Post Harvest Handling & Seed Quality Evaluation for Selected Value Chain Commodities in Nigeria

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List of Acronyms

ADP	Agriculture Development Program (Project)
CBFE	Community Based Family Enterprises
CIMMYT	International Center for Maize and Wheat Improvement (Spanish Acronym)
CNFA	CNFA, Inc. Formerly Citizens Network for Foreign Assistance
CGIAR	Consultative Group for International Agriculture Research
HYV	High Yielding Varieties
IARC	International Agriculture Research Center
ICRISAT	International Center for Research in the Semi-Arid Tropics
IITA	International Institute for Tropical Agriculture
IRRI	International Rice Research Institute
LAPO	Lift Above Poverty Organization
MSADP	Madibira Smallholder Development Project (Tanzania)
MARKETS	Maximizing Revenues & Key Enterprises in Targeted Sites Project
NARS	National Agriculture Research Systems
NGO	Non Government Organization
OPM	Open Pollinated Maize
SME	Small & Medium Enterprise
T&V	Training & Visit aka Talk & Vanish
USAID	United States Agency for International Development
WARDA	West Africa Rice Development Association
WASA	West Africa Seed Alliance

Executive Summary

The consultancy look at what intermediate term interventions over the next two to five years WASA/Seeds, as part of the overall USAID MARKETS project could undertake to assist the smallholder beneficiaries increase their net revenue through better access to improved seeds including the handling of retained seed and the local community level post harvest processing of the targeted value chain crops of cassava, rice, sorghum, cowpea and sesame. This was done in conjunction with WASA/Seeds established mandate of working through a network of agro-dealers and registered seed companies.

The result indicated that, like many other African countries the variety improvement and related seed multiplication from breeder seed through foundation seed to registered seed is so underfunded that it basically only exists on paper, and can no longer be relied upon for providing new genetic material and has not done so for considerable time. This has resulted in farmers having no choice but to continue to use the seed available in the local markets or retained by individuals until, except for rice, the original variety identification has been lost. What is actually delivered through the government's major subsidized seed distribution of "certified" seed, which only involves rice among the five targeted value chain crops, can only be questioned as if it is really certified seed according to international standards. The variety development of the targeted value chain crops in Nigeria is done by local outreach offices of the IARCs with worldwide mandates for the particular value chain crop. This includes IITA for cassava and cowpeas, WARDA and IRRI in conjunction with IITA for rice, and ICRISAT for sorghum. No organization is involved with sesame.

Thus the most appropriate intermediate term intervention for WASA/Seeds is an increase in the level of effort by quietly by-passing the national variety improvement and seed multiplication programs and going directly to IARCs to obtain at least a starter amount of seeds or cuttings of promising lines and working with seed companies to multiply this into variety evaluation kits that can be sold to interested agro-dealers for multiplication in demonstration plots for farmer approval, and then further multiplication for sale to farmers. This would basically be a genetic pump of fresh material for final multiplication and distribution at the smallholder community level.

In addition WASP/Seeds need to adopt an appreciative approach to the retained seed in communities and work with the agro-dealers and farmers to provide training on how best to maintain the seed and improve it quality, mostly by enhancing the genetic purity and removing and debris.

Regarding the community level post harvest processing of targeted value chain crops, only cassavas being converted to garri and rice being parboiled and milled have major post harvest processing at or near the producers community. Sorghum, cowpeas, and sesame are all marketed up the value chain as seeds with any processing done just prior to final utilization. Both the converting of cassava to garri and parboiling and milling of rice are relatively time consuming activities that require some capital out lay, particularly for rice. This than requires an analysis of if, under the overall economic and operating condition of Nigeria and other

developing countries, the processing should be done by farmers, by farmer groups, or by small private operations in what might best be referred to as Community Based Family Enterprises. The answer for both cassava and rice appears to favor the latter as farmers may not really have the time to get fully involved in post harvest processing as it could conflict with additional field work and more agronomic production. With cassava processing there appears a major movement to outsource the garri making to family enterprises, frequently headed by women. The intervention for WASA/Seeds and MARKETS might be to facilitated this movement and assist interested persons in the community go into the garri processing business by reviewing business models and finding funding.

