IMPROVING THE COMMERCIAL VIABILITY OF SORGHUM AND PEARL MILLET IN AFRICA

D D Rohrbach

International Crops Research Institute for the Semi-Arid Tropics, Box 776, Bulawayo, Zimbabwe,
E-mail: d.rohrbach@cgiar.org

Sorghum and pearl millet are primarily grown as subsistence food crops in Africa. Less than 5% of annual production is commercially processed by industry. This paper reviews the main constraints to the commercialization of these crops. These include a) low levels of productivity relative to commercial grain substitutes, b) high grain assembly and marketing costs, c) high processing costs, and d) the lack of familiarity of commercial food and feed processors with these crops. Efforts to promote the commercialization of sorghum and pearl millet face an essential conundrum. Farmers are reluctant to invest in the crop management necessary to improve the levels and consistency of production without reliable markets. But grain processors face little incentive to invest in market development as long as alternative grains are more consistently available at competitive prices. Suggestions are offered for resolving this challenge. These highlight findings drawn from recent market development efforts in southern Africa.

INTRODUCTION

Sorghum and pearl millet are major food crops in Sub-Saharan Africa. The two grains account for 56% of the area planted to cereals in this region, and 41% of the region's cereal grain production. In comparison, maize accounts for 36% of cereal grain production. Rice and wheat make up most of the remaining 23%.

Despite their relative importance in regional food systems, very little sorghum or pearl millet is commercially processed. Rough estimates suggest less than 3% of Sub-Saharan Africa's sorghum production is used in the formal food and feed industries. Industrial utilization of pearl millet is rare.

The relative importance of these crops in rural food systems suggests substantial opportunities should exist for their commercialization. In the first instance, commercial grain milling can provide urban migrants from sorghum or pearl millet production zones with a familiar food product. As incomes rise and food preferences evolve, a growing share of cereal grains will be consumed in processed form. But such foods may still be based on sorghum or pearl millet. Available data confirm that the commercial processing of sorghum and pearl millet is growing. However, this remains much more limited than would be expected.

Many factors help explain the lagging commercial interest in these crops. These include low and variable levels of production, high assembly costs, high processing costs, and uncompetitive grain prices. Further, many commercial grain processors are simply unfamiliar with the use of these grains. They then question consumer preferences for sorghum and pearl millet based food and feed products. In contrast, maize, wheat and rice are relatively well known commercial inputs.

This paper reviews recent efforts to promote commercial investment in sorghum and pearl millet, with an emphasis on describing recent experiences of the Sorghum and Millet Improvement Program (SMIP) in southern Africa. The assessment starts with a brief overview of recent commercial utilization patterns, highlighting constraints limiting industrial demand. This analysis is extended with a review of problems of sorghum and pearl millet grain supply. The analysis concludes with a brief summary of several strategies for promoting more commercial grain processing of sorghum and pearl millet for food and feed.

SORGHUM AND PEARL MILLET SUPPLY AND DEMAND

According to FAO data (FAO, 2003), Sub-Saharan Africa annually produces about 18 million metric tons of sorghum, and 13 million metric tons of millet (Table 1). The published data do not distinguish between various species of millet. We estimate that approximately 87% of this is pearl millet (ICRISAT and FAO, 1996). This compares with the production of about 27 million metric tons of maize, the closest cereal grain substitute in both production and commercial processing systems.

Table 1. Area, yield and production of major coarse grains in Sub-Saharan Africa, 1999-2001.

	Area (million ha)	Yield (mt/ha)	Production (million mt)
Sorghum	21.8	0.8	18.1
Millets	20.0	0.7	13.1
Maize	21.0	1.3	27.2

Source: FAO, 2003.

Equal production areas are planted to sorghum, millet and maize. But since maize tends to be grown in higher rainfall zones, this grain offers higher average yields. Sorghum and millet yields tend to remain low, because these crops tend to be grown in drier, drought prone regions. Correspondingly, sorghum and pearl millet are better known as food security crops.

