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Analysis of the competitiveness of mono-crop and mixed crop enterprises in farming system of smallholder farmers in Niger State, Nigeria

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ABSTRACT
This paper makes a comparative assessment of the competitiveness of mono-cropping and mixed cropping enterprises in Niger State, North central Nigeria during the 2009 cropping season considering available resources. Linear Programming model was used for optimizing gross margins. Results indicated that resources were not optimally allocated and after optimization, gross margins could be increased. Cereal-legume cropping patterns showed dominance in both the existing and optimum plans. As a result of inter variation in capital resource endowment and management, the gross margins were higher in the borrowed capital (₦87,322.89/ha) as compared to the limited capital situation (₦51,211.54/ha). The study recommends strong financial support, farm advisory services and adequate supply of modern inputs at fairly competitive prices to the small holder farmers.

Keywords: Linear Programming, Marginal value products, Mixed cropping, Mono-cropping, Shadow prices

INTRODUCTION
Sole cropping is the growing of a particular crop on a piece of land. Intercropping on the other hand is the growing of two or more crops simultaneously on the same piece of land with distinct row arrangement (Alamu 2002). Growing crops in a mixture is a farming practice that is common among farmers of the tropics (Yusuf, et al. 2008). In Nigerian savanna, mixed cropping is a common practice among the traditional farmers. The northern part of Nigeria is known to be characterized by mixture of cereals, leguminous grain and fibre. In the southern part of Nigeria, the cropping system is reported to consist of root crops, tree crops and occasional stands of maize and vegetables (Olukosi and Ogungbile 1991). Remison and Onelemhemhen (1999) observed that mixed cropping has been shown to lead to better utilization of land, labour and capital. It also results in less variability in annual returns compared with sole cropping. Mixed cropping system also ensures food security against total crop failure or with intent to maximize yield and profit making by the use of the same quantity of labour input. The food crops are normally grown on relatively fertile lands cleared from bush fallows of varying durations which allow for soil organic matter nutrient build-up (Ayodele et al. 2007). The main advantages of mixed cropping relate to maximizing returns from limited resources and stabilizing income over time. Tanko and Mbanasor (2006) further affirmed that intercropping can be rationalized on the basis of higher gross returns per hectare and per unit input of labour, higher profitability and considerable biological inputs into the soil especially by leguminous crops from which other crops gain.According to Ibrahim (2007), the study of farm management involves three successive stages: (i) analysis

of the present position of the farm business, (ii) interpretation of the present position for indication of possible improvements and (iii) preparation of an acceptable course of action for improvement of the farm business (Tajuddin et al. 1994). Most farm management studies in Nigeria have been concerned with analysis of existing performance in the arithmetic fashion, usually of groups of sample farms selected under certain criteria. Some studies e.g. Okezie and Okoye (2006), Fasasi (2006), Sanusi and Salimonu (2006), Rahman et al. (2005), attempted production function analysis showing the marginal conditions of resource use with respect to production of individual or selected enterprises. Few others, such as Ayoola and Adedzwa (2006), Okezie and Ude (2006) used budgeting techniques to evaluate economic benefits of alternative crop production systems. Such types of analysis do not specify what the optimum combination of enterprises under given restraining conditions would be. Expansion of such enterprises may also be constrained by physical, economic, social and environmental constraints (Alam, 1994, Alam et al. 1995, Schipper et al. 1995, Stonehouse 1996, Sama 1997, Adejobi et al. 2003, Ibrahim et al. 2004, Alford 2004). In addition, such studies are only descriptive and very partial in nature by addressing only the existing aspect in the organization and operation of the crop farm enterprises. Farmers' profit cannot be maximized without optimum cropping patterns, which ensure efficient utilization of available resources. The use of Linear Programming makes it possible to devise equilibrium solution, which include the specification of products levels as well as factor and product prices (Hassan et al. 2005). It is therefore imperative to use the techniques of mathematical programming and the methods of budgeting in the planning process of the farm. Developing optimum farm plan for small-holder farmers could lead to the resolution of the food crises given that the Nigerian farmer does not seem to exploit fully his/her opportunities for capital formation, improved resource base, higher productivity, innovation and improved management techniques (Olayemi 1980). The farmer is faced with the challenge of rationing his scarce resources among intended activities as well as optimizing the result of the rationing (Olayemi and Onyenweaku 1999). This requires the choice of appropriate mix of crop activities to achieve a well defined technical relationship between inputs and outputs (Sama 1997). This therefore creates an allocation problem. Up to now, little attention has been devoted to the role of farm planning in the resolution of the food crisis and raising income earnings of smallholder farmers. Formulating optimum farm plans for small holder farmers could lead to the resolution of the food crisis and consequently improve on the living standards of small holder farmers. The need to provide such suitable farm plans and education on the importance of the efficient use of scarce land and other resources taking into cognizance other motives of production imposed on the farmers by their socio-economic and cultural environment is obvious. The specific objectives of this study are to quantitatively assess the competitiveness of mono and mixed cropping enterprises by comparing existing with optimal farm plans under limited and borrowed capital situations as well as determine the shadow prices of excluded activities and marginal value products (MVP) of limiting resources.

