Productivity and limitations of plantain (*Musa* spp. cv AAB) production in compound gardens in Southeastern Nigeria.

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PRODUCTIVITY AND LIMITATIONS OF PLANTAIN (*MUSA* SPP. CV. AAB) PRODUCTION IN COMPOUND GARDENS IN SOUTHEASTERN NIGERIA.

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ABSTRACT - This paper, based on a socio-economic survey, investigates the productivity of compound plantain production and constraints to large scale production on the basis of the compound production methods. The paper shows that production under the compound system results in nearly four times as much yield as in non-compound system. This is attributed to regular application of kitchen and other compound wastes, close cultural attention given by the farmers, and to nutrient recycling to the benefit of the compound plantains from deep rooted perennial tree crops interplanted. Large scale production employing the compound methods is limited by supply of organic matter and by available market for plantains. Available market can be expanded by increased production during the slack period of June to September when output is low and by packaging to reduce damage in transit to take advantage of distant markets.

PRODUCTIVITE ET LIMITES DE LA PRODUCTION DU PLANTAIN DANS DES JARDINS COMPLANTES DU SUD-EST DU NIGERIA.

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RESUME - Cet article appuyé sur une enquête socio-économique étudie la productivité du bananier plantain en association et les contraintes pour une production à grande échelle à partir des méthodes pratiquées en cultures associées ; on montre que ce dernier système produit près de quatre fois plus. Ceci s'explique par l'application régulière de déchets domestiques, une attention suivie du paysan et le bénéfice alimentaire retiré par les plantains des arbres complantés pérennes à enracinement profond. Les limites du système sont liées à la fourniture de matière organique et au volume du marché. On peut accroître la production pour la période creuse de juin à septembre et aussi en vue de la conquête des marchés éloignés grâce à de bons emballages.

INTRODUCTION

In the high rainfall areas of Eastern Nigeria plantain ranks high as a carbohydrate source. Although fairly large quantities are produced, it is not commonly found in the shifting cultivation systems in which most popular food crops are found. The bulk is produced in small intensively managed village compound gardens. These gardens are highly productive when compared with plot in shifting cultivation or large scale commercial field. Interestingly, village compound garden plantains do not suffer from the rapid decline phenomenon observed in other fields. BRAIDE and WILSON (1) concluded that the high productivity of the village compound garden plantain was the result of organic matter in the form of household refuse and kitchen waste applied regularly to these gardens that are usually close to the house and the kitchen.

Important as these gardens are, they are not well understood. There have been cursory investigations into the biological factors, but the economics remain unknown. This report represents preliminary findings of investigation into the economics of plantain production in village compound gardens and their contribution to household income. The report is based on a sample survey of smallholder plantain producers in southeastern Nigeria conducted from January to December 1985. The objective was to describe the smallholder plantain production practices and assess the value of resources used in it.

The survey was conducted at Umuagwo, a small rural community about 20 km southeast of Owerri to Port

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Figure 1 - A plantain mat in the compound garden in the dry season.

Harcourt road. Every household in this community had plantain mats (Fig. 1) in the compound and a few also had some plantain mats in locations a kilometer or two away from the compound. Eleven compound plantain producers were purposely selected for the survey. The selection basis was the willingness of the farmers to allow free access to their compound farms to the enumerator who collected the farmers compound plantain production information. All non-compound plantain plots in the area, three in all, were also included in the study for comparative purposes.

The study was in the form of direct observation of the plantain production activities of the farmers in their existing compound or non-compound plantain for a period of 12 calender months. This was necessary because the farmers did not keep records.

Information including yield rate attained ; and labour, organic matter, and stake inputs were obtained by direct observation by the enumerator on daily basis. At the end of each day during the 12 months period of January 1 to December 31, 1985 the enumerator visited all 14 households with a weighing balance and a structured proformer. During the visit he determined the number of plantain bunches harvested that day, the weight of each bunch, and whether the bunches were to be sold or eaten at home. He determined hours of labour used in the various plantain production operations such as harvesting, staking, weeding, organic matter application, etc. on that day. He notes whether or not organic matter was applied, whether any plantain plant staked, and whether any plantain plant fell over as a result of storm or other causes.