Estimates of the quantities of grain being commercially processed are difficult to obtain. A partial summary of available estimates for sorghum and pearl millet is outlined in Table 2. This includes estimates for Botswana, Mali, Nigeria, South Africa, Tanzania and Zimbabwe. Significant quantities of sorghum are also commercially processed in the Sudan and Kenya. But these data were not available for this paper.

In general, the level of commercial utilization of sorghum and pearl millet appears to depend more on the size of the commercial food and feed economy than the level of crop production. Nigeria, Sudan, Ethiopia, Burkina Faso and Tanzania are the largest producers of sorghum in Sub-Saharan Africa, accounting for about 75% of the region's production. However, South Africa is the largest commercial processor of this grain. This is not only the largest single economy in sub-Saharan Africa, but also the economy with the highest levels of per capita income. South Africa correspondingly has one of the largest agro-industrial economies on the continent.

South Africa annually produces between 200,000 and 300,000 mt of sorghum per year. In 2001/02, the country commercially processed an estimated 206,000 t of sorghum (Table 2). Virtually all of this was purchased from the large-scale commercial farm sector. About 90% of this is used for food production and 10% for animal feed. The main use of this sorghum is for the production of opaque beer malt. This includes grain malted for sale as beer powder, as well as grain malted and used directly by the industrial breweries. Approximately 65,000 t is milled and sold as sorghum meal.

Pearl millet is grown commercially in South Africa as a forage grass. But virtually none of this grain is commercially processed.

Table 2. Examples of commercial utilization of sorghum and pearl millet in Sub-Saharan Africa.

	Sorghum	Pearl millet
South Africa (2001/02)	113,000 t malt 66,000 t meal 11,300 t grits and rice 16,200 t animal feed	No significant commercial utilization
Nigeria (1992 estimates)	120,000 t brewing (mostly adjunct) 25,000 t animal feed	No significant commercial utilization
Botswana (1999 estimates)	60,000 t meal 4,000 t malt	No significant commercial utilization
Zimbabwe (2000 estimates)	17,500 t brewing (mostly malt) 1,800 t animal feed 150 t meal	75 t animal feeds 30 t brewing
Tanzania (2002 estimates)	750 t brewing (mostly adjunct) 80 t meal 400 t school feeding program 5 t animal feed	No significant utilization
Niger (2000 estimates)	50 t biscuit flour less than 5 t for couscous	No significant utilization

Sources: SAGIS (2003), Rohrbach et al. (1993), Rohrbach (2000), Rohrbach, et al. (2000), Rohrbach et al. (2001) and ICRISAT data files.

The second largest commercial processor for which data are available is Nigeria. This country annually produces about 7.5 million mt of sorghum and 5.8 million mt of millet. Estimates derived from an ICRISAT survey in 1992 suggest about 150,000 t of sorghum is commercially processed – about 2% of annual production. Most of this is used as a source of starch in the brewing of lager beer, or as a source of malt in the production of non-alcoholic malt drinks. A residual of about 25,000 mt is estimated to be used in the animal feeds industry. However, 98% of sorghum production, and virtually all pearl millet production, is still consumed without commercial processing.

Botswana is the third largest commercial processor of sorghum. An estimated 60,000 t of sorghum is commercially processed by the milling industry into sorghum meal, despite the fact that this country only produces about 11,000 mt of grain annually. Botswana imports virtually all of the sorghum grain being commercially processed. Most sorghum grain being produced on the domestic market is too expensive for the commercial market. High wage costs lead to high product prices, and drought limits the level and consistency of production. Therefore most of this grain is consumed in the rural areas where it is produced.

The combination of rising incomes and rapid urbanization has led to a sharp increase in the demand for commercially processed meal. In addition, the government has

periodically purchased a sorghum-based weaning food for use in drought relief programs.

An estimated 4,000 t of sorghum is used as malt for the commercial production of opaque beer. This is entirely imported, as malt. Virtually no sorghum is used in animal feeds.

Small amounts of pearl millet are produced in Botswana, but not commercially processed.