For rice the parboiling and milling is well established and finding a place for intervention by MARKETS may be more challenging. The most obvious point would be to help upgrade what appears to be outdated equipment with more modern mills as can be found in other African countries like Tanzania and Ghana, however, the impact of parboiling on the toughness of the grain to withstand rough milling may mean the old mills are the most appropriate. The quality remains acceptable for local use, and only slightly discounted from imported Thai parboiled rice. Other possible points of intervention would be eliminating the destoning process whenever possible. That would require backing up to harvest and increasing the mechanization of the harvesting and threshing process to reduce the handling in which the rice get left on the moist ground where the mud clods contaminate it. The increased mechanization would require introducing small combines from Japan or South Korea. These are beginning to appear in Africa through Japanese and South Korea assistance. Another possible intervention would be reducing the time and effort of winnowing at each step in the parboiling and milling process by replacing the windblown baskets with manually operated winnowing equipment.

While there is no post harvest processing for sorghum, cowpeas and sesame, there is an unusual practice in Nigeria and other countries in which about 15% trash is deliberately included in closed bags of these commodities. Since the traders are automatically discounting for this the farmers oblige them and make certain it is included. WASA/Seeds and MARKETS through their network of agro-dealers with an interest in commodity procurement could intervene and help eliminate this by facilitating a direct link between the community and SME processors to serve as the processor purchasing representative, making certain the produce in clean and the SME can pay full value and not discount for the trash and costs of cleaning the trash. Saving could be passed back to the farmers as well as the SME processors.

Post Harvest Handling & Seed Quality Evaluation for Selected Value Chain Commodities in Nigeria

R.L. Tinsley[1]

Introduction

This consultancy report was completed for the United States Agency for International Development (USAID) funded Maximizing Agricultural Revenues & Key Enterprises in Targeted Sites (MARKETS) Project. It was contracted by CNFA, Inc. as part of its support for the West Africa Seed Alliance (WASA) Seeds Project (WASA/Seeds). The MARKETS project is to develop or enhance the value chain of selected commodities that are expected to either be primary cash crops or can be expanded beyond any subsistence needs to become major cash crops with potential for industrial application. Part of this effort involves assuring the smallholder beneficiaries have access to the necessary inputs in terms of seed, fertilizer and plant protection materials. This is done through a network of agro-dealers facilitated by CNFA through WASA/Seeds. These agro-dealers are currently only involved in providing inputs, mostly agro-chemicals and imported vegetable seed. They have limited involvement in agronomic seed or fertilizer as these are mostly handled through subsidized government programs. At present they do not get involved in marketing produce up the value chain to the processors. The marketing of produce up the value chain in Nigeria is left to farmer organizations. Unfortunately, such organizations virtually universally represent a socially ideal but highly cumbersome business model that rarely, if ever, can develop or maintain a sustainable competitive advantage over an efficient agro-dealership.

WASA/Seeds involvement is mostly in the seed business working with the private seed producers through the agro-dealer network to assure the farmers have the best quality seed possible and will incur no measurable yield loss from seed quality. This consultancy was interpreted be primary to assist WASA/Seeds in evaluating the quality of seed available and how well it was being handled within the industry with an emphasis on the post harvest handling of seed retained within smallholder communities, between harvesting and sowing to assure that the seed sown was the best possible quality. This constitutes over 95% of the seed used by smallholders and considered the primary mandate of WASA/Seeds. In addition the consultancy evaluated how well the grain was being processed as it moved up the value chain which appears to be an area WASA/Seeds is moving into, although outwardly it looks a fairly distant from the primary mandate as convey by the name. The mandate was to evaluate five crops targeted by the MARKETS project. These include cassava, rice, sorghum, cowpeas and sesame, with converting cassava to garri and parboiling rice having the largest post harvesting processing requirements at the community level. Both are time consuming processes that best done within the community but perhaps independent from the producers. Sorghum, cowpea and sesame are mostly marketed up the value chain as grain with little community processing. It also involved six states including Kano, Kaduna, Bene, Ebonyi, Anambra and Kwara. These states form a ring around Abuja, the federal capital district, with

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Kano and Kaduna to the north, Benue to the southeast, Ebonyi and Anambra to the south and Kwara to the west (Fig 1).

The consultancy took place between 8 September and 15 October 2009. The daily activities log for the consultant with indicating notes is attached as Appendix A. The consultancy corresponded to the middle of the rainy season in Nigeria that is consistent with the northern tropics, which has a rainy season between May and October. This meant that there was really very little seed to observe, just the crops produced from the seed. The seed had either all been planted with any surplus sold for grain or recalled and put in long term storage for next season.

