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NUTRITIONAL IMPLICATIONS OF THE DEMAND FOR FOOD IN NIGERIA

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ABSTRACT

This study determines the influence of price and income changes on the availability of food nutrients to Nigerian households segmented by location of residence. Demand elasticities were obtained. The nutritional effects of changes arising from changes in income and prices were computed using both the AIDS model and a nutrient availability measure developed by Huang. The findings show that maize and guinea corn are the foods that have the greatest implications for the nutrient status of households resident in rural areas. Increasing the prices of these food items by one per cent would lead to reduced intake of some nutrients by as much as 50 per cent. Households resident in urban areas would have their nutritional status most affected by increases in the prices of beans and maize. The analytical technique provides a veritable means to explore the probable effect of government agricultural and food policy on the populace.

Keywords: Food demand, Almost Ideal Demand System, Urban, Nigeria

INTRODUCTION

In the mid-1970s, Africa was the least urbanised region in the world. About 25 per cent of its population lived in urban settlements. By the year 2000, 37 per cent of the African population was living in urban areas. This proportion is projected to be more than half by 2025. Although these proportions are still lower than those for other continents and for the world as a whole, the annual growth rates of the urban population are highest in Africa (UNCHS, 1996).

Nigeria is Africa's most populous country with a population of 125 million. Since independence, Nigeria has become an increasingly urbanised society. The urban population has grown from 11 per cent of the total population in 1952 to 46 per cent in 2002. It has more large cities than other sub-Saharan African countries. Nigeria also has the largest number of people residing in urban areas in sub-Saharan Africa. (DFID, 2004).

Agriculture is the most important sector of the Nigerian economy. It once contributed over 60 per cent of gross domestic product. The percentage contribution has fallen drastically (DFID, 2004) since independence in 1960. The decline is attributed to the boom in the petroleum sector and the growth of the industrial sector. The Nigerian agriculture is also characterised by low farm incomes, low capacity level to satisfy food and fibre needs of the country and traditional techniques of production as a prototype of peasant agriculture. This characteristic is responsible for the influx of many able-bodied men from the rural into the urban areas.

In the recent past, growth in production of staple foods exceeded population growth. This is an achievement in view of the Nigeria's large and growing population and the relatively minor official support for such production. The cities represent the largest and fastest growing market for farmers. Over 90 per cent of total agricultural production is used for domestic consumption and less than 3 per cent of the quantity of food consumed is imported (FAO, 2003). However, the influence of urban demand for food and labour is unevenly spread in the country. Increase in food demand generated by the growth of cities and expansion of transport capacity is a major driving force of agricultural production and modernisation through the 1990s. Urbanisation has played an important

role in reducing pressures on scarce land and rural environmental resources and allowing the remaining rural population to develop viable production (Alaba, 2001). The rural areas are left with a demographically unbalanced population of women, younger children and older people. The rapid growth of urban populations has thus created challenges in Nigeria's largest cities. These relate to congestion leading to urban squalor, rampant violence, flimsy housing and filthy living conditions. These are accompanied by hunger and malnutrition, housing shortages, invasion of urban open spaces and green belts with low quality housing. Added to these are the problems of the rapid accumulation of urban waste, breakdown of urban infrastructure and atmospheric as well as groundwater pollution (IFPRI, 2002).

Urbanisation brings changes in diets that may pose new risks to people's health and nutritional status. Urban dwellers often have less time available for buying and preparing food. They however have greater exposure to advertising and easier access to supermarkets and street foods. As a result they often eat more processed and prepared foods. According to IFPRI (2002), city residents in Nigeria spent up to 50 per cent of their total food expenditures on street foods. The FAO (2003) found out that in urban areas, people spend an average of 30 per cent more on food than in rural areas yet they consume fewer calories. Whereas urban residents typically consume more micronutrients and animal proteins than rural residents, they however tend to consume more saturated and total fat and sugar and less fiber.