Zimbabwe annually produces about 100,000 t of sorghum and 45,000 t of pearl millet. About 20% of the sorghum is commercially processed, mostly for use as malt in the opaque beer industry. The animal feed industry will use sorghum if this is available at prices substantially lower than the price of maize. However, average levels of utilization remain small. Several millers have expressed interest in the commercial production of sorghum meal. But investments here have recently been constrained by grain price and movement controls. Small quantities of pearl millet are also used for beer malt and animal feed.

Tanzania annually produces about 750,000 t of sorghum, but commercially processes less than 1000 t on an annual basis. Approximately one-half of this is used for the production of opaque beer, though entirely as a source of starch. The single, commercial opaque beer brewer in the country imports its malt requirements from South Africa. Approximately 100 to 150 t of grain are processed each year for sale as sorghum meal. In 2002, 400 t of sorghum grain were processed, for the first time, for school feeding programs.

Niger annually produces about 500,000 t of sorghum. But commercial processing remains extremely limited. One baker has recently experimented with the use of about 50 t of sorghum in the production of sweet biscuits. And a small amount of grain is processed and commercially sold as couscous.

While these data are incomplete, the picture that emerges is one of extremely limited commercial processing, particularly in countries with smaller agro-industrial sectors and lower incomes. As incomes rise, and countries become more urbanized, commercial agro-processing increases. This pattern is reinforced by the shift in consumer demand toward pre-processed or convenience foods. Further growth in incomes is linked with the rising demand for grain fed livestock products – particularly poultry and dairy products. The agro-industries in countries like South Africa, Botswana, Nigeria and Zimbabwe are relatively advanced compared with those in countries like Mali and Tanzania.

The actual levels of utilization of any given grain also depend on its relative competitiveness as an industrial input. If all cereal grain inputs offer similar advantages, industry will use those with the lowest cost. But industry also needs its grain inputs to be consistently available throughout the year. The grain must meet minimum standards of quality. It must be easy to process with readily available technologies. And consumers must accept the taste. Correspondingly, incentives to use sorghum or pearl millet depend both on the relative availability of quality grain, and the characteristics of the processing industry.

Brewing and malt drinks

The most common commercial use of sorghum, south of the Sahara, is in the production of beer or malt products. Sorghum beer is a traditional drink in much of eastern and southern Africa. As incomes have increased, sorghum beer production has been commercialized. This provides consumers a more convenient and consistent product. In some countries, particularly in southern Africa, beer malt is sold to households seeking to produce their own beer. In Nigeria, non-alcoholic malt drinks offer a related beverage to Moslem populations. These are also starting to be sold in East Africa.

Preferences for sorghum based beer allow some brewers to offer a premium price for sorghum used for malting. However, there are limits to this advantage. Shortages of clean sorghum have led opaque brewers in Zambia and Tanzania to produce 100% maize beer using industrial enzymes as malt. ICRISAT worked with Darbrew Ltd in Tanzania to obtain clean sorghum grain allowing the re-establishment of production capabilities for sorghum-based opaque beer. The brewery was concerned, however, that consumers had become accustomed to its maize-based product. A series of preference surveys and market tests were required to allay these fears.

Milling

Though sorghum and pearl millet are most commonly consumed in various forms of thin and thickened porridge, industrial processing of sorghum and pearl millet meal has been relatively limited. In comparison, maize meal is much more widely produced on an industrial scale – particularly in southern and eastern Africa. There are many reasons for the dominance of maize in these economies, not least the relatively higher productivity of maize production in higher rainfall zones. Investments in maize production have also been reinforced by historical market supports favoring maize, including price supports, and stockholding arrangements. Overtime, these have encouraged the optimization of maize processing systems. Maize now tends to be more readily available to major millers at prices equal to or less than the price of sorghum. Relative prices for pearl millet tend to be consistently higher than those for maize. As a result, in many countries commercial millers are simply unfamiliar with the processing of sorghum and pearl millet, and skeptical about levels of demand.