RESEARCH METHODOLOGY

Study Area

The study area is Niger State of Nigeria. The State is located in North-central Nigeria between Latitudes 8°20′N and 11°30′ N and Longitudes 3°30′ E and 7°20′E with a total

land area of 76,363 square kilometers and a population of 4,082,558 people (Wikipedia, 2008). Agriculture is the predominant source of livelihood; 80% to 90% of the population reside in farm households. Mixed farming is widely practiced. The animals provide energy for ploughing, while their droppings are used for manuring the soil. Thus, the animals aid in mechanization and encourage intensification of land use. The State is well suited for production of a wide variety of crops such as yam, cassava, maize, millet, rice, cowpea, tomato, etc because of the favourable climatic condition. The annual rainfall is between 1100 and 1600mm with average monthly temperature ranging from 23°C to 37°C (NSADP 1994). The vegetation consists mainly of short grasses, shrubs and scattered trees. The State covers a land area of 80,000 square kilometers or 8 million hectares constituting 8 percent of the total land area of the country. About six million hectares, representing 85% of the total land area is arable. The range of local climatic and soil conditions, resource availability, and markets or farmers' tastes and preferences allows a wide variety of cereal, pulse and tuber crops to be grown. Cropping operations are almost exclusively done manually. Labour is the major input. The amount of land cultivated annually per household is therefore a function of family and/or hired labour availability during periods of peak demand, namely during land preparation and weeding.

Sampling Technique

The sampling frame for this study comprised of all the crop farmers in Niger State. The data used for this study were mainly from primary sources collected from farmers who were selected using multi-stage sampling. The three Agricultural Development Project (ADP) Zones in the State, namely, Bida, Kontagora and Kuta were considered for the study. The first stage involved random selection of two LGA's each from the ADP zones as follows: Lavun and Bida were randomly chosen from Bida Zone, Mariga and Kontagora from Kontagora Zone, as well as Shiroro and Paiko from Kuta Zone. In the second stage, two villages were selected randomly from each of the LGA's giving a total of twelve (12) villages. The third stage involved random selection of eighteen (35) farm households from each of the villages bringing the total sample size to 420. The data were collected using well structured questionnaire. Extension Officers resident in each of the locations as well as well trained enumerators assisted the researchers in data collection. Data collection lasted for five months (August-December 2009) using the limited cost-route approach to data collection.

Data collected for this study include input information such as farm size in hectares, human labour input in man days, animal traction input in cattle days, tractor hiring in number of hours utilized, quantity of fertilizers in kilogrammes, cost of agrochemicals in naira, depreciation on farm tools and equipment etc., input and output prices, socio-economic characteristics of farmers such as years of schooling, farming experience, age, household size, etc. as well as output information.

