INDUSTRIAL UTILIZATION OF CEREALS: THE CASE OF SORGHUM AND MAIZE

by

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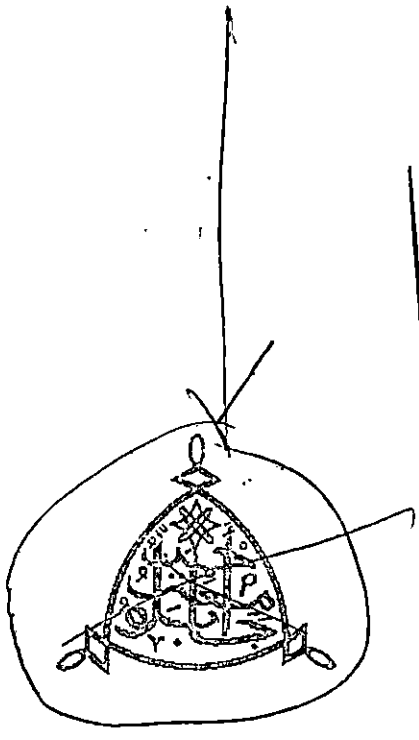

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Introduction

Sorghum and maize are the most important cereal crops grown in Nigeria in terms of hactarage and total output (Ogungbile *et al.*, 1996). Sorghum occupies about 45% of total land area under major cereal crops and about 30% of total arable crop land (NARP, 1995). Currently annual sorghum production is about 8.4 million tonnes with an average yield of one tonne per hectare. With current annual production of about 6.5 million tonnes, maize ranks second to sorghum in terms of total output. It occupies about 20% of the total land area put onto major cereal crop production with an average yield of 1.8 tonnes per hectare. Maize has emerged from being a backyard crop in 1970s to now become one of the most important food and industrial crops in Nigeria. Although maize is grown in virtually all parts of the country except in the drier northern Sudan savanna and Sahel, the production and expansion of maize in recent time have been concentrated in the northern states where the environmental conditions of the northern Guinea savanna suits its cultivation most.

Sorghum and maize are principally major staple food crops that are used in various ways. However, the ban on imported cereals especially wheat, barley maize and barley malt into Nigeria had initiated rapid changes in the demand and utilization of sorghum and maize (ICRISAT, 1990). Following the ban on barley in 1988, the brewing industry in Nigeria has been using sorghum and maize as raw materials for alcohol and non-alcohol drinks and beverages. The food industries use their malt extracts and nutritionally fortified the products to produce balanced food. Bakeries experiment on substitution of wheat flour with local flours and more of the locally produced maize and sorghum grains were used in animal feed production.

Industrial utilization of sorghum and maize is presently noticeable in the brewing and beverage, food and feed industries (Jojo, 1998). While sorghum has a greater potential in being used as raw materials in the brewing sector, maize has a better advantage in animal feed production. Potential for the utilization of these locally produced grains may not be realized unless suitable cultivars with high extract yield and comparable qualities of imported barley and wheat are found. Research efforts have therefore been devoted into developing suitable varieties that can be used as industrial raw materials in place of barley and wheat. This is expected to increase the demand for these crops and ultimately improve the income and welfare of the farmers. This papers presents some of the findings and observations experienced from a study to promote production and utilization of sorghum products in Nigeria. The study was sponsored by IFAD with ICRISAT as the regional facilitating institute.

Supply and Demand for Sorghum and Maize

Import restrictions on cereals and other food items and the abolition of commodity boards have increased producer prices. As a result, total agricultural production including food grains has grown by about 4% per annum (CBN, 1998). A decline in real incomes and bans on imported foods have caused a shift in consumption of expensive food to staple foods. The shift has also induced additional production. An analysis of the production trend of major cereal crops shows that sorghum experienced a growth rate of 5.6% per annum between 1988 and 1992 and 5.9 between 1996 and 1997. The current annual production of sorghum is 8.5 million tonnes (Table 1).

In the case of maize output rose from 2.08 million tonnes to about 6.6 million tonnes during 1991-1996 (CBN, Ahmed *et al.*, 1998). Since then, aggregate maize production has stabilized to approximately 6.5 million tonnes. The stagnation in production of maize can be attributed to scarcity of fertilizers and fluctuations in maize grain prices.