In Botswana, the Rural Industries Innovation Centre (RIIC) started promoting the sale of small-scale sorghum dehullers and hammermills in 1979 (Rohrbach et al., 2000). It took ten years, and the establishment of a government program of grants to small-scale entrepreneurs to help with the purchase of an initial set of equipment, to firmly establish this market. Most of the growth in commercial processing occurred after 1990. Yet this was a country where sorghum is well know to be the main traditional food staple. Approximately 90% of cereal grain area is planted to sorghum or pearl millet. But, until recently, the main processed grain meal being sold in retail shops was made from maize. The fastest growth in cereal grain consumption was in wheat based products and rice.

During the past few years, ICRISAT has supported several initiatives to convince millers in Tanzania and Zimbabwe that consumers will accept the taste of sorghum meal. Consumer surveys were been conducted in both countries. These gave several millers the confidence to purchase and mill initial grain stocks, and also to begin

investing in grain cleaning equipment. But the relative size of this market remains uncertain. Not enough grain has been available at competitive prices to adequately test this market. And as long as milling throughput remains low, it is difficult to compete with larger-scaled commercial maize millers.

Millers also commonly complain about contamination of their grain with sand and stones. This results from the common practice of threshing the grain on the ground, and then sweeping the threshed product into grain bags destined for the market. ICRISAT worked with the University of Zimbabwe to test the use of mechanical grain threshers at the farm gate. However, this still did not assure that clean grain arrived at the factory gate. Grain assemblers could still add the stray bag of contaminated grain during the process of collection. Ultimately, ICRISAT worked with Induna Foods, Ltd. in Zimbabwe, and later with Power Foods, Ltd. in Tanzania to identify and test grain cleaning systems at the factory gate. One solution was a small-scale screen and aspiration system originally manufactured for wheat producers in South Africa. In Tanzania, however, this had to be supplemented with a destoner. The total cost of this equipment (about US$20,000) significantly adds to the capital costs of establishing a sorghum or pearl millet milling facility. Yet without this investment, the production of any significant volume of grain meal would be virtually impossible.

The only exception to this is the use of mechanically harvested sorghum produced by large-scale commercial farmers in South Africa. This can be milled directly without specialized cleaning.

The combination of higher consumer incomes and a more sophisticated milling sector have brought more substantial investments in sorghum milling in South Africa. Sorghum meal trades competitively with maize meal in many retail shops. The development of such industries and markets may simply need more time in other parts of the continent.

Animal Feed

More than 95% of the sorghum produced in higher income, industrialized countries, and the majority of millet, is used for animal feed (ICRISAT and FAO, 1996). In contrast, the levels of sorghum and millet use for feed in Sub-Saharan Africa remain extremely limited. The justifications for this limited utilization merit further investigation.

Part of the problem is that animal feed manufactures lack consistent access to low priced grain. This may be available after a particularly favorable rainy season, but supplies may then be limited when rains are poor. While industrial manufactures of feed will commonly shift their ingredients as relative input prices change, this practice is less common among the many smaller-scale feed manufacturers in Sub-Saharan Africa. Many seem to prefer a consistent formulation.

Several additional problems have been cited in interviews conducted with animal feed manufacturers in countries such as Botswana, Nigeria, Tanzania and Zimbabwe. It is common to hear skepticism regarding the feed value of sorghum and pearl millet. Some argue that sorghum has low levels of protein, or that tannins (believed to be in all sorghum) unacceptably reduce the digestibility of sorghum based feeds. We have

heard arguments that 'the tannins in sorghum killed my chickens'. Related questions arise about the risks of mycotoxins. Some argue that sorghum lacks essential amino acids necessary, and otherwise unavailable, for poultry growth. When feed data are provided to manufacturers they argue that they need proof of the value of these grains from other feed manufacturers in Africa. Data provided from university laboratories and research trials are discounted.

Several feed manufacturers have also complained that sorghum does not mill well. Whereas maize can be cracked in a hammermill, softer sorghum grains become powder. This is said to reduce feed efficiency. Few feed manufacturers outside of the larger industries use extruders.