Fig. 1. Map of Nigeria

Rainfall in Nigeria varies from some 600 mm in the north to some 2000 mm in the south, for which the 1200 mm at Minna in the middle of the country is about typical. The annual variation in this rain fall is somewhat more stable than most tropical countries, but still considerably higher than most people will conceptualize at around 10 to 15% and greater to

the 20% maximum variation most people will place as the upper limit of variability for planning purposes. The year to year coefficient of variation for monthly rainfall for the on-setting month of April when crop establishment is critical, running 85%, while the mid-season months is closer to 30% (Table 1). This high variation for the critical on-setting crop establishment months for the recommended early planting of value chain crops means the farmers are forced more to respond to the incident rains than anticipate when the rains will onset or how much there will be. The annual variation in monthly rainfall can be expected to increase the further north into the dryer areas, and conversely the variation will decrease the further south into wetter areas.

Overall Economic Environment

Before getting into the details of the seed quality and post harvest handling of seed and produce, it might be best to look at the overall economic environment in which the smallholder beneficiaries are operating and how this will impact what they can afford to invest in seeds as well as other inputs, how well they can manage their lands in the timely manner expected of them, the time they may have for value added post harvest processing, and the ability of the government to provide the public support services for smallholder producers' benefit. The best way to do this is look at the comparative consumer prices for food goods in Nigeria compared to the USA (Table 2). This analysis indicates what might best be referred to as a financially suppressed economy[2], in which for goods produce in Nigeria and most other host countries, particularly the perishable fruits and vegetables or staple energy crops; the consumer price is only a fraction of the USA price. Often this is done with fuel prices well above the USA fuel prices and comparable with the European fuel prices. However, since Nigeria is a major oil producing country the fuel prices are actually below or comparable to USA prices, even though Nigeria mostly exports it's crude only to import back refined products.

Implication for Investments in Inputs: The implication here is that, to produce and market goods at a fraction of the USA price, represents a very efficient business model. It also means farmers are not making large profits for their produce, and thus cannot afford to invest heavily in certified seeds, fertilizer or other inputs. Likewise the dealers providing the inputs are operating on very limited profit margin after considering all their expenses including off-tarmac transportation costs when serving remote villages. The economically optimal levels of these inputs are then forced well below the recommended maximum yield levels as promoted by the extension program, and still represent the maximum possible profit. For example, it is possible that the economic optimal rate of fertilizer is as low as 50% the recommended maximum yield rate and the yield potential reduced to only 75% of the maximum yield. It would also result in an economic bias toward using retain seed over commercially certified seeds, particularly if the certified seed is twice as expensive, and perhaps of questionable quality. Thus using retained seed could represent an astute business decision on the part of the smallholder producers.

Implication for crop management: The implication on crop management is associated with the calorie energy balance in terms of how many calories people have access to via purchase or from subsistence stocks, relative to the calories they are expected to exert in implementing

[2] *http://lamar.colostate.edu/~rtinsley/FinancialSuppressed.htm*

1963	0	3	2	60	40	140	260	260	160	160
1964	0	0	4	70	120	120	229	292	533	122
1965		48	10	3	132	251	195	193	206	107
1966	0	0	0	71	129	231	145	140	300	145
1967	0	0	5	126	76	180	170	307	409	100
1968	0	0	74	150	94	253	253	209	172	81
1969	0	0	10	61	189	128	230	201	202	220
1970	0	0	10	14	66	98	173	345	341	69
1971	0	5	7	26	140	213	233	245	242	29
1972	0	0	47	31	227	83	316	427	187	51
1973	0	0	4	22	79	85	85	393	266	60
1974	0	0	5	8	120	120	287	210	252	128
1975	0	19	21	15	127	180	113	142	380	78
1976	0	86	0	44	141	189	142	183	154	242
1977	0	0	0	4	122	138	280	390	323	94
1978	0	0	17	204	262	123	201	397	249	121
1979	0	0	15	15	138	196	254	406	137	148
1980	0	0	0	7	239	130	203	249	149	141
1981	0	0	0	22	57	188	239	276	183	92
1982	0	0	13	99	45	137	288	353	160	104
1983	0	0	12	59	85	175	244	206	41	133
1984	0	0	3	54	81	116	188	163	170	57
1985	0	0	60	17	141	250	233	244	176	61
1986	0	0	39	15	86	183	221	243	315	83
1987	0	0	13	44	104	83	143	238	94	100
1988	10	0	0	57	94	135	175	309	382	36
1989	0	0	7	48	215	250	188	206	179	85
1990	0	0	0	107	199	94	198	181	187	141
1991	0	0	0	114	336	180	192	268	190	33
1992	0	0	1	158	176	162	196	231	230	46
Count	30	31	31	31	31	31	31	31	31	31
Sum	10	161	379	1845	4190	4991	6424	8317	7299	3287
Ave.	0.33	5.19	12.23	59.52	135.16	161.00	207.23	268.29	235.45	106.03
Std. Dev	1.86	17.84	18.52	51.53	69.10	53.18	53.47	82.01	103.56	50.82
CV (%)	557.09	343.53	151.50	86.58	51.12	33.03	25.80	30.57	43.98	47.93
	Ave. Total Annual Rainfall					**1194**				