The government has gradually been easing the import restrictions on wheat, rice, maize and barley primarily to moderate food price increases and in conformity with its trade liberalization policy. The removal of import restrictions may likely reduce the incentives for farmers to grow these crops. The demand for staple foods is expected to continue to grow because of high population growth rate and deteriorating purchasing power of consumers and the likely further depreciation of the Naira which would make imported products mor expensive. The present trade liberalization in the grain market will require high efficiency not only in the production of these crops but also in their uses as industrial raw materials in order to be competitive.

Marketing of Cereal Grains

Marketing of cereal crops has basically two distinct patterns. The first pattern consists of producers and itinerant petty traders carrying their grains to local periodic market for sale themselves. This type of marketing channel involves relatively short distances and essentially serves local markets and customers for local consumption. The second pattern involves relatively long distance trade which connects the food-deficit population and industrial centres with the producing areas. Sorghum and maize marketing for industrial purposes belongs to this category of market. Merchants or their agents purchase grains directly from farmers or village market wholesalers. After the industrial firms had tried in vain to get into direct production of the grains, they have resorted

to purchasing in bulk from merchants. A survey of sorghum markets reveals that farmers do not sell directly to processors (users). Buyers of sorghum for use as food or for industrial use procure from agents or middlemen (Figure 1). Farmers as individuals could not deal directly with the industries because of the large quantities of grains involved and the cleaning and quality standards required by the industries. SK 5912 (short kaura) and KSV 8 (farafara) are mostly the preferred varieties in the brewing industry, but the firms are not prepared to pay any premium price for their purchase in the market. ICSV 400 and ICSV 111 recently identified to be suitable for brewing are not available in sufficient quantities. Figure 2 shows the trend of retail prices of major cereals in Nigeria from 1989 to 2000. Sorghum and maize prices were consistently lower than that of rice. Sorghum prices fell below those of maize and millet as from 1994. There is the need to promote marketing strategies and training that will enable farmers as a group to sell there produce directly to the users.

Utilization of Sorghum in Nigeria

A baseline survey was conducted in 2000 to four States in northern Nigeria (Kaduna, Kano, Katsina and Plateau) as benchmark to determine constraints to commercial utilization of sorghum grain. Focus group approach was used to interview three categories of participants in the sorghum industry. The first group consisted of farmers and processors involved in the production of porridge, snacks, beverages and drinks produced from sorghum locally. Three selected groups were chosen each from Katsina and Kano States. The production activities of these products were dominated by women. The second group consisted of communities using sorghum to brew local opaque drinks known as 'Pito' and or 'Burukutu'. Communities interviewed were located in Kaduna State. The third set of participants interviewed comprised commercial (industrial) companies and processors of sorghum, sorghum malt, beer and beverages, baby weaning foods, non-alcoholic drinks, confectioners and animal feed producers.

Sorghum utilization was broadly grouped into two categories: local and industrial.

Local utilization.

About 20 products are made out of sorghum locally for human consumption (Maigida *et al.* 2001; Atala *et al.* 1999). Most important of these products are *Tuwo* (thick porridge), *Burukutu/pito* (opaque beer), *kunu* and *koko/Akamu*. Other minor products are the various snacks produced by small scale processors such as *Danwake, Kosai, Jollof dawa, Fura, Dashishi* popped sorghum Pate, Buza, German rice amongst others (Table 1).

Direct human consumption up till date remains the most important source of demand for sorghum, hence much of the varieties under cultivation today follow sorghum grain consumption trait preferences of households importantly consistency and keeping qualities (Akingbala and Rooney, 1990). Thus corneous flour particle produced from intermediate and hard grains irrespective of size, produce harder and more viscous pastes, most preferred quality for tuwo by households; while soft and intermediate grains were most preferred for snacks and drinks. A recent survey on sorghum utilization in Kaduna State by Atala *et al* 1999 showed that red guinea variety of sorghum was most preferred for burukutu and pito making followed by 'Fari' type (white guinea and Farafara varieties) Table 2.