Competitive Grain Intake Prices

The combination of problems of grain availability, cleaning, and processing, along with uncertainty regarding consumer demand place sorghum and pearl millet at a distinct disadvantage relative to maize. This is highlighted in the relative prices offered for the three grains by commercial processors in Zimbabwe (Table 3). Prices for sorghum and pearl millet are often discounted compared with those for maize. But these relative prices are also highly variable, even within the same industry. The opaque beer industry tends to offer intake prices for sorghum and pearl millet that are marginally lower than those for maize. Though if the industry is particularly short of sorghum, these prices may rise marginally above those for maize.

Table 3. Coarse grain buying prices (Z$/t) offered by industry in Zimbabwe, June 2001.

Industry	*Buyer/company*	**Maize**	**Sorghum**	**Pearl Millet**
Brewing	Chibuku	7500	7000	No purchases
	Ingwebu	7500	6500	7000
Milling	Jati Millers	8500	5557	No purchases
	Blue Ribbons	8000	No purchases	No purchases
	National Foods	8200	8000	7000
Animal feed	Feeds & Feeds	7500	5500	5000
	National Foods	8200	8000	7000
	Agrifoods	8400	6900	8000
	Premier milling	8300	6000	6500
Grain trading	Grain Marketing Board	7500	5500	5000

Source: ICRISAT Surveys.

Sorghum and pearl millet tend to be most heavily discounted in the animal feeds industry. These range around 70 to 80% of the prices offered for maize. Two of the three millers processing sorghum in Zimbabwe similarly indicated they would purchase sorghum or pearl millet if the price dropped less than 75% the price of maize.

The prices offered by Zimbabwean industry are mirrored in the prices offered by the parastatal Grain Marketing Board. The Board offered similar prices for sorghum, pearl millet and maize during the mid-1980s, but then experienced difficulty selling its sorghum and pearl millet stocks. These were ultimately sold at a loss. Since then,

the Board's intake prices for sorghum and pearl millet have been heavily discounted compared with its intake price for maize.

The relative levels of intake prices for alternative grains vary by country and industry. But these sorts of discounts are not uncommon. Rather, they are indicative of the under-development of commercial demand for these crops in much of Africa.

In contrast to the offers of industry, sorghum and pearl millet commonly trade at prices equal to or above those for maize in the rural market. ICRISAT's 2002/03 price monitoring surveys in Zimbabwe indicate that rural sorghum prices have tracked close to maize prices during the past 12 months. Pearl millet prices are commonly 40 to 50% above the price of maize. In central Tanzania, ICRISAT's 2002/03 surveys indicate that sorghum is selling at prices 10-15% below the price of maize in the rural market, but in the commercial center of Dar es Salaam, sorghum prices are much higher.

Lagging Productivity of Sorghum and Pearl Millet

The competitiveness of sorghum and pearl millet in Sub-Saharan Africa is further undermined by continuing lags in productivity growth. Aggregate production of the two crops continues to grow (Table 4), but most of this results from continuing expansion in area planted. The 2.6% rate of area growth is only marginally less than the average rate of African population growth. In contrast, average sorghum and pearl millet yields remain unchanged. These marginally increased during the 1960s and 1970s, but have shown little gain since then. In comparison, average yields of maize marginally increased during this period.

Table 4. Growth rates (%/yr) in area, production and yield of sorghum, millet and maize in Sub-Saharan Africa, 1979-2001.

	Area	Yield	Production
Sorghum	2.6	-0.2	2.4
Millets	2.7	0.0	2.7
Maize	2.7	0.6	3.4

Source: FAOSTAT, 2003.

The lack of productivity growth is partly explained by the limited adoption of improved varieties. This is linked with the limited interest of commercial seed companies in multiplying and selling open pollinated crop varieties. However, even when new varieties have been more widely disseminated, aggregate yield gains remain limited. In Zimbabwe, for example, adoption rates for new varieties have increased to at least 30% for sorghum and close to 50% for pearl millet during the past 10 years. However, aggregate statistics suggest no improvements in aggregate grain yields. According to national statistics, sorghum yields have marginally declined by 0.2% per year over the past 10 years. Pearl millet yields have declined by more than 5% per year. In Namibia, where new varieties of pearl millet have been adopted on an estimated 50% of planted area, average pearl millet yields have declined by 3.5% per year.