The empirical model

The objective function of the linear programming model is to maximize total gross margin of producing the crops less costs of hired human labour, bullock labour, hired tractor/power tiller, capital borrowing and marketing. The model will be used to derive optimum farm plans for farmers under limited and borrowed capital situations. The model is specified as follows:

$$\text{Maximize } Z_0 = \sum_{j=1}^{n} P_j X_j - \sum_{t=1}^{5} Wh L_t - \sum_{k=1}^{n} Wb K_t - \sum_{t=1}^{3} Wd R_t - \sum P_k Y_k - \sum_{r} M_t \quad \text{--- (1)}$$

Subject to:

$$\sum_{j=1}^{n} l_{js} X_j \leq L_s \quad \text{(Land)} \quad (s = 1, 2, \ldots, 72) \quad \text{--- (2)}$$

$$\sum_{j=1}^{n} a_{jt} X_j - L_t \leq H_t \quad \text{(Human labour)} \quad (t = 1, 2, 3, 4, 5) \quad \text{--- (3)}$$

$$\sum_{j=1}^{n} b_{jt} X_j - K_t \leq B_t \quad \text{(Bullock labour)} \quad (t = 1, 2, 3, 4, 5) \quad \text{--- (4)}$$

$$\sum_{j=1}^{n} d_{jt} X_j - R_t \leq S_t \quad \text{(Tractor/power tiller)} \quad (t = 1, 2) \quad \text{--- (5)}$$

$$\sum_{j=1}^{n} c_{jt} X_j - M_t \leq C_t \quad \text{(Capital)} \quad (t = 1, 2, 3) \quad \text{--- (6)}$$

$$\sum_{j=1}^{n} f_k X_j \geq F_{(min)} \quad \text{(Minimum subsistence farm-family cereal/legume requirement)} \quad \text{--- (7)}$$

Where; Z_0=Total gross margin of the farm in Naira; X_j=Units of the j^{th} crop activity in hectares; P_j = Gross value of output per ha of the j^{th} crop activity in Naira; Wh = Wage rate per unit of hired human labour in Naira; L_t = Number of hired human labour in t^{th} period; Wb = Wage rate per unit of bullock labour in Naira; K_t = Number of hired bullock labour in t^{th} period; Wd = Wage rate per unit of tractor/power tiller; R_t = Tractor/power tiller hired in t^{th} period; P_k = Marketing expense per unit of the product sold in t^{th} period; Y_k= Units of crop products sold in t^{th} period; r = Rate of interest for six months; M_t = Capital borrowed in Naira in t^{th} period; f_k = Food production in tons/hectare of k^{th} cereal/legume activity; L_s = Total available land in hectares for the crops with (s) restrictions; H_t = Total man-days of family labour owned by the farmer in t^{th} period; B_t = Total bullock labour owned in t^{th} period; S_t = Total tractor/power tiller owned in t^{th} period; C_t = Total working capital owned/available in Naira in t^{th} period; $F_{(min)}$= minimum quantity of cereal/legume required by the farm family per annum in tons; l_{js} = Input coefficient of land which is one hectare with s restrictions; a_{jt} = Input coefficient of human labour (in mandays) for j^{th} crop activity in t^{th} period. b_{jt} = Input coefficient of bullock labour for j^{th} crop activity in t^{th} period; c_{jt}= Amount of capital used in producing one hectare of j^{th} crop activity in t^{th} period and $\sum$ = Summation of j^{th} crop activities (j =1 to n);

RESULTS

Socioeconomic Profile of Respondents

A summary of the statistics of farmers in the study area is presented in Table 1.

Table 1. Summary of socioeconomic characteristics of respondents

	Minimum	Maximum	Mean	St. Deviation	Variance
Age	27.00	67.00	43.63	9.89	97.96
Marital status	0.00	1.00	0.90	0.29	0.08
Household size	3.00	14.00	9.18	2.64	6.97
Farm size	0.01	4.00	0.96	1.00	1.00
Education	0.00	12.00	6.18	4.05	16.48
Labour	35.00	220.00	99.66	31.91	1018.74
Experience	10.00	35.00	24.01	5.39	29.15
Cooperative	0.00	1.00	0.39	0.48	0.24
Credit	0.00	80000.00	12600.00	22271.25	4.96
Tenurial status	0.00	1.00	0.75	0.43	0.18
Ext. contact	1.00	3.00	2.02	0.77	0.60

Source: Field survey data, 2009

Optimum land use pattern under borrowed capital situations

The existing and optimum cropping patterns of respondents under borrowed and limited capital situations are presented in Table 2.