Industrial Utilization of Sorghum

Although the percentage of domestic sorghum production used in industry had been low in the past (Baidu-Forson and Ajayi, 1998), current reports show that there is a significant increase in the amount of sorghum used by industries. A survey on industrial utilization of sorghum in North and Central States of Nigeria by Ogungbile and Marley (1999) has revealed that many industries now use sorghum/or sorghum malt as a major raw material in alcoholic and non-alcoholic, beverages. Currently, the malting and brewing industry represents the largest industrial user of sorghum grains. The International Beer and Beverages Industry (BBI) Nigeria Ltd which has five other breweries use 100% sorghum grain as raw material using about 48,000t/annum. Jos International Breweries Ltd also uses 100% sorghum grain for its products utilizing at peak production about 7,680t/annum. Sorghum grain utilization in malt drink production accounted for 55% of Guinness turnover in 2000 (O. A.. Bello - personal communication). Labande Cereals Ltd, a malting company produces malt for up to 6 brewing/beverage companies at current production levels of about 21,600t/annum.

Further, the study showed that 42 beverage and baby weaning foods products

contain sorghum malt as malt base. Other industrial uses of sorghum include production of sugar confectioneries and biscuits (Aluko *et al.* 1994) and the livestock feed subsector. However, use of sorghum grain in feed mills and in milling/baking remains small in comparism to sorghum utilization in the brewing and malting industry. Although several constraints such as customer preferences for 100% wheat confectionery, continue to stunt progress of sorghum utilization in this direction, technologies for production of quality composite wheat sorghum bread and confectionery have been developed in IAR laboratory (Aluko *et al.*, 1994) and are currently been extended to bakers and millers in Nigeria (Chindo *et al*, 2000). The use of maize in feed mills as source of carbohydrates is much more acceptable than sorghum grain due primarily to cost and losses associated with milling of sorghum. With over 34 breweries, several beverage, livestock feeds companies it is estimated that current sorghum malt and grain utilization is in excess of 350,000 metric tones/annum.

All industries that utilize sorghum grain or malt maintain that it is cheaper to use than to import barley grain or malt, this has led to the resuscitation of many breweries that had gone out of business. Table 3 shows industries that utilize sorghum in their production systems. These show clearly, the prospect of sorghum replacing imported barley which large sums of money has been spent on it's importation. Baidu-Forson and Ajayi, (1998) reported that between 1980-1990, a total of $601 million was spent on the importation of $1.13 million and 54.8 thousand metric tones of malt and barley grain.

Although current trade liberalization policies of Nigerian government may have indirectly lifted the ban on barley malt and grain importation, it appears however, that some industries e.g Nigerian Breweries Ltd have resorted to importation and use of barley malt and grain. Thus this appears to be a serious impediment to current commercialization and utilization efforts. Further, most farmers in the Sudano-sahelian zone of Nigeria that are to benefit from commercialization tend to detest the use of sorghum for alcohol production on religious grounds. This has constrained efforts to extend and popularize recently developed high yield varieties that are suitable for industrial use.

Commercialization and Utilization: Benefits

Various groups such as the producers and users have short medium and long-term benefits as industrial utilization of sorghum increases. Currently, short and medium term perspectives show that the brewing industry, grain merchants and sorghum selling fames make substantial financial gains. As earlier mentioned, host brewing industries indicated their intention to continue using

sorghum a raw material due to substantial foreign exchange savings. Grain merchants and sorghum selling farmers who in most cases serve as processors make substantial gains because they procure at low prices, store and resell to end users especially when processed at high prices. Most small-scale farmers will benefit in the medium to long-term through productivity gains and also through ensuring that their produce meet the requirements of end users. In this regard, various strategies have been deployed by an on-going project to make small-scale farmers benefit in the short and medium term.