There are many reasons to question the accuracy of national data on sorghum and pearl millet. However, it is difficult to know why the bias underlying these data would be consistent.

It is also possible to argue that average yields would have declined further if the new varieties had not been available - though there is similarly a lack of clear proof for this observation.

The yield gains offered by the new varieties are also likely to be small if either the average gain, or the proportion of area planted to the new seeds, is relatively small. In southern Africa, where adoption rates have been favorable, farmers commonly tell us that yield gains are limited when rains are favorable, but can be substantial if the rainy season ends early. The main contribution of the many new varieties is early maturity. In a longer rainy season, later maturing varieties are expected to offer higher grain yields. In a drought year, the traditional medium to late maturing varieties commonly fail. But the new, early maturing varieties commonly offer a harvest. Thus, farmers commonly cite early maturing as a main justification for adoption. The main contribution of the new varieties may be to reduce the variability of grain harvests, and enhance rural food security, rather than increasing aggregate yield and production levels. This explains the favorable adoption rates for the new varieties.

While gains in productivity may still be found in better varieties and hybrids, there seems little question but that larger improvements in productivity must still be derived from better crop management. Fertilizer use on sorghum and pearl millet remains relatively rare. ICRISAT's experimental trials and crop simulation models suggest that small doses of nitrogen or phosphorous fertilizer offer the prospects of substantial yield gains. On farm trials in Zimbabwe indicate that as little as 8 kg of nitrogen per hectare can increase yields by 25 to 50 percent, depending on rainfall, and complementary production practices. Improvements in water management, derived from technologies such as more timely planting, double ploughing and deeper ploughing, can offer similar gains. The question remains, why farmers fail to adopt these practices.

We can hypothesize that poor management results from a lack of information about new technologies. Indeed, national extension recommendations proposing applications of high rates of manure, chemical fertilizer, insecticide on early planted crops are essentially irrelevant to most farmers. They need more information about how best to use one bag of fertilizer or a limited amount of goat manure. Correspondingly, SMIP is pursuing a combination of simulation modeling, participatory research and farmer field schools in an effort to resolve this information constraint.

But one can also hypothesize that management practices reflect a roughly valid set of perceptions about the relative returns to alternative farm and non-farm investments. Farmers in semi-arid areas tend to diversify their income sources in order to both reduce their risks and raise average returns. When Zimbabwean farmers are asked how they would be willing to invest a given sum of cash, they claim the larger proportion of investment is more likely to be allocated to livestock production. Investments in crop production are more likely to be targeted to a cash crop. Thus, if

sorghum or pearl millet can be made cash crops, investment may be stimulated in technologies offering the prospect of improved yields.

Yet commercial trade remains discouraged by the variability of sorghum and pearl millet grain supplies, grain quality concerns and the lack of familiarity with these crops. Maize is readily available on the commercial market. This grain may also be more readily imported if domestic cereal grain stocks are limited.

Thus, we are left with a "chicken and egg scenario". Farmers have little incentive to adopt yield improving technologies without a consistent, commercial market. However, the development of this market is constrained by the lack of consistent grain supplies.

GRAIN ASSEMBLY CONSTRAINTS

The relative underdevelopment of the sorghum and pearl millet market translates into reduced trading volumes and high trading costs. These are reinforced by the fact that sorghum and pearl millet tend to be grown in outlying areas, distant from urban-based agro-industry.

Grain Search and Assembly Costs

ICRISAT recently completed a review of trading margins in a main sorghum production zone in central Tanzania. Assembly commonly starts with small-scale village traders moving from household to household in search of individual bags of grain. One 90 to 100 kg bag may be purchased, and then transported by bicycle one to ten km to a local assembly point. Larger traders visit more accessible villages to purchase larger quantities of grain. Each bag of grain is commonly opened to check for grain quality and the existence of impurities, then transferred to a stronger bag supplied by the trader. One or more traders would hire a truck to collect the grain once a minimum quantity is obtained. However, before the grain leaves the village, a local tax must be paid. The truck may transport the grain to a nearby town for larger assembly, or to the urban market.