Global changes have resulted in deepening social differentiation and increasing poverty (Tacoli, 1998). Life in the urban areas has become more expensive while employment in the formal sector has gone down. Real wages do not keep up with the price increases or have even declined in absolute terms (UNCHS, 1996). Increases in food prices and service charges and cuts in public expenditure on health, education and infrastructure have been particularly felt by low-income groups (Tacoli, 2002). The urban poor spend as much as 60 to 80 per cent of their income on food, making them especially vulnerable to higher food prices, such as those caused by transport costs or monopolistic practices by powerful traders (CBN, 1998 and IFPRI, 2002). Protection under successive inward-looking regimes combined with currency overvaluation has directed resources away from the agricultural sector in Nigeria. This has inflicted heavy cost on rural consumers and producers while subsidising urban consumers. Yet, relatively little is known about the direction of food demand and its effects on the livelihood of Nigerians.

This paper intends to examine the demand for food in Nigeria and the nutritional implications of existing food consumption patterns on urban and rural consumers in Nigeria.

MATERIALS AND METHODS

The Study Area

The study area is Nigeria. It covers an area of 923,768 square kilometers on the shores of the Gulf of Guinea, with Benin to the west, Niger to the North, Chad to the North-East and Cameroon to the South and South-East. The population is projected to be more than 120 million (World Bank, 2002). The climate is characterised by relatively high temperatures throughout the year, with average annual maximum temperature varying from 35°C in the north to 31°C in the south, average annual minimum temperature between 23°C in the south and 14°C in the north. Annual total rainfall ranges from over 3800mm at Forcados on the coast to under 650mm at Maiduguri in the north east. The length of the rainy season ranges from almost 12 months in the south to under 5 months in the north. Cattle, goats and sheep constitute important animal resources with poultry and pigs growing in importance. Fish are caught in inland lakes and rivers, and lagoons, creeks and distributaries along the coast. The major crops cultivated are maize, cowpea, cassava, yam, sorghum, fruits, cocoa, vegetables, timber and rubber (Mabogunje, 2000).

The data used for this study were a subset of the 1996/1997 National Consumer Survey (NCS)

of the Federal Office of Statistics (FOS), Nigeria. This is the most comprehensive household level survey to date in Nigeria, with data on almost 10, 000 Nigerian households. A two-stage sampling technique was used in sample design for the NCS. As a first stage, a list of all Nigerian households was obtained from the National Population Commission (NPC, 1998). This list is based on the enumeration areas (EA) used for census purposes. The second stage involved the selection of five household units (HU) from each EA. These were chosen randomly using a table of random numbers. The different data available in the NCS are data on household socio-economic characteristics such as age, sex, educational and marital status, household income, etc. other data in the NCS are detailed records of the money value, quantity and the types of food purchased by the households over a one-week period. The data used for this study were randomly drawn (using SPSS software) from the full NCS dataset.

Analytical Tools

A model of household demand for the different food items which compete for the household budget allocation requires a complete demand system framework. Because of its theoretical consistency with the postulate that households maximise utility (minimise cost) in their consumption decision making process, and its flexibility to encompass broad ranges of behaviour, the 'almost ideal demand system' (AIDS) was selected for modelling household behaviour. The basis for the AIDS approach comes from the minimisation of a cost or expenditure function (Deaton and Muellbauer, 1980).

However, the true AIDS model is non-linear and is thus difficult to estimate. The model estimated in this study is a linear approximation of the strict AIDS model (LA-AIDS) and it corresponds to those used by Savadogo and Brandt (1988), Fulponi (1989), Mergos and Donatos (1989) and Soe et al (1994). The model hypothesises that the portion of total expenditure that accrues to a particular commodity (or budget share) is related to prices and income as follows:

$$w_i = a^* + b_i \log(M / P^*) + \sum_j^n c_{ij} \log p_j \qquad \text{(1)}$$

where i = 1,...., N

n = number of food items

w_i = average budget share of commodity i

M = total nominal expenditure on all goods

p_j = price of the jth good

P* is a price index defined as:

$$\log P^* = a_0^* + a_k^* \log P_k + \tfrac{1}{2} \sum_k^n \sum_j^n c_{kj} \log p_k \log p_j \qquad \text{(2)}$$

Equation (2) allows the AIDS flexibility but complicates the estimation procedure of eq. (1) which is nonlinear in the parameters. In empirical work, the following geometric price index is often used instead:

$$\log P = w_j \log P_j \qquad (3)$$

Where w_j is the budget share of food item j. Deaton and Muellbauer (1980) found in their application that Stones index P closely approximates P*. This results in the following linear (in the parameters) demand system:

$$w_i = a_i + b_i \log(M/P) + \sum_j^n c_{ij} \log p_j \qquad (4)$$

Adding a disturbance term completes the equation.