These are:

(i) Varietal purity - From earlier reports and surveys conducted across industrial users (Ogungbile and Marley, 1999), small-medium and large scale opaque beer makers (Atala *et al.*, 1999) and other local snacks and drinks producers (Maigida *et al.*, 1999), five varieties of sorghum, SK 5912 (SAMSORG 17), KSV 8 (SAMSORG 14) ICSV 400 (SAMSORG 39), ICSV 111 (SAMSORG 40) and red guinea (local) were identified as most suitable varieties for malting. In the 2000 cropping season, 4.2 tons of certified seed of SK 5912, KSV 8 and ICSV 400 were produced and are ready for distribution to 420 farmers in Kano, Kaduna and Katsina States. (Aba and Marley, 2000). This is to ensure supply of pure seeds into the sorghum production system, thus maintaining varietal purity.

(ii) Assessment of new varieties - although about 41 sorghum varieties have been released in Nigeria over 35 years of research by IAR (Aliyu *et al.*1997), many of these and other promising lines have not been evaluated for their malting qualities. In 2000, IAR in collaboration with JIB characterised 4 varieties for their malting qualities. Results (Table 3) show that SK 5912 had the lowest malting loss of 1.1% followed by ICSV 400 with 4.1%, ICSV 111 with 4.4% and KSV 8 with 8.9%. Further, IAR evaluated 10 varieties in laboratory, and found that KSV 4 (BES; SAMSORG 3), KSV 12, KSV 13, NR 71176 were suitable for malting similarly to KSV 8 and ICSV 111 (Table 4).

(iii) Training of farmers on sorghum grain quality maintenance and marketing - IAR in collaboration with partners such as grain merchants, maltsters and brewing industry organised a workshop to train farmers on the quality of grain required by end users. Further, farmers were advised on how to perform production,

harvesting, threshing and storage operations to ensure good quality grains. Farmers were further taught marketing channels for all grain that met end-users requirements.

These strategies which we hope are sustainable were directed to make small-scale farmers obtain short and medium term benefits of commercialization and utilization of sorghum in Nigeria

Conclusion

Brewing industry in Nigeria is using sorghum and maize extensively in the production of beer and food drinks. Lager beer brewers need to use imported enzymes. Researchers should concentrate on developing cultivars that would require little or no artificial enzymes or work on the production of locally – manufactured enzymes in order to make our beer internationally acceptable and save foreign exchange from importing enzymes.

Products of composite flour such as bread and biscuits are still not acceptable to the Nigerian consumers. While efforts should be made to improve the quality of these products, Nigerians may have to change the taste for foreign food. At present, farmers sell their grains raw without cleaning and processing. Until farmers begin to do some processing to add value to their grains, they may not be able to reap the benefit of increase in the demand as a result of industrial commercialization of their crops.

Table 1: Output of Some Agricultural Commodities ('000 tonnes)

	Sorghum	Maize	Millet	Rice
1986	5455	1336	4111	283
1987	5455	4612	3905	808
1988	5182	5268	5136	2081
1989	7265	5008	4770	3303
1990	4185	5768	5136	2500
1991	5367	5810	4109	3226
1992	5909	5840	4501	3260
1993	6051	6290	4602	3065
1994	6197	6902	4757	2427
1995	6997	6931	5563	3203
1996	7514	6217	5803	3122
1997	7954	6285	5997	3230
1998	8401	6435	6328	3486
1999	8504	6515	6423	3522

Table 2: Products made from sorghum in Nigeria

S/No	Local products (Drinks/snacks)	Industrial products
1.	Tuwo	Beer
2.	Burukutu/Pito	Stout
3.	Kunu	Malt drinks
4.	Koko/Akamu	Malt extract
5.	Pate	Livestock feeds
6.	Dambu	
7.	Danwake	
8.	Tubani	
9.	Gauda	
10.	Jollof dawa	
11.	Waina	
12.	Fura	
13.	Wasa-wasa	
14.	Dashishi	
15.	Kosai	
16.	Buza	
17.	Popped sorghum	
18.	Jiko	
19.	Alkaki	
20.	German Rice	