Table 2. Existing and optimum cropping patterns under borrowed and limited capital situations in Niger State, Nigeria, 2009

Cropping patterns	Existing plan		Optimum plans	
	FWLC	FWBC	FWLC	FWBC
1. Maize (HL)	-	0.95 (6.66)	-	-
2. Cowpea (HL)	0.44 (4.65)	0.62 (4.34)	-	-
3. Sorghum (LL)	0.25 (2.64)	0.87 (6.10)	-	-
4. Groundnut (HL)	0.39 (4.12)	0.99 (6.94)	-	-
5. Millet (LL)	0.71 (7.50)	-	-	-
6. Rice (LL)	-	0.45 (3.15)	-	-
7. Yam (HL)	0.62 (6.55)	0.80 (5.61)	-	-
8. Melon (LL)	-	0.28 (1.96)	-	-
9. Sweet potato (LL)	0.03 (0.32)	-	-	-
10.Cassava (LL)	0.05 (0.53)	0.06 (0.42)	-	-
11.Maize/Cowpea (HL)	-	0.89 (6.24)	-	0.32 (7.60)
12. Maize/Groundnut (HL)	0.95 (10.03)	1.60 (11.21)	-	-
13. Maize/Sorghum (HL)	0.75 (7.92)	0.34 (2.38)	-	-

14.Maize/Groundnut/Cowpea (HL)	1.28 (13.52)	1.35 (9.46)	-	-
15.Sorghum/Maize/Cowpea (HL)	0.88 (9.29)	0.91 (6.38)	-	-
16.Millet/Cowpea (HL)	-	0.67 (4.70)	-	-
17.Yam/Okra (HL)	0.78 (8.24)	-	-	-
18.Yam/Maize (HL)	0.45 (4.75)	0.70 (4.91)	-	-
19.Sorghum/Cowpea (LL)	0.90 (9.50)	1.01 (7.08)	-	-
20.Melon/Okra (HL)	0.02 (0.21)	0.04 (0.28)	2.85 (71.07)	2.85 (67.70)
21.Sorghum/Cowpea/Groundn (HL)	0.65 (6.86)	0.90 (6.31)	1.16 (28.93)	1.04 (24.70)
22.Sorghum/Groundnut (HL)	0.32 (3.38)	0.84 (5.89)	-	-
Total cropped area	9.47 (100.00)	14.27 (100.00)	4.01 (100.00)	4.21 (100.00)
% Sole crops	31.06	35.18	0.00	0.00
% Crop mixtures	68.94	64.82	100.00	100.00

Source: Computed from field survey data, 2009

Note: HL=Highland; LL=Lowland; FWLC=Farmers with limited capital; FWBC=Farmers with access to capital borrowing. Figures in parentheses are the respective percentages.

Activities included in the optimum plans under borrowed and limited capital situations

The following activities presented in Table 3. Were prescribed by the optimum plans under the borrowed and limited capital situations.

Table 3. Activities included in the optimum plans under borrowed and limited capital situations

No.	Activity name	Unit of activity	Optimal value/Activity levels	
			Borrowed capital	Limited capital
1.	Maize/Cowpea	Hectares	0.32	-
2.	Melon/Okra	Hectares	2.85	2.85
3.	Sorghum/Cowpea/Groundnut	Hectares	1.04	1.16
4.	Capital Borrowing	Naira	1,823.50	-
5.	Maize selling	Naira	606.80	-
6.	Cowpea selling	Naira	113,877.20	113,877.20
7.	Sorghum selling	Naira	49,160.59	54,578.00
8.	Groundnut selling	Naira	64,781.22	71,920.00
9.	Melon selling	Naira	243,475.50	-
10.	Okra selling	Naira	297,759.50	286,197.00
	Max. Objective		₦87,322.89	₦51,211.54

Source: Computed from field survey data, 2009

Gross Margin per Hectare in Naira in the Existing and Optimum plans

The gross margins for the existing and optimum plans under different capital situations are presented in Table 4.