$$w_{ih} = a_i + b_i \log m + \sum c_{ij} \log p_j + U_{ih} \qquad (5)$$

i = 1, ...,n

Where i indexes commodity prices; m = M/P is real income and u random error. The parameter a_i represents the average value of the budget share in the absence of price and income effects. The parameters b_j and c_{ij} represent the effects on the expenditure share of good i of a 1 per cent change in real income of price of good j. A positive (negative) b_i indicates that the good has an income elasticity greater (less) than unity. Similarly, a good for which c_{ij} is negative (positive) has an own price elasticity greater (less) than 1 in absolute value. When c_{ij} is positive (negative), the goods are considered substitutes (complements). The model is estimated using the SURE regression function in LIMDEP econometric software. The formulae and procedures for the computation of elasticities after Beggs (1988) and Greene and Alston (1990) are:

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income elasticities

$$\varsigma_{iy} = 1 + b_i / w_i \qquad (6)$$

own-price elasticities

$$\varsigma_{ii} = c_{ii} / w_{ii} - (1 + b_i) \qquad (7)$$

cross-price elasticities

$$\varsigma_{ih} = c_{ih} / w_i - b_i w_h / w_i \qquad (8)$$

The second stage of the analysis is the use of a technique developed by Huang (1996) to explore the linkage of the demand model to nutrient availability. To do this, information about the

nutrient values of each food consumed is needed. Let a_{ki} be the amount of the kth nutrient obtained from a unit of the ith food. The total amount of that nutrient obtained from various foods, say Φ_k may be expressed as

$$\Phi_k = \Sigma_i a_{ki} q_i \qquad (9)$$

This is referred to by Huang (1996) as the consumption technology of consumer behaviour. The values of a_{ki}'s for non-foods will be assigned zero, thus the terms associated with non-foods will disappear. This equation, including all foods consumed, plays a central role in the transformation of food demands into nutrient availability. By substituting a demand equation for the quantity variable of equation (9), changes in consumer nutrient availability become

$$d\Phi_k = \Sigma_i a_{ki} [\Sigma_j(\delta q_i/\delta p_i)dp_i + (\delta q_i/\delta m)dm] \qquad (10)$$

Furthermore, the relative changes of consumer nutrient availability can be expressed as functions of the relative changes in food prices and per capita income as follows:

$$d\Phi_k / d\Phi = \Sigma_j \quad (\Sigma_i e_{ij} a_{ki} q_i/\Phi k)dp_j p_j + (\Sigma_i \eta_i a_{ki} q_i/\Phi k)dm/m = \Sigma_j \Pi_{kj} dp_j/p_j + \rho_k dm/m \qquad (11)$$

Where $\Pi_{kj} = \Sigma_i e_{ij} a_{ki} q_i/\Phi_k$ is a price elasticity measure relating the effect of the jth food price on the availability of the kth nutrient, and ρ_k represents the effect of income on the availability of that nutrient.

Obviously, the measurement represents the weighted average of all own- and cross-price elasticities (e_{ij}'s) in response to the jth price with each weight expressed as the share of each food's contribution to the kth nutrient ($a_{ki}q_i/\Phi_k$'s). Similarly, the measurement of $\tilde{n}_k$ represents the weighted average of all income elasticities (η_i's) with each weight again expressed as the share of each food's contribution to the kth nutrient. Thus the general calculation of nutrient elasticity matrix, say N, for the case of l nutrients and n foods can be obtained as a product of multiplying matrix S by matrix D as follows:

$$N = S^* D \qquad (12)$$

where N is the l x (n+1) matrix of nutrient elasticities in response to changes of food prices and income, S is the l x n matrix with entries of each row indicating a food's share of a particular nutrient, and D is the n x (n + 1) matrix of demand elasticities. From these nutrient elasticity measurements, a change in a particular food price or per capita income will affect all food quantities demanded through the interdependent demand relationships and thus cause the levels of consumer nutrient availability to change simultaneously. The MMULT option of the Excel worksheet was used to compute the nutrient elasticities.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents

The summary of the socioeconomic characteristics of the respondents are presented in Table 1. The regions with the largest number of respondents are the North Central and the North West regions. All the regions have a greater number of people resident in the rural areas as against the number resident in urban areas except in the South West. This could be due to the fact that it is the region of Nigeria with the most educational institutions and hence a sizeable number of industries to employ city dwellers. Expectedly, most households are headed by males (84 per cent) with households comprising 2-4 members (46 per cent) constituting the modal family size and almost three-quarter of household heads are married. The greater proportion of households is headed by illiterates aged between 35 and 54 years. Sixty six per cent of all respondents report farming as their primary occupation, though it is an activity that is more predominant in the rural areas.

Table 1: Socioeconomic Characteristics of Respondents

Socioeconomic Characteristics	Urban		Rural		Total
	Number	% of Total	Number	% of Total	
Region of Residence					
North Central	16	4.42	61	16.85	77
North East	10	2.76	48	13.26	58
North West	16	4.42	58	16.02	74
South East	8	2.21	39	10.77	47
South West	39	10.77	21	5.80	60
South South	9	2.49	37	10.22	46
Sex of Household Head					
Female	19	5.25	38	10.50	57
Male	79	21.82	226	62.43	305
Family Size					
1	18	4.97	34	9.39	52
2-4	43	11.88	124	34.25	167
5-9	35	9.67	101	27.90	136
More than 9	2	0.55	5	1.38	7
Marital Status of Household Head					
Non-married	28	7.73	55	15.19	98
Married	70	79.34	209	57.73	264
Level of Educational Attainment of Household Head					
None	44	12.15	180	49.72	224
Primary	24	6.63	46	12.71	70
Secondary	22	6.08	30	8.29	52
Tertiary	8	2.21	8	2.21	16
Age of Household Head					
15-24	1	0.28	9	2.49	10
25-34	28	7.73	33	9.12	61
35-54	54	14.92	163	45.03	217
More than 54	15	4.14	59	16.30	74
Occupation of Household Head					
Farming	19	5.25	220	60.77	239
Non-farming	79	20.44	44	12.15	123
Total Income of Household					
Less than ₦ 1000	5	1.38	58	16.02	63
₦ 1000-₦ 1999	67	18.50	177	48.90	244
₦ 2000-₦ 2999	25	6.91	27	7.46	52
More than ₦ 3000	1	0.28	2	0.55	3
Total	**98**	**27.07**	**264**	**72.93**	**362**

Source: Result of Analysis, 2004.

Food Demand Elasticities for Study Households

The elasticity computations for both rural and urban households are shown in Table 2. The study showed that maize is a luxury food while millet and guinea corn are essential food items. For the households, millet and guinea corn are the price elastic food items. Besides, the study showed that rice substitutes guinea corn and maize while yam complements rice, garri and beans.

The elasticities for urban households show that guinea corn is an inferior food in the urban areas. Other inferior foods are rice, garri and beans. Own price computations show that rice and guinea corn are price elastic. Garri is a complementary food item to rice, millet, guinea corn, yam and beans, and millet is a complement to yam, garri and maize.

Table 2: Income and Price Elasticities for Nigerian Households by Area of Residence

Food Items	Income Elasticities	Price Elasticities						
		Rice	Millet	G. Corn	Yam	Garri	Beans	Maize
Households Resident in Rural Areas								
Rice	-0.05	0.10	0.14	-0.04	-0.13	0.44	0.18	-0.14
Millet	0.56	-0.26	-1.46	0.06	0.66	1.03	1.21	0.69
G. Corn	0.23	1.27	1.00	-2.84	0.96	0.57	1.92	0.76
Yam	-1.33	0.23	0.12	0.11	-0.40	-0.01	-0.05	-0.19
Garri	-0.00	-0.77	-0.16	0.11	-0.07	-0.16	0.16	0.43
Beans	-0.14	0.02	-0.02	0.07	-0.78	1.21	0.24	-0.76
Maize	1.18	0.83	0.57	-0.26	0.49	0.07	-0.06	-0.52
Households Resident in Urban Areas								
Rice	-0.73	-1.48	1.90	0.31	0.73	-1.74	-1.06	0.16
Millet	0.99	-0.17	0.11	-0.38	0.62	-0.43	-0.15	0.07
G. Corn	-1.28	0.43	0.90	2.18	-0.70	-0.28	-0.12	1.05
Yam	0.09	0.11	-0.11	-0.08	0.49	-0.23	-0.46	0.81
Garri	-0.15	0.44	-0.06	0.37	-0.49	0.13	0.75	-0.04
Beans	-0.12	0.76	0.28	-0.11	0.25	-0.57	-0.61	0.65
Maize	0.14	0.12	-0.13	-0.05	0.21	0.13	-0.33	-0.70

Source: Result of Analysis, 2004.