In addition, retail market prices of plantain bunches were collected on weekly basis in the rural market, Eke Umuagwo, where the same farmers sold. The price information was also collected by direct method as follows : the enumerator bargained for and weighed a number of bunches individually and bought one. Purchasing some of the commodity was necessary so that the enumerator would be regarded as a customer to whom competitive prices would be quoted. In this rural market as in most other Nigerian markets commodities such as plantain bunches did not carry fixed price. They were sold and bought by subjective appraisal and haggling. This necessitated the bargaining process of getting the price information.

The sample size was small, but, in studies of this nature involving frequent collection of information by direct observation over extended period, large samples would prove too expensive. However, in traditional agriculture production practices are generally fairly similar among producers in the same village and marginal effect on level of accuracy of increase in sample size may not be significant. There were not many non-compound producers in the area ; that system of production was included merely to highlight the productivity of the compound system.

SMALLHOLDER PLANTAIN PRODUCTION PRACTICES

In the compound, plantains are not grown in layed out fields or gardens. Plantain mats which are perennial are located at various convenient points in the compound sometimes within compound arable crop garden. Consequently, the size of compound plantain production may not be estimatable in terms of land area but in terms of number of mats. The eleven compound producers had an average of 44 mats each with a range of 12 to 112. In a laid out plantain production system one hectare will take 1600 mats. The compound production system is therefore on a small scale and there is a wide range of variation in the scale from household to household depending on how much space was available in the compound ; how many people in the household were interested in owning mats ; the need of the household for numerous other possible compound tree crops.

The plantains were estimated to have been planted between 1971 and 1980. The common variety was a false horn type known locally as «**Abagba**». Most of them were interplanted with arable crops such as cocoyam (*Colocasia esculenta*). All were interplanted with perennial crops such as oil palm (*Elaeis guinensis*), African bread fruit (*Treculia africana*), coconut (*Cocos nucifera*), African pear (*Dacryodes edulis*), kolanut (*Cola acuminata*), oranges (*Citrus sinensis*), and «**Oha**» (*Pterocapus soyauxii*). Some of the plantains were originally planted in borrough pits from where soil was taken for house construction. However, at the time of the study most of them stood on refuse mounds built up by continuous dumping over time. The most common items in the refuse were cassava peels and

kitchen wastes especially wood ash. The corms of the plantains were covered with a mulch of applied organic matter from household wastes.

Weeding was done occasionally because frequent application of refuse suppressed weeds. Staking to prevent falling over of plants carrying bunches was very common. An average of about 10% of all stands was staked each month during the fruiting period.

Two of the non-compound plantain fields were established in 1981 and the third in 1982. The cultivar used was the same as that used in the compound gardens. In all three, the fields were laid out in garden fashion with spacing of 3 m x 3 m. The mean area for the three fields was 0.11 ha and hence they were at small scales. The owners were mere part time plantain producers. They all engaged in other agricultural and even non-agricultural activities. One owner had pineapple and another cassava intercropped with plantain on half of the fields. One field received a large quantity of poultry manure at planting. The others did not receive any special application of organic matter. All three fields had good weed control. Inorganic fertilizer was not applied in either the compound or non-compound plantains.

COSTS AND RETURNS IN COMPOUND AND NON-COMPOUND PLANTAINS

Table 1 shows estimates of yield and value parameters in both compound and non-compound plantains. Bunch yield in terms of both number per hectare equivalent (1600 mats) and weight per bunch appear significantly higher in compound than in non-compound plantains. This resulted in total yield per hectare being nearly four times as much in the compound as in the non-compound plantains (Table 1).

The difference in yield could be attributed to the difference in production practices. Organic matter from household wastes was applied on the average nearly 300 days in compound and less than 30 days in non-compound plantains out of the 365 days of the study (Table 2). In other words, most compound plantains received organic matter daily.

While the corms of most compound plantains were completely covered with the organic matter the corms of non-compound plantains were in most cases exposed to adverse conditions. This could be responsible for severe attack by plantain weevil (*Cosmopolites sordidus*) in the biggest of the three non-compound fields in March and April. That incidence reduced yields significantly in that field.

Labour input was also higher in compound than in non-compound plantain (Table 2). While in non-compound plantain the relatively limited labour input was used for weeding, harvesting and staking ; labour input in compound plantain was used mainly for harvesting and staking. Consequently rate of staking was higher (Table 2) and stand losses lower in compound than in non-compound plantain. The rates of stand losses, fallen over of plantain trees due to storm or other causes, were 248 plants per hectare equivalent in compound and 364 in non-compound plantains during the study period.