Table 4. Gross margins per hectare realized by farmers in the borrowed and limited capital situations

Farmer Category	Gross margin/ha Existing plan(₦)	Gross margin/ha Optimum plans(₦)	Increase over existing plan	% increase over existing plan
FWLC	45,026.10	51,211.54	6,185.44	12.08
FWBC	63,800.25	87,322.89	23,522.64	26.94
Average	54,413.18	69,267.22	14,854.04	19.51

Source: Field survey data, 2009. Note: FWLC and FWLC are as previously defined.

Marginal Value Products of Resources

Resources that are not used up or are non-limiting or do not constrain the attainment of a programme's objective and vice versa have zero shadow prices. The marginal value product attached to a resource shows the amount by which the value of the programme will change if the available resource is increased by one unit. The marginal value product for human labour for the two categories of farms is zero implying that labour supply is non-limiting in the study area. The marginal value products of land, bullock labour and tractor hiring for the two categories of farmers are presented in Tables 5 and 6.

Table 5. Marginal value product of land in Naira

Farmer category	Lowland(₦)	Highland(₦)
FWLC	10,142.69	13,840.71
FWBC	14,950.18	19,138.90

Source: Field survey data, 2009.
Note: FWLC and FWLC are as previously defined.

Table 6. Marginal value product of bullock labour, tractor hiring and capital inputs in Naira

Farmer category	Bullock labour	Tractor Hiring	Capital
FWLC	0.00	0.00	-
FWBC	0.00	0.00	0.22

Source: Field survey data, 2009.
Note: FWLC and FWLC are as previously defined.

Shadow Prices of excluded activities

Shadow prices are marginal returns to increments of available resources. In a maximization problem, shadow prices are income penalties. They indicate the amount by which farm income would be reduced if any of the excluded activities is forced into the programme. Generally, only excluded activities have positive shadow prices. The shadow prices of included activities are zero. The higher the shadow price of an excluded activity, the lower is its chance of being included in the final plan. The shadow prices of excluded activities under the borrowed and limited capital situations obtained as by-products of the linear programming solution are presented in Table 7.

Table 7. Shadow prices (in naira) of excluded crop activities in the linear programming solution under the borrowed and limited capital situations

S/No	Excluded Activity	Reduced Income/Opportunity cost (₦) Borrowed capital	Limited capital
1.	Maize	27,611.05	12,047.79
2.	Cowpea	16,766.56	10,763.03
3.	Sorghum	28,589.70	12,134.41
4.	Groundnut	10,999.78	10,362.29
5.	Millet	19,048.26	12,985.58
6.	Rice	26,946.04	10,821,.84
7.	Yam	16,059.53	9,093.80
8.	Melon	8,704.12	3,542.33
9.	Sweet potato	7,219.43	3,461.89
10.	Cassava	11,859.43	6,152.14
11.	Maize/Cowpea	-	1,539.18
12.	Maize/Groundnut	24,577.73	11,098.04
13.	Maize/Sorghum	14,163.5	8,282.24
14.	Maize/Groundnut /Cowpea	14,124.64	4,689.13
15.	Sorghum/Maize/ Cowpea	2,223.97	2,740.78
16.	Millet/Cowpea	9,488.4	7,941.56
17.	Yam/Okra	2,307.15	254.71
18.	Yam/Maize	3,073.96	8,311.57
19.	Sorghum/Cowpea	8,345.22	6,104.30
20.	Sorghum/Ground nut	12,555.05	7,968.31

Source: Computed from field survey data, 2009.