Nutritive Value of Foods Consumed in Nigeria

Table 3 shows the nutritive values per kilogramme for selected food items. Yam has the least energy content of the food items, but the highest moisture content. Beans has the highest protein value and yam and garri the least. Yam has the least carbohydrate content and millet the highest calcium content. Guinea corn has the highest phosphorous content while beans has no iron content. Further details on the nutrient contents of the different foods are as seen in Table 3.

In addition to the unit nutritive value of the study food items, the amount of food consumed is another factor determining the level of nutrients available to consumers. Averages of food consumption over the study period were obtained from the Central Bank of Nigeria, 1998. Maize is the food item consumed in the greatest quantity by Nigerian households and beans is consumed in the least quantity.

Table 3: Weekly Nutrient Consumption per Capita

Nutrients	Rice	Millet	G. Corn	Yam	Garri	Beans	Maize
Energy (cal)	3630	3290	3450	1190	3510	3380	3570
Moisture (%)	120	109	101	690	126	114	116
Protein (g)	70	74	107	19	10	225	94
Fat (g)	5	13	32	2	11	14	42
Carbohydrate (g)	799	777	741	278	842	610	736
Calcium (mg)	90	3970	260	520	450	1040	160
Phosphorous (mg)	1270	2440	3300	610	790	4160	2200
Iron (mg)	17	171	106	8	16	-	36
Thiamine (mg)	1	1.8	3.4	1.1	0.8	0.8	3.3
Riboflavin (mg)	0.3	1.1	1.5	0.2	0.3	0.9	1
Niacin (mg)	28	8	33	3	10	40	22
Food(Kg)	35.89	69.83	88.38	274.59	394.56	21.74	1009.09

Source: Central Bank of Nigeria, 1998.
Food and Agricultural Organisation, 1968.

Food Share of Nutrients

Table 4 presents the source of nutrients and is the first step for obtaining nutrient elasticities for the selected food items. Table 4 showed that consumption of maize and garri accounts for more than 80 per cent of all energy consumption. Also, maize is a major source of protein, fat, phosphorous, thiamine, riboflavin and niacin. Garri and millet are the principal sources of calcium; and yam accounts for 50 per cent of food moisture.

Table 4: Nutrients Share Based on Average Food Consumption

Nutrients	Rice	Millet	G. Corn	Yam	Garri	Beans	Maize	Total
	Percentages							
Energy	2.15	3.80	5.04	5.40	22.88	1.21	59.5	100
Moisture	1.13	2.01	2.35	49.92	13.10	0.65	30.84	100
Protein	1.99	4.10	7.50	4.14	3.13	3.88	75.25	100
Fat	0.35	1.76	5.49	1.07	8.43	0.59	82.31	100
Carbohydrate	0.02	4.13	4.99	5.81	25.30	1.01	56.57	100
Calcium	0.40	34.32	2.84	17.68	21.99	2.80	19.99	100
Phosphorous	1.38	5.17	8.85	5.08	9.45	2.74	67.33	100
Iron	0.91	17.89	14.03	3.29	9.46	0.00	54.42	100
Thiamine	0.81	2.84	6.79	6.82	7.13	0.39	75.22	100
Riboflavin	0.76	5.40	9.32	3.86	8.32	1.38	70.96	100
Niacin	3.11	1.73	9.02	2.55	12.21	2.69	68.89	100

Source: Result of Analysis, 2004.

Nutrient Elasticities of Foods Consumed by Nigerian Households

Table 5 shows that maize and guinea corn are the foods that would have the greatest implications for the nutrient status of households resident in rural areas. Increasing the prices of these food items by one per cent would lead to reduced intake of some nutrients by as much as 50 per cent.