Table 2. Comparative Consumer Prices (Nigeria vs. USA)

Commodity	Nigeria Price Naira (₦		US Price (US$)		Adjusted to US$ & Common Unit			Compar-ison Ratio
	Price	Unit	Price	Unit	Nigeria	US	Unit	Ni/US
Dry Goods								
Flour	107	kg	0.23	lbs	0.71	0.50	Kg	1.43
Sugar	160	kg	0.58	lbs	1.06	1.27	Kg	0.83
Salt	38	kg	0.49	lbs	0.25	1.08	Kg	0.23
Pasta	200	kg			1.32			
Rice (local parboiled)	400	mudu	0.50	lbs	1.06	1.10	Kg	0.96
Rice (Thai parboiled)	168	kg			1.11			1.01
Veg.Oil	300	lit	1.54	qt	1.99	1.45	lit	1.37
Tea	4	bag			0.03			
Coffee	4,600	kg	9.98	lbs	30.46	21.96	Kg	1.39
Cowpeas	370	mudu	0.54	lbs	0.98	1.19	Kg	0.83
Sorghum (red)	220	mudu			0.58			
Sorghum (White & yellow)	190	mudu			0.50			
Cassava garri	200	mudu			0.53			
Cassava flour	220	mudu			0.58			
Sesame	500	mudu			1.32			
Groundnuts	350	mudu			0.93			
Dairy								
Eggs	25	ea	1.03	doz	0.17	0.09	ea	1.93
Milk Power 1,444 kg								
Meat								
Beef	800	kg	3.99	lbs	5.30	8.78	Kg	0.60
Goat	400	kg			2.65			
Fish	250	kg	5.49	lbs	1.66	12.08	Kg	0.14
Vegetables								
Tomatoes	100	kg	3.99	lbs	0.66	8.78	Kg	0.08
Beans	250	kg	1.00	lbs	1.66	2.20	Kg	0.75
Onions	250	kg	0.66	lbs	1.66	1.46	Kg	1.13
Eggplant	60	kg	1.59	lbs	0.40	3.50	Kg	0.11
Potatoes	83	kg	0.99	lbs	0.55	2.18	Kg	0.25
Sweet Potatoes	50	kg	1.49	lbs	0.33	3.28	Kg	0.10
Yams	120	kg			0.79			
Cucumbers	100	kg	0.99	lbs	0.66	2.18	Kg	0.30
Fruits								
Plantain	150	kg			0.99			
Bananas	200	kg	0.50	lbs	1.32	1.10	Kg	1.20
Pineapples	300	Ea	4.99	kg	0.00	1.43	Kg	0.00
Other								
Gas	65	lit	2.15	gal	0.43	0.57	lit	0.76
Diesel	116	lit	2.59	gal	0.77	0.69	lit	1.12

Exchange rate US$ = ₦ 151 Date: 23 September 2009

"Mudu" is local volume measure, approximately 2.5 kg for dry goods[3]

the value chain farm enterprise[4]. The calorie requirements for a healthy adult are normally 2000 calories per day just to meet biological metabolism needs. That would be a typical