Most of the compound plantains were under the shade of the other perennials also grown in the compounds. As deep rooted trees some of those perennials might have recycled nutrients to the benefit of plantains which are shallow rooted. Most of the non-compound plantains studied were not interplanted with such perennials.

The plantain production in the area was mainly market oriented. As much as 80% of total output in both the

TABLE 1 - Efficiency of resources in smallholder compound and non-compound plantain production in Umuagwo, Imo State, 1985.

Efficiency Standard	Compound	Non-compound
Bunch yield (No. of bunches/mat/year)	1.40	0.40
Bunch weight (kg/bunch)	9.05	7.90
Total yield (MT/ha/yr)	20.4	5.5
Gross value (N*/ha/yr)	9,900	2,900

* : N1.00 was approx. US$ 0.25

TABLE 2 - Input use in smallholder compound and non-compound plantain production in Umuagwo, Imo State, 1985.

Input	Compound	Non-compound
Labour (manhours/hectare/year)	928	792
Stake (number/hectare/year)	1280	600
Organic matter rate of application (No. of days applied/mat/year)	290	30

compound and non-compound plantains was sold for cash ; about 20% in either case was consumed at home. The value of production per hectare equivalent per year (*) was nearly N10,000 (N1.00 is approximately US $ 0.25) in compound and less than N3,000 in non-compound plantains (Table 1).

Most of these returns were Gross Margin because most of the inputs were obtained from household sources. Apart from the largest of the three non-compound producers who employed hired labour on monthly wage basis none of the producers studied purchased inputs during the study period. Stake was cut from the bush with family labour, and organic matter used in the compound plantain came from household wastes.

LIMITATIONS TO EXPANSION OF COMPOUND PRODUCTION

At such a rate of return it might be surprising that the compound production was still on small scale. The average compound farmer who owned 44 mats and made only N220 in cash and had N55 worth of plantain consumed at home could have made more if he produced on a bigger scale. However, production on a larger scale may not be efficient given the constraints of the farmer.

The compound which had an area of about 0.2 ha. also carried in addition to houses, perennial crops which besides their direct benefits to the farmer may have enhanced plantain production by aiding nutrient recycling. On the average, the 11 compound producers studied had, in addition to the 44 plantain mats, three oil palm (*Elaeis guinensis*), one African breadfruit (*Treculia africana*), three African pears (*Dacryodes edulis*), two cola (*Cola acuminata*), two coconuts (*Cocos nucifera*), five Citrus (*Citrus sinensis*), and one «Oha» (*Pterocapus soyauxii*) trees all in the compound.

The supply of organic matter is also regarded as a major constraint to expansion of production in the compound garden situation. Exact figures on the amount of organic matter to maintain high productivity in these gardens has not been determined. The potential of inorganic fertilizer in compound gardens is also not known, but inorganic fertilizers do not maintain production under field conditions (1). Inorganic fertilizers do not supply mulch which appear to be a major factor causing the high yield of compound plantains.

But as important as resource limitations to expansion of compound plantain production in the area is aggregate demand limitation. Figures 2 and 3 show that yield was seasonal and followed the rainfall pattern. The total rainfall for Owerri in 1985 was about 2800 mm. However, that was not evenly distributed over the 12 months, falling mostly between May and October. November to February were the dry months. The major harvest season began in October and continued through May when bunches formed during the rains matured. The bunch took about three months to mature (2). Bunches that developed during the rainy months were more robust than those that developed during the dry months because of more favourable soil moisture during the rainy season (4).

Figure 4 which compares retail price and yield trends in the area during the study period suggests that price was very sensitive to supply. The differential between the highest price observed in June and the lowest observed in