These trading costs are summarized in Table 5. Here, the farmer obtains 60% of the cost of grain delivered to the nearest business center. If this grain is transported to the main center of industry on the coast, where most sorghum is currently processed, the farmer may obtain only 42% of the factory gate price.

Table 5. Example of grain trading margins in central Tanzania, 2002.

	Unit	Per unit	Per kg
Grain	Bucket (16 kg)	900	52.94
Grain bag	1	300	3
Village stay	1 week	2000	0.33
Village storage	Room	8000	1.33
Guard	2 per week	2500	0.42
Tax levy	per bag	300	3
Labor for filling bags	per week	1500	0.25
Loading	Bag	150	1.5
Truck hire to Dodoma	Bag	2150	21.5
Unloading	Bag	150	1.5
Grain cost	Bag	8577	85.77

Source: ICRISAT surveys, 2002.

Farmers commonly complain that they do not earn enough to justify expanding production. But given such high transaction costs, grain processors can barely afford to pay more. The prices on offer are capped by the prevailing prices for maize grown in higher potential regions of the country where trading volumes are higher, and market infrastructure is more developed. In consequence, sorghum prices may be lower than maize prices in sorghum production zones, but higher than maize prices in the main commercial processing centers of the country.

Grain Stockholding

A related constraint to the development of commercial marketing is the lack of commercial grain stocks for sorghum or pearl millet. Processors must be willing to purchase and hold these stocks on their own, or they need access to traders willing to take the risk of holding such inventories. Historically, sorghum or pearl millet stocks were commonly held by government grain marketing parastatals. However, when markets were liberalized, these stocks disappeared (though public stocks of maize were commonly maintained).

Millers experimenting with the production of sorghum meal in Zimbabwe and Tanzania have each complained about running out of sorghum grain stocks months prior to the next harvest. Each found it difficult to estimate their needs in this evolving market. Since the costs of holding stocks are high, the proclivity of these processors is to hold more conservative levels of stocks. Induna Foods Ltd, in Zimbabwe, purchased 100 t of grain, but then found its sales expanding to 20 t per month. Rather than rationing its production, the mill simply processed sorghum grain until it ran out of stocks. Since the next season was a drought year, followed by the imposition of grain price and market controls, production of sorghum meal then stopped altogether.

Power Foods, Ltd., the main commercial miller of sorghum meal in Tanzania, has run out of sorghum grain at least four months prior to the next harvest during each of the past two years. This miller has sought to purchase more expensive grain on the local city market in Dar es Salaam. But the company cannot easily pass on these higher input costs to the consumer. This would drive the price of sorghum meal further

above that for maize meal, further limiting grain purchases, and the development of the market.

One of the main reasons for the rapid development of commercial sorghum milling industry in Botswana, between 1980 and 2000, was the ready availability of grain supplies from South Africa. Less than 5% of the annual sorghum intake of the milling industry comes from domestic production. Few of these millers have the capital to maintain more than a truckload of grain inventory. But most can rely on weekly or monthly deliveries of sorghum grain from traders based across the border. If this supply chain was not well developed, few of these millers would remain in business.

PROMOTING THE DEVELOPMENT OF COMMERCIAL MARKETS

The successful commercial processing of sorghum in countries like South Africa, Botswana and Nigeria suggest potential for the development of these markets. However, the constraints experienced in countries like Zimbabwe and Tanzania highlight the need to promote continuing improvements in market operations. This process is likely to take a sustained commitment over a number of years. Priorities need to be set with care to identify the most practical commercialization opportunities with the greatest chances of success. In this context, three strategies for market development may be considered.

The ‘premium market option’ is to encourage the development of commercial markets wherein these grains have unique values, as in the production of malt. In these circumstances, traders and processors may be willing to pay a premium price for high quality grain specially suited to their manufacturing process. This may partly offset the higher costs of finding, assembling and cleaning these grains. The limits to this strategy depend on the relative availability and cost of alternative inputs. The continuing production of maize based opaque beer in several countries in Africa suggests that even such traditional sorghum based products are not immune to the demands of competitive input prices.