[3] *The USA prices cannot be completed until December when the consultant returns to the USA*

office worker or the proverbial couch potato. If people are expected to engage in agriculture field work including post harvest processing they must have access to additional calories ranging from 270 cal/hr for routine garden work such as weeding to 340 cal/hr for more arduous work such as basic land preparation with a hoe. For a full 10 hour work day needed to complete crop establishment in a timely manner, or contribute extensively to post harvest processing such as garri making or parboiling rice this could require an addition of some 3000 cal/day for a total of 5000 cal/day. To obtain a diet of 5000 cal/day a person would have to consume:

- 1.37 kg Uncooked Rice (3.85 kg cooked), or
- 1.38 kg Maize Flour (8.33 kg cooked), or
- 4.09 kg Plantains, or
- 3.43 kg Fresh Cassava, or
- 5.83 kg Sweet Potatoes, or
- 1.37 kg Wheat flour or pasta

This is an enormous amount of food (Fig. 2) that is difficult to envision an individual being able to consume even if they had three or four hearty meals a day. It is nearly 2.5 times the average Myanmar per capita consumption of 200 kg/year of rice or 547 g/per/day that will provide 2000 calories and represent the world's highest national per capita consumption of rice. For maize consumption the highest is Zambia at 411 g/per/day which would provide only 1525 calories. This is considered to provide 62% of the daily calories for an estimated total dietary caloric intake of 2104 calories.

Fig. 2. 5000 calories derived from 4.09 kg plantains (18 fingers), 5.83 kg Sweet potatoes (21 tubers), 3.34 kg cassava (10 roots), 1.37 kg or maize, rice or wheat (2 bowls on right). Photo opportunity provided by Whole Foods Market, Fort Collins, CO, USA.

Typically in countries like Nigeria the rural population spends up to 80% of their income for food and subsistence needs. Often this still results in diets of only around 2000 calories or less. Using the consumer prices for Nigeria listed above to purchase 5000 calories from various common stable crops in Nigeria it will cost a person from US$ 0.70 to US$ 4.05 (Table 2). Conversely, if people at the poverty level only had US$ 1.00/day (₦ 151) to live on, they could only purchase from 1234 to 6338 calories (Table 3). This would than allow them to work anywhere from no work to a full day. Only with cassava garri and sorghum can someone be expected to work a full day; with yams and plantains no work would be possible. With sweet potatoes, rice and pasta some work is possible. When applied to value chain enterprises, unless people are consuming a steady diet of cassava garri or sorghum, they cannot be asked or expected to work a full day in the field implementing value chain enterprises including post harvest processing within the community. While garri, a shredded and dried non-perishable form of cassava, is the most common food for many Nigerians, sorghum is not normally consumed in large quantities, and is raised mostly for the Guinness Stout malt beer industry. The result of the limited caloric intake is a limited work day, often only three to four hours, which can only substantially

[4] *http://lamar.colostate.edu/~rtinsley/CalorieEnergyBalance.htm*

prolonged crop establishment period, which ultimately easily renders most of the recommended production packages, including those associated with targeted value chains, null and void. It could also mean that farmers are better off both financially and health wise by having other members of their community concentrate on the post harvest processing so they can concentrate on the crop production. It should also be noted this accounts only for caloric energy and not a well balanced diet need for good health. That would require balancing out the protein, and essential vitamins and minerals daily requirements. These foods are normally more expensive and can only be obtain by reducing the calories.

Table 3. Cost of 5000 Calories and Calories & Working Hours for UD$ (₦ 151)

Staple Food	Cost/ 5000 cal		Cal/US$ & Working Hours			
	Kgs	Cost (US$)	US$/kg	Kgs	Cal	Hour/Work
Rice	1.37	1.45	1.06	0.94	3431	4.8
Sorghum	1.47	0.73	0.58	1.72	5846	Full day
Cassava (garri)	1.37	0.80	0.58	1.72	6338	Full day
Sweet Potato	5.83	1.92	0.33	3.03	2599	1.9
Yams	4.24	3.35	0.79	1.26	1487	No work
Plantains	4.02	4.05	0.99	1.01	1234	No work
Pasta	1.37	1.81	1.32	0.75	2737	2.45

In Nigeria the agriculture casual laborers might be slightly better off than the US$ per day as the best estimate of wages are ₦ 200 (US$1.35). This is divided between ₦ 150 in wages and ₦ 50 in provided meals.