DISCUSSION

Results in Table 1 show that a typical farmer sampled is about 44 years old, married, had nine family members, had attained at least primary level of education and cultivated1.06 hectares of land. The typical farm household head had 24 years of experience in farming, owned the land he/she cultivated, belonged to a cooperative society and had at least two contacts with an extension agent during the 2009 cropping season. A typical respondent with access to credit received at least ₦12,000.00 as loan. As the age of the farmer increases, the adoption of agricultural technology will likely decrease while sensitivity to risk will increase. Older farmers are more risk averse. The preponderance of experienced farmers in the state will make planning imperatives worthwhile. Previous experience enables the farmer set realistic time and cost targets by identifying production risks and constraints with ease. A large family size provides a ready source of cheap family labour. Small holder farmers over rely on meagre household resources and would strive to ensure minimum usage of paid labour as a result of the paucity and dearth of resources. Education plays a crucial role in technology dissemination and adoption. The ability of the farmer to cope with complexities of new innovations, the intricacies of the product and factor markets increases as the level of education increases. Smallness of cultivated land is a common feature in small holder agriculture. Farmers usually own several plots devoted to crops in scattered locations, the average in the study area being two.

The results in Table 2 also show that the relaxation of the capital input, by allowing capital borrowing resulted in an increase in the cultivated area. Results show that melon/okra was the most dominant cropping pattern in the highland situation which occupied about 67.70% of total cropped area. The next cropping pattern prescribed by the optimum plan was sorghum/cowpea/groundnut under the highland situation which accounted for about 24.70% of total cropped area. A third crop enterprise, namely, maize/cowpea occupying 7.60% of total cropped area under highland situation was included in the optimized plan. This suggests that cropping patterns under borrowed capital were more cash generating as the number of crops included in the optimum plans were observed to have increased. Credit plays a crucial role in smallholder agriculture as it enables the farmer to purchase production inputs and hire more labour to accomplish farm operations. The optimum plans also devoted the total cropped area to mixed cropping enterprises.

The activities presented in Table 3. were prescribed by the optimum plans under the borrowed and limited capital situations. The results indicate the dominance of mixed cropping enterprises in the optimized plans. Cash crops also exhibited dominance under both capital situations.

Results in Table 4 indicate that optimum plans under both limited and borrowed capital situations resulted in an increase in gross margins over the existing plan by 12.08% and 26.94% respectively. Marked disparity in gross incomes was witnessed in both category of farms. Access to adequate and timely credit is likely to raise farm incomes, improve the livelihoods of the farmers by raising their purchasing power to be able to acquire more productive inputs, hire labour, etc.

Results in Table 5 show that the marginal value product of land ranged from ₦13, 840.71 in the highland under limited capital situation to as high as ₦19,138.90 under the highland borrowed capital situation. The use of capital increased marginal value product of land substantially with marked variations. Put in another way, if highland resource is

reduced by one hectare under the borrowed capital situation for example, the value of the programme will reduce by ₦19,138.90. Land resource was therefore limiting.

Table 6 shows that bullock and tractor hiring had zero marginal value products. Tractor and bullock labour hiring activities are a function of the ability of the farmer to pay. Adejobi et al. (2003) opined that one of the production motives of small holder farmers is ensuring minimum usage of paid labour. Capital borrowing however, increased under borrowed capital situation to the tune of 22%. This underscores the crucial role credit plays in the production activities of the smallholder farmer.

The reduced income column in Table 7. indicates the amount by which farm income would be reduced if any of the activities appearing in the table is forced into the programme. In other words, they represent income penalties. The results show that in the case of farmers with access to capital borrowing, sole sorghum inclusion would reduce farm income the most by ₦28,589.70. This was closely followed by sole maize. The inclusion of Sorghum/maize/cowpea mixture would reduce farm income the least by ₦2,223.97. Mixed cropping enterprises were found to be in better competitive positions as compared to sole cropping enterprises. In the case of farmers with limited capital, the following cropping enterprises, namely, sole millet and sorghum were found to have the propensity to reduce farm income the most by ₦12,985.58 and ₦12,134.41 respectively and therefore, in least competitive positions as compared to mixed cropping enterprises. Yam/okra, a mixed cropping enterprise with the least shadow price of ₦254.71 was in the best competitive position as compared to sole cropping enterprises. The most complex mixtures and highest yielding plots are usually small areas close to the household where soil fertility is maintained at high levels through concentrated additions of animal manure, night soil, household sweepings, ash, etc. The complexity of crop mixtures, as well as crop yield, generally decline in fields more distant from the household. In these fields, yields are generally proportionate to the additions of organic manure and chemical fertilizer and the levels at which crop rotations and fallowing are practiced.

Generally, it was observed that the shadow prices of sole crops were higher than those of crop mixtures for both categories of farms thereby lending credence to previous findings (Adejobi et al. 2003, Tanko 2004, Alam et al. 1995). The accumulation of monetary income or economic considerations are not the only factors that a farmer takes into account before including certain enterprises in his crop mix (Adejobi *et al.* 2003, Tanko 2004). Diffusion of agricultural innovation had been identified as one of the major factors that could lead to sustained food security. One of the fundamental problems facing extension agents has been to persuade peasant farmers to grow crops as sole stands only. However, available research evidence seems to support the peasant farmer's preference for intercropping and challenge the notion that sole cropping is superior to intercropping under the peasant agricultural set up by indicating that intercropping generates greater cash returns per hectare. Moreover, the points against intercropping are more often based on findings of researches involving sole cropping conducted on research stations employing improved technology. The accumulation of monetary income or economic considerations are not the only factors that a farmer takes into account before including certain enterprises in his/her farming activities. For instance, the production objective of the desire to produce food for family consumption to maximize revenue or gross margin may be

the primary concern of the farmer while planning his farming activities as well as ensuring minimum utilization of paid labour. More often than not, the goals are conflicting. In such cases, an indication of the income the farmer is likely to forego in order to achieve that objective can be useful in aiding him make more rational and better decisions in the future.

CONCLUSION AND RECOMMENDATIONS

This study has shown that given the existing level of technology, farm resources were not optimally allocated. Under the existing level of technology and resource availability, crop mixtures were in a better competitive position than sole crops. Gauging the sensitivity of the plans to increase in land under cultivation indicated that agricultural land acted as a constraint to production. This is likely to hamper production activities of farmers.

Based on the findings of this research, certain policy instruments and their implications are identifiable. The existing land use pattern was found to be sub-optimal, thereby suggesting more scope for farm management. The prototype combinations of enterprises could be found useful in the extension education package of Niger State Agricutural Development Project (ADP) and the Niger State Fadama Coordination Office (NSFCO). Effective extension programmes and farm advisory services that will educate the farmers on efficient allocation of resources should be further strengthened. This has the propensity to improve the livelihoods of the smallholder farmer, curb the incidences of widespread hunger, unemployment and poverty. The optimum combination of enterprises, in addition to increasing gross margins were also capital intensive as capital investments were observed even at higher rates of interest. Adequate supply of agricultural credit, modern production inputs at terms and times convenient and at fairly competitive prices should be made available to practicing farmers.

A trend towards specialization was indicated by the plans. This however is in conflict with the concept of diversification. There is need to give special attention to minor crops in developing improved varieties with higher profitability, dissemination of technology to the farmers and improvement in the post harvest processing and utilization. For the goals of food security, increased income and reduced farm production costs, farmers should allocate farm resources as prescribed by the plans.

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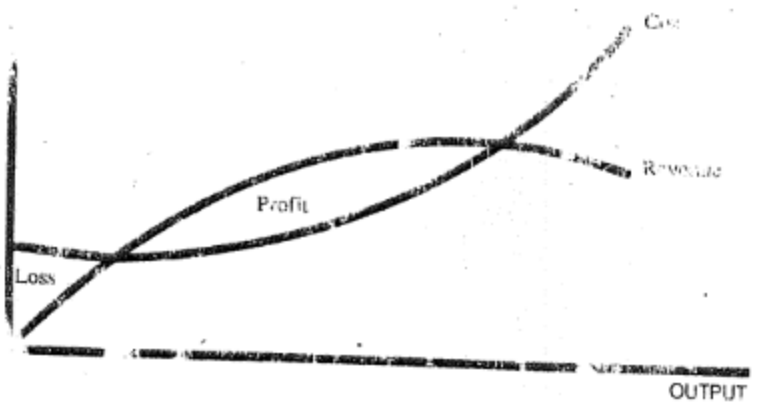

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