td>
<td>10.2</td>
<td>52,1077.15</td>
<td>1,070,800.00</td>
<td>163,030.50</td>
</tr>
<tr>
<td>Average</td>
<td>2.04</td>
<td>104,215.43</td>
<td>214,160.00</td>
<td>109,944.57</td>
</tr>
</tbody>
</table>

Source: Allison-Oguru (2004)
10.6 ha of land was devoted to multiple cropping (i.e. mixed and intercropping) of six crop combinations giving an average of only 1.76 ha per crop mixture. The other reason is that most of the farmers that practise sole cropping have higher profit motive behind their farm enterprises. Besides, a crop like swamp rice in the area for lack of appropriate technology can for now be cultivated only sole. Another reason why farmers in the area still practise sole cropping despite the fact that mixed cropping is more profitable could be ignorance on the part of farmers in the area.

Besides the yield and profit advantages associated with mixed cropping other advantages are: reduced losses on account of weeds, insects and diseases; and more efficient use of available resources of water, light and soil nutrients. In addition to these advantages, multiple or mixed cropping serves as good precaution strategy against risk and uncertainties arising from crop failure. As several crops are grown on the same farm, failure of one crop to produce enough, either at actual harvest or in terms of cash, can be compensated by other crops in the mixture. These findings are in agreement with those of Rapenbrink et al. (1970), Beets (1982) and Francis (1986) as reported in Allison-Oguru (2004). All these benefits are what translate to the higher farm profit associated with multiple or mixed cropping.

In terms of relative returns to the factor endowments of resource-poor farmers in the area, it can be argued that multiple or mixed cropping is more advantageous to sole cropping. Given the fact that cultivable land is limiting in the Niger Delta area of Nigeria relative to other parts of the country, multiple or mixed cropping promises to be a viable strategy for promoting agricultural growth in the area. This coupled with double cropping through small-scale irrigation would further enhance the economic fortunes of small-holder crop farmers in the area.

**Table 3. Profitability status of the mixed cropping enterprise surveyed**

<table>
<thead>
<tr>
<th>Crop Enterprise</th>
<th>Hectareage cultivated</th>
<th>Profitability Measures</th>
<th>Net Annual Return/ha</th>
<th>Profitability Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total Costs (₦)</td>
<td>Value of Production (₦)</td>
<td>Net Annual Return (₦)</td>
</tr>
<tr>
<td>Plantain/Cassava/Vegetables</td>
<td>0.6</td>
<td>51,084.06</td>
<td>106,750.00</td>
<td>55,000.00</td>
</tr>
<tr>
<td>Plantain/Yam/Vegetables</td>
<td>2.4</td>
<td>168,588.19</td>
<td>430,240.00</td>
<td>261,655.81</td>
</tr>
<tr>
<td>Plantain/Cocoyam/Vegetables</td>
<td>1.8</td>
<td>77,694.22</td>
<td>226,160.00</td>
<td>148,465.78</td>
</tr>
<tr>
<td>Cassava/Plantain/Maize</td>
<td>2.2</td>
<td>93,012.15</td>
<td>230,000.00</td>
<td>136,987.85</td>
</tr>
<tr>
<td>Plantain/Sugarcane/Vegetables</td>
<td>2.3</td>
<td>99,295.16</td>
<td>311,320.00</td>
<td>212,024.84</td>
</tr>
<tr>
<td>Cassava/Cocoyam/Plantain</td>
<td>2.5</td>
<td>97,244.99</td>
<td>279,400.00</td>
<td>182,155.21</td>
</tr>
<tr>
<td>Total</td>
<td>10.6</td>
<td>587,518.57</td>
<td>1,583,870</td>
<td>996,289.49</td>
</tr>
<tr>
<td>Average</td>
<td>1.76</td>
<td>97,919.76</td>
<td>263,978.33</td>
<td>166,048.25</td>
</tr>
</tbody>
</table>

Source: Adapted from Allison-Oguru (2004)
thereby providing a vehicle for their economic empowerment.

SUMMARY AND CONCLUSION

This study has shown that crop farming in the central Niger Delta area of Nigeria is generally profitable. Farmers in the area were observed to practice sole cropping as well as mixed and intercropping. Though the amount of arable land devoted to sole cropping was observed to be higher than that devoted to multiple or mixed cropping, the relative returns to land was higher in the multiple or mixed cropping enterprises than in the sole cropping enterprises. Several reasons have been given in explanation of this phenomenon—reasons which confirm earlier findings by researchers in this area. In terms of relative returns to the factor endowment of the resource-poor farmers in the study area, therefore, it can be argued that multiple or mixed cropping is more advantageous to sole cropping.

Granting that cultivable land is limiting in the Niger Delta area of Nigeria relative to other parts of the country, multiple, mixed and double cropping stand out as viable options for promoting agricultural growth and development in the area. It is therefore recommended that agricultural extension packages in the study area should be put together in such a manner as to promote multiple, mixed and double cropping among farmers in the area through a variety of production, processing, and marketing incentives.

REFERENCES