While the above analysis represents food purchased in the market, smallholders do produce a substantial portion of their own food. However, these subsistence stocks are still very close to the 2000 cal/day listed above. In Malawi smallholders typically set aside 200 kg of maize for personal consumption. This results in some 547g of maize per day and 2030 cal. This would be comparable to the Myanmar rice consumption. The Millennium Village Project for East Africa allocates 1.1 t of maize per family of 5.7 people. This results in only 492 g/day or 1930 calories, basically the same as Malawi substance stocks. This diet may be enough to marginally sustain someone, but not enough to do more than a few hours of field work per day, either working in their fields or post harvest processing, but not both. Subsistence stocks for Nigeria were not readily available during this consultancy, but could be easily obtained when visiting smallholders in village settings. In Nigeria subsistence stocks could be a combination of cassava, yams, plantains, maize, and rice.

The calorie energy balance analysis discussed above is really a 40 year oversight in the development process that completely reverses the basic premise upon which development is based. Instead of claiming the observed prolonged crop establishment period a result of a risk adverse strategy that could be corrected by improved technology, better extension, and motivation to plant early; it would have been recognized that the delayed crop establishment was the result of hunger and exhaustion. The development effort would then have concentrated on drudgery relief and facilitating smallholders' access to the means to manage their land more expediently, such as facilitating access to contract mechanization for basic land preparation, etc. It also highlights the major fallacy in agronomy. That is the small plots used for research and extension demonstrations may be very effective in determining the physical potential of an area. However, they do nothing to determine if the farmers have the means to extend the demonstration across their entire holding. The means to extend small plot research and demonstration is just assumed. In reality this is an administrative void in development with no one clearly responsible for determining if the labor, contract machinery or other operational resources are available, or how long it should take to complete a task like

crop establishment with the limited amount that is available, or how much time a farmer or spouse can commit to post harvest processing.

Implication for Value Chain Enterprises: Since there are no provisions in the value chain promotion to enhance the resources farmers have to manage their land and relieve the drudgery or time required for basic crop establishment that would allow them to expand the area they are cultivating, a value chain enterprise can only be introduced or enhanced at the expense of another crop in the farm enterprise system, either a cash or subsistence crop. Thus, any valued gained from participating in the value chain program is the net difference between the value chain enterprise and the one it replaced, and should be accurately recorded as such. Also, if the farmers' available labor is already stretched to the limit, there is really little time to participate in any value added processing activities as often envisioned in value chain promotions. Such participation may only be possible at the expense of additional crop management and enhancing the yield of the farm enterprise complex. This then requires the farmer to optimize his economic opportunities on virtually a daily basis by choosing between increasing yields and adding value. This is an analysis value chain promoters should undertake in considerable detail before beginning a value chain introduction.

Implications for Public Services: When most of the population has to expend the majority of their income or production just for food and the essential survival needs of their families, and since the government cannot tax survival income but only discretionary income, there is very little tax base for the government to derive the revenue needed for public services such as health care, education, and agriculture research & extension services, including seed certification. The result is that the civil servants are poorly paid, but more important the vast majority of government revenue is used for personal contractual obligations to the officers such as salary and the accompanying fringe benefits including health insurance, retirement and often housing. The result is that there are very few funds for operating an agricultural service program such as research, extension or seed certification in terms of travel, equipment, and laboratory materials or demonstration inputs, and public support services are financially stalled, with many of the officers forced to spend most of their time in their offices with little opportunity for providing the desired services without external donor assistance[5]. The salaries are also sufficiently low that financial necessity requires many government officers to seek supplemental income in order to have the minimum standard of living, comparable to their international colleagues. This often results in a high expectation for gratuities for service rendered. That in turn can create a conflict of interest between the government official and those they are supposed to be supervising and can lead to government officials becoming more an obstacle to projects than a facilitator. This was clearly shown in an Afghanistan seed and fertilizer voucher program a few years ago[6].

It also means that governmental officials' understanding of farm activities is mostly stereotyping from the limited contact they have the opportunity to meet farmers and often limited to a few contact farmers, who are also members of any sponsored organizations. Also, the overall attitude toward other farmers is often one of supervision of research extension recommendations than facilitation and appreciating the limitation the smallholders are operating under. Under these conditions the majority of the country's agriculture activities are managed completely independently of the government's control and effort to improve production. For WASA/Seeds to be effective in assisting smallholders versus becoming

[5] *http://lamar.colostate.edu/~rtinsley/FinanciallyStalled.htm*
[6] *http://lamar.colostate.edu/~rtinsley/InformalIncome.htm*

involved in capacity building of government institutions, it will have to operate as independently of government as possible. For WASA/Seeds to work though the government organizations such as ADPs, most likely will result in a distorted sample, as only five percent of smallholders are members of government sponsored organizations. Thus, WASA/Seeds programs will under represent 95% of the intended beneficiaries who are independents. The agro-dealer network where it exists and as it expands could provide a more representative sampling of the smallholder farm population.