A ‘low cost market option’ would involve encouragement of the use of sorghum or pearl millet as low cost substitutes for alternative grains following favorable harvests when their prices are most competitive. The most obvious opportunity is in the animal feed sector. Here, maize can be readily replaced with sorghum or pearl millet once competitive feed input price ratios are achieved. The logical target would be the expansion of the poultry feed industry. In the initial stages of market development, sorghum and pearl millet may only be used when available at substantial (20-40%) price discounts relative to maize. However, over time, as the animal feeds industry gains greater familiarity with these grains, such discounts should decline. This process may be speeded with efforts to work with industry to better diagnose their constraints and encourage experimentation with these grains.

The third ‘market development option’ would involve efforts to reduce marketing costs necessary to assure the competitiveness of sorghum or pearl millet as an undifferentiated food and feed input. This may best be pursued by targeting public support for large enough increases in trade flows necessary to achieve scale economies. Commercial sorghum milling more than tripled in Botswana after the

government offered grants for the establishment of small-scale milling enterprises, and eliminated tariff and non-tariff barriers to sorghum grain imports.

In Tanzania, ICRISAT has encouraged the World Food Programme to purchase 400 t of sorghum grain for use in local school feeding programs. If this pilot program proves successful, public purchase of sorghum could be similarly expanded to include sales to hospitals, the army and refugee programs. Replacement of 10% of the maize the government currently purchases for these institutions could quickly increase aggregate demand by several thousand tons. The commercial milling industry may then obtain scale economies necessary to promote wider sales and consumption of sorghum or pearl millet meal and related food products.

ICRISAT has also encouraged the government of Tanzania to include sorghum in its national Strategic Grain Stock. Tanzania currently seeks to maintain a stock of 100,000 t of maize grain. If 10% of this is converted to sorghum, this would increase the levels of sorghum purchases on rural markets by tenfold. A consistent purchase, in regions targeted for commercialization, could provide farmers with enough incentive to expand investment in these crops, increasing crops yields and productivity. Traders would gain an incentive to invest in building regular channels of grain collection and delivery. Efforts to rotate such a 10,000 t grain stock could provide a residual source of supply to industry.

The main objective should be to identify and exploit larger market opportunities. Smaller projects targeting 50 to 100 t of grain consumption will never stimulate investments in developing trading channels and processing systems necessary to commercialize these crops. Rather, market development would be based on minimum targets of 5,000 to 10,000 t of grain demand. In complement to these efforts, governments should be encouraged to re-look at the implicit support currently provided to alternative grains like maize, and shift some of this to crops more important in poorer, semi-arid regions of their countries.

REFERENCES

Food and Agriculture Organization of the United Nations, 2003. FAOSTAT. http//apps.fao.org.

ICRISAT and Food and Agriculture Organization of the United Nations. 1996. The world sorghum and millet economies. Hyderabad, India: ICRISAT.

Rohrbach, D.D., Baidu-Forson, J., Ajayi, O., 1993. Sorghum utilization in the bewing and malting industry of Nigeria: a case study of distributive impact and research needs. Bulawayo, Zimbabwe: ICRISAT. Mimeo.

Rohrbach, David D. 2000. Commercialization of Sorghum and Pearl Millet in Zimbabwe. Pages 1-15 in Proceedings of the Workshop to develop a strategy for the

multiple use of Mahanngu and sorghum in Namibia. 27-28 June 2000, Mokuti Lodge. Windhoek, Namibia: Centre for Research Information Action in Africa.

Rohrbach, David D., Mupanda, K., and Seleka, T., 2000. Commercialization of sorghum in Botswana: trends and prospects. Working Paper No. 6. Bulawayo, Zimbabwe: Socioeconomics and Policy Program, ICRISAT.

Rohrbach, D. D. and Kiriwaggulu, J.A.B. 2001. Commercialization prospects for sorghum and pearl millet in Tanzania. Working Paper Series no. 7. Bulawayo, Zimbabwe: Socioeconomics and Policy Program, ICRISAT.

SAGIS. 2003. www.sagis.org.sa.