Table 3: PRELIMIARY COMPILATION OF FIRMS USING SORGHUM IN NIGERIA

LIVESTOCK FEED	FOOD, CONFECTIONARY AND BEVERAGES	BREWERIES	STARCH AND ADDITIVES	PROCESSORS
Medecowa, Kano	Northern Nigeria Flour Mills, Kano	Sava Malt, Kano	Gaskiya Textile, Kano.	Labande Cereals Ltd, Offa.
Nom Feed, Kano	Kaura Biscuits and Makaroni, Kano.	IBBI Limited, Kaduna	Dangote Textile, Kano	
Pfizer, Kaduna	Capital Food Company, Kaduna.	Nigeria Breweries Ltd, Kaduna, Lagos.	Northern Textile Manufactures, Kano	
Sanders, Kaduna	Kaduna Grains Processing Company Ltd. Kaduna.	Jos International Breweries Limited, Plateau.	Teridex, Kano	
Feedmaster, Kaduna	Ideal Flour Mills Limited, Kaduna.	Sona Breweires Ltd Otta, Ogun State.	African Textile, Kano	
Feedex, Kaduna	Nestle Food Products, Lagos.	Guinness Nig. PLC, Lagos	Spinner and Dyes, Kano	
Nargata, Kaduna	Cadbury Nigeria Limited, Lagos.	Golden Guinea Breweries, Onitsha.	Angel Spinner and Dying	
Pillar Feed, Kaduna	Grand Cereals and Oil Mills, Jos.		Arewa Pharmaceuticals, Kaduna	
Silvers, Kaduna	Pioneer Milling Co. Ltd. Jos.		Arewa Textile, Kaduna	
Guinea Feed, Kaduna	Jos Flour Mills, Jos		Kaduna Textile, Kaduna	
NAPRI, Kaduna	Nasco Groups Ltd., Jos.		Nigeria Tobacco Company, Kaduna	
Vita Feed, Jos	Lifecare Ventures, Offa		Rigidpack Ltd., Kaduna	
ECWA Rural Development Ltd, Jos			Sterling Products Nigeria Limited	
			Supertex Nigeria Ltd., Kaduna	
			United Nigeria Textile PLC, Kaduna	
			Unitex Nigeria Ltd., Kaduna	

Table 4: Varieties Preference by Ranking

Rank	Variety	No. of Respondents	% preference (N=9)
1st	Red	7	78
2nd	Fari	6	67
3rd	Mori	2	22
4th	Kaura	1	10
5th	Any	1	10

Table 5: Result of Malting Loss and Moisture Content Analysis

1. Malting Loss	ICSV 400
Weight of sorghum before steeping weight of sorghum after germination drying.	KG 270
Malting Loss	259 11kg or 4.1%
2. Moisture Content Analysis	
Moisture content during germination	37.18 - 39.5%
Moisture content after sun drying	5.86%
Moisture content after kilning	0.58%
	SK 5912
1. Malting Loss	
Weight of sorghum before steeping	Kg 270
Weight after germination and drying	267
Malting Loss	3kg or 1.1%
2. Moisture Analysis	
Moisture content during germination	(%) 36.07 - 38.14%
Moisture content after sun drying	6.38%
Moisture content after kilning	0.92%
	ICSV 111
1. Malting Loss	
Weight of sorghum before steeping	Kg 270
Weight after germination and drying	258
Malting Loss	12kg or 4.4%
2. Moisture Analysis	
Moisture content during germination	(%) 3708 - 38.97%
Moisture content after sun drying	7.46%
Moisture content after kilning	0.97%
	KSV 8
1. Malting Loss	Kg
Weight of sorghum before germination	180
Weight after germination and drying	164
Malting Loss	16kg or 8.9%
2. Moisture Analysis	
Moisture content during germination	33, 35 - 36.04%
Moisture content after sun drying	6.35%
Moisture content after kilning	0.86

Table 6: PERCENT MALTING LOSS OF TEN SORGHUM CULTIVARS

DAY	KSV 4	KSV 8	KSV 12	KSV 13	ICSV 111	SRN 4841 (improved)	SSV 98001	NR 71176	NR 71168	NRL 3
1	3.33	3.33	6.67	11.92	6.67	6.68	12.50	3.33	9.09	6.06
2	8.33	11.67	8.00	13.03	10.00	12.90	13.13	8.33	11.36	12.12
3	10.00	13.33	13.33	13.41	13.33	16.13	15.63	10.00	13.64	15.15
4	10.00	20.00	16.67	15.71	20.00	24.19	18.75	10.00	18.18	16.97
5	11.67	21.67	16.67	19.54	23.33	25.81	21.88	13.33	22.73	18.18
6	13.33	26.67	20.00	23.37	26.67	27.42	37.50	15.00	29.55	19.70

Values are means of triplicate determinations.