While the Nigerian government appears to receive considerable revenue from oil and other mineral royalties, these funds do not appear to be allocated to agriculture research, extension and other agriculture services, including the seed certification program. In Nigeria, the concept of a financially stalled public sector support services for agriculture were never better illustrated than during this consultancy. Most of the agriculture support programs including the seed certification program are phantom programs, nicely specified on paper, but with no funds to effectively implement them.

It also resulted in the variety improvement efforts largely depending on outside contributions. There appears no one working on sesame, thus the seed comes from outside sources such as Sudan or circulates informally within the farm communities, without any government screening or release. New cassava and cowpea materials come mainly from the International Institute for Tropical Agriculture (IITA) which is headquartered in Ibadan. It is one of the International Agriculture Research Centers (IARC) sponsored by the Consultative Group for International Agriculture Research (CIGAR). Likewise, the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), another one of the IARCs headquartered in India, provides most of the new genetic material for sorghum. Rice is then left to the West Africa Rice Development Association (WARDA). The national program is left with little they can do but conduct final verification trials and release the promising line, often under local variety names[7]. While variety improvement is an ongoing process and there are usually several lines in the final selection process, actual variety releases occur about once every five years for each crop. However, even though the government periodically releases new varieties, the existence of these varieties and where seed or planting material can be obtained is not well publicized. Publicizing the existence of approved varieties of the different targeted value chain crops and were the seed or cutting can be obtain could be a major initiative for WASA/Seeds. Also, given the tremendous underfunding of the variety evaluation program, mostly likely the frequency of releasing varieties has spread out, and the farmers are more or less left to their own means to obtain new material.

The same problem could be a factor in the formal certification of seed. In Kano, as in most states there is only one certification team to make three inspections of each seed production field, often containing less than 0.5 ha. This would be a Herculean task, and impossible to comply with. Thus, the question arises how much of the certification is based on faith, and if perhaps some gratuities are exchanged.

The mineral royalties from oil etc. that are used for agriculture appear to be used mostly for the subsidized inputs programs for fertilizer, and certified seed. However, these programs appear to be administered outside the normal government agriculture technical services effort, and often considered to be based on political patronage. Even the suspicion of such

[7] The IARCs actually encourage NARS to release the IARC's distributed lines under local names. As internationally publicly funded programs, the IARCs consider the genetic material they develop and perhaps patient as public domain and available for national programs to use as they desire including locally naming varieties.

patronage unfortunately generates an overall administrative environment in the civil services in favor of gratuity-based services. Also, even with the extensive petroleum industry that usually produces large quantities of natural gas (CH_4), the primary ingredient for ammonium and urea fertilizer production, Nigeria does not produce any N fertilizer but imports all of it. It is understond that Nigeria at one time had an ammonium/urea plant but it closed. Apparently the natural gas must be flared off, and contribute to green house gas concentration.

Seed Quality & Post Harvest Handling

With WASA/Seeds main mandate to assure reliable quality of seed to smallholder communities, there is a need to quickly review what is needed for quality seeds. In the context of smallholder agriculture and agriculture in general, seed quality refers to the degree to which seeds are genetically uniform, have high germination, and are free of contaminants such as stones, mud, chaff, and weed seeds.

Genetic Qualities

Variety Classification: Genetic quality is normally expressed as a named variety. Historically, varieties are classified as traditional varieties, representing those varieties farmers used prior to major variety improvements starting some 40 years ago with the development of high yielding varieties (HYV) by the IARCs, most notably the International Rice Research Institute (IRRI) for rice and the Maize and Wheat Improvement Center (CIMMYT) for wheat and to a lesser extent, maize. These HYVs were generally short-statured and thus could tolerate considerable higher levels of fertilizer without lodging. The combination resulted in the "green revolution" with the greatest success in Asia. For the most part farmers interested in high yields have adopted these high yielding varieties. The exception would be traditional varieties with very specific grain qualities that are used mostly for special occasions, and are either locally consumed or demand premium