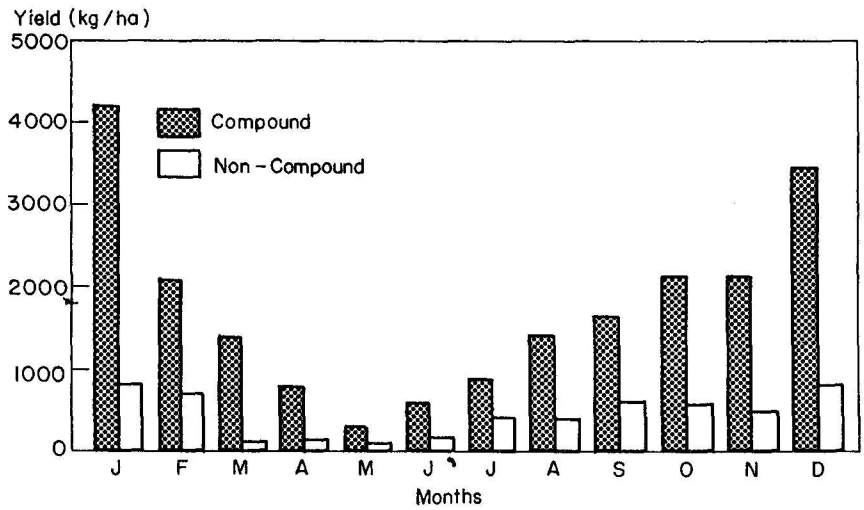


Figure 2 - Yield (kg/ha) in compound and non-compound plantain production at Umuagwo, Jan.-Dec. 1985.

$$* VP = \sum_{i=Jan}^{Dec} Y_i * P_i$$

Where VP : Value of production (N) per ha. equivalent per year.
Y_i : Yield (MT) per ha. in month i.
P_i : Average price per MT for month i.

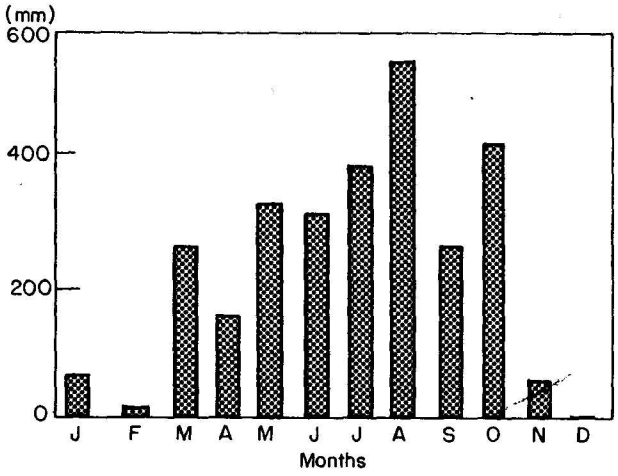


Figure 3 - Total monthly rainfall (mm/mth) in Owerri 20 km west of Umuagwo, 1985.

December was almost 60%. This situation would suggest that the market was easily saturated. The market could absorb expanded production, especially along present seasonal distribution of supply, only at give away prices and hence at capital losses to the producers. The market could however, absorb more output if the supply could be increased during the rainy months when output is at present low. Such a redistribution of supply may require irrigation which the small scale producers cannot afford.

There is also possibility for expansion of available market in Nigeria when packaging and transporting are improved to allow the product to be presented in good condition in distant places. Plantain bunches are bulky and perishable and hence expensive to transport to distant non-producing areas. It is estimated that an average plantain finger consists of 30% peel (3) which is not consumed by humans.

Figure 5 shows the price differential between the village market in the study area and Oweri urban market only 20 km apart. The market price differential between the two locations over the study period was about 10%. This could be considered substantial in relation to the limited distance between the two market centres. It might not all be due to differences in demand but also due to transportation costs especially because the Owerri urban consumers frequently made their purchases in the village market.

Figure 4 - Indices of retail market prices/ Mt at Umuagwo village market and plantain bunch yield in Umuagwo, Jan.-Dec. 1985.