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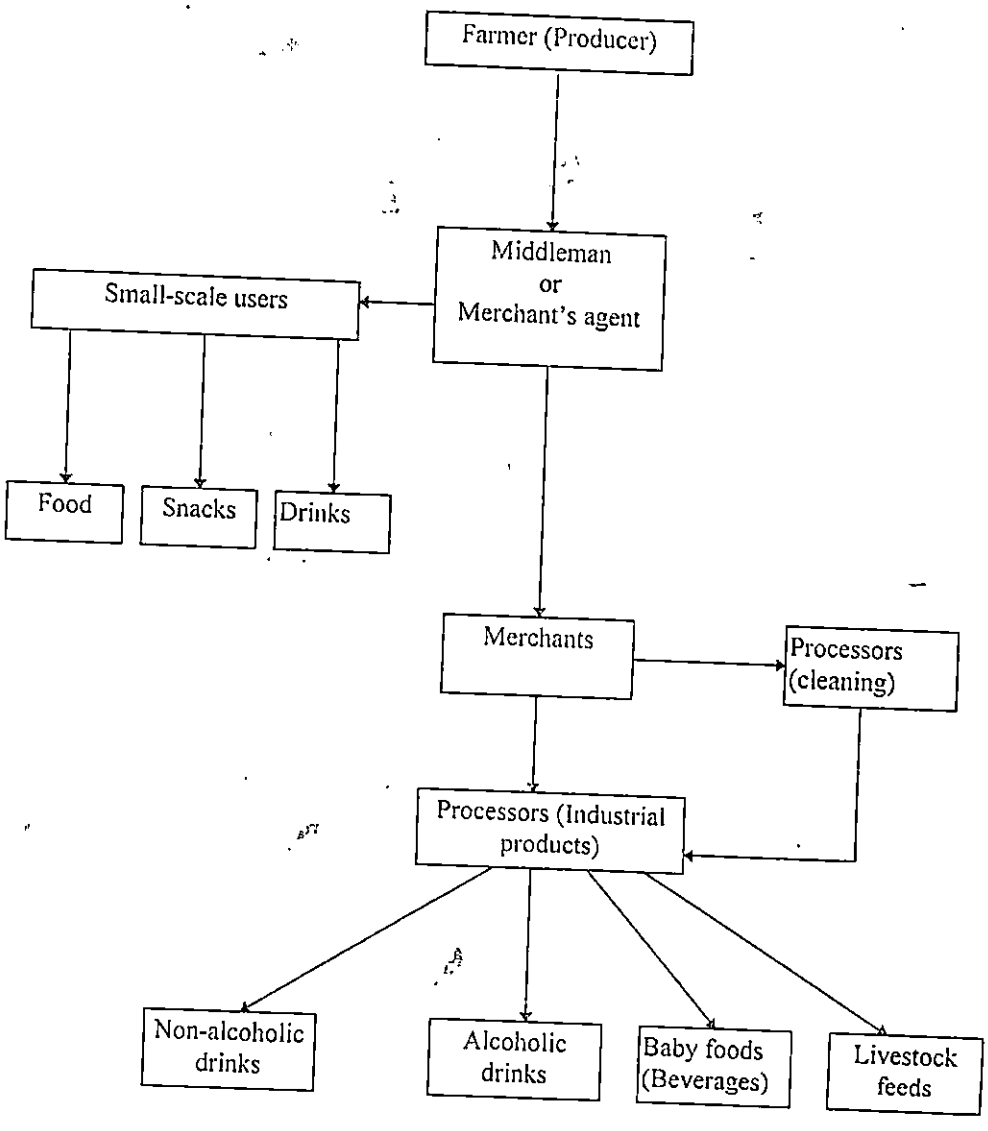
Figure 1: Chart showing marketing structure in the sorghum industry



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