Households resident in urban areas would have their health status most affected by increases in the prices of beans and maize. Increasing the prices of millet and garri would have a similar effect but it would affect fewer nutrients. Conversely, increasing the income of households resident in urban areas by one per cent would increase the availability of all nutrients except niacin whose consumption will decrease by 4 per cent.

Table 5: Nutrient Elasticities for Foods Consumed by Nigerian Households

Nutrients	Income	Rice	Millet	G. Corn	Yam	Garri	Beans	Maize
	Nutrient Elasticities for Foods Consumed in Urban Households							
Energy	66.0383	38.6614	30.671	-26.4461	31.5165	9.6471	14.773	-16.8958
Moisture	-28.4838	29.5797	21.0338	-7.6393	-2.8447	4.2571	5.0531	-17.3679
Protein	86.6671	69.7352	44.6035	-39.6273	41.6183	18.7937	16.4292	-33.2691
Fat	97.8509	68.6338	48.6539	-35.8143	45.2401	10.2122	9.2317	-34.4902
Carbohydrate	62.3434	34.0941	27.8369	-25.14	30.3501	8.1829	15.1874	-13.7696
Calcium	19.5342	-1.4946	37.2697	-6.6601	24.3254	38.2365	49.159	19.3569
Phosphorous	77.1711	59.8639	38.9159	-40.5947	39.8898	17.4425	21.3719	-23.8956
Iron	73.0397	51.8988	17.9386	-51.5549	49.8455	29.0871	46.8322	-1.9762
Thiamine	82.746	66.4848	45.3022	-37.141	41.614	11.6802	12.9992	-30.6341
Riboflavin	83.5354	63.9142	41.094	-43.1884	43.98	16.476	21.777	-24.401
Niacin	80.174	59.5679	44.3815	-41.6849	39.0819	14.3758	18.3218	-25.3839
	Nutrient Elasticities for Foods Consumed in Urban Households							
Energy	0.9801	17.06	-0.324	15.1352	4.6298	1.9915	-9.1509	-32.1907
Moisture	4.9244	14.4464	-5.6213	3.9494	25.1068	-9.6284	-25.4932	21.1731
Protein	2.9788	13.3942	1.6427	12.0465	16.0121	-0.3	-30.3806	-39.0812
Fat	4.7441	15.696	-5.359	10.261	11.3299	8.3108	-22.9857	-50.8723
Carbohydrate	2.2134	20.7411	-4.2451	15.2716	1.6643	5.5232	-4.2213	-29.723
Calcium	30.8049	10.942	2.0123	-1.312	22.3684	16.4538	-5.8578	6.5886
Phosphorous	0.92	15.763	2.0442	17.1784	10.7008	0.1489	-22.4399	-32.1796
Iron	5.5843	12.6995	8.3198	24.5853	10.34	-5.6568	-17.7087	-19.9693
Thiamine	3.5574	14.4483	-2.885	12.2627	13.3409	4.3828	-24.9496	-39.9628
Riboflavin	1.7298	15.6142	0.6638	17.571	10.44	2.378	-22.5282	-35.9388
Niacin	-4.4114	14.9218	5.0277	20.5536	7.3929	-0.2837	-20.9626	-35.6629

Source: Result of Analysis, 2004.

CONCLUSION

There is an increasing realisation that food demand studies should go beyond the realm of being mere academic exercises to having an impact on the livelihood of people who consume the foods. This study has attempted to do this by examining the changes in nutrient availability arising from price and income changes in Nigerian households segmented by sector of residence.

Using demand elasticities from traditional demand studies, the study was able to show the intervening relationship between nutrient changes arising from changes in economic factors. The major policy implications of the study are that it provides a means to derive a nexus between economic planning and the (nutritional) well being of the citizens of the nation. With this tool, therefore, it is possible to foretell the non-immediate effects of food policies vis a vis import restrictions, farm subsidies and associated government legislation on food nutrient status.

On the basis of the findings of this study, therefore, it is recommended that there be especially concerted effort to ensure sustainability in the production of those crops that have been found to especially impact negatively on nutrient adequacy in Nigerian households. These are maize, guinea corn and beans. Programmes that would provide credit to the farmers, improve the crop seed and enhance existing distribution and marketing channels are especially desirable.

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