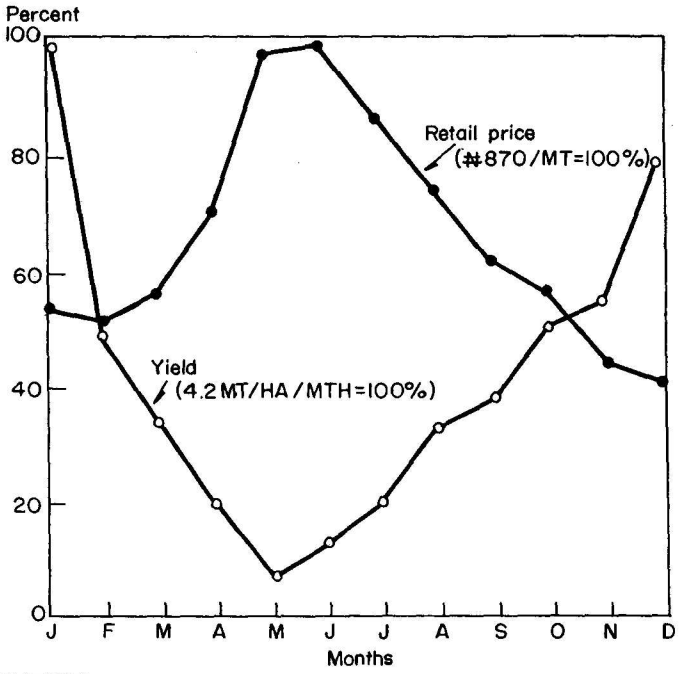
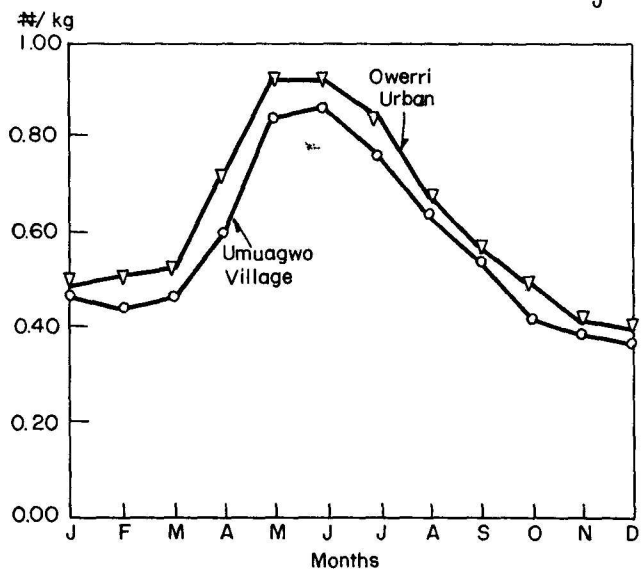


Figure 5 - Retail prices of plantain bunches in Owerri Urban and Umuagwo Village markets, Jan.-Dec. 1985.



CONCLUSION

Plantain production in compound gardens in the Owerri area of Nigeria is profitable, but expansion of production is constrained by limited resources and aggregate demand during the main season. The potential for expansion exists if supply can be increased during the off season which occur during middle of the rainy season or when packaging and transporting are improved to allow the product to be presented in good condition in distant places.

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PRODUKTIVITÄT UND ERTRAGSGRENZEN DER MEHLBANANE IN OBSTBAUMGESELLSCHAFTEN DES SÜDÖSTLICHEN NIGERIA.

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KURZFASSUNG - Ausgegangen wird von einer sozio-ökonomischen Erhebung über die Produktivität der Mehlbanane in Pflanzengesellschaften und die Sachwänge einer Grossproduktion, die von der Methode her auf Pflanzengesellschaften beruht. Es wird der Nachweis dafür erbracht, dass das letztgenannte System viermal ertragreicher ist. Diese Ertragssteigerung erklärt sich durch den regelmässigen Einsatz von Haushaltmüll, die sorgfältige Überwachung durch den Obstbauern und die Nahrungszufuhr tiefwurzelnder Nachbarstauden für die Mehlbanane. Das Dargebot an organischer Substanz und die Verfügbarkeit von Absatzmärkten setzen dem System der Pflanzengesellschaft Grenzen. Ertragssteigerungen sind möglich für die unergiebige Zeitspanne von Juni bis September, sowie durch sinnvolle Verpackungsverfahren zur Erschliessung weiter entfernt liegender Absatzmärkte.

PRODUCTIVIDAD Y LIMITES DE LA PRODUCCION DEL PLATANO EN JARDINES COPLANTADOS DEL SURESTE DE NIGERIA.

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RESUMEN - Este artículo apoyado en una encuesta socio-económica estudia a productividad del plátano en asociación y las limitaciones para una producción a gran escala a partir de métodos practicados en cultivos asociados ; se prueba que este último sistema produce casi cuatro veces más. Esto se explica por la aplicación regular de desechos domésticos, una atención seguida del campesino y el beneficio alimentario retirado por los plátanos de los árboles coplantados perennes con enraizamiento profundo. Los límites del sistema están ligados al suministro de materia orgánica y al volumen del mercado. Puede acrecentarse la producción para el período «vacío» de junio a setiembre y también con vistas a la conquista de los mercados alejados gracias a buenos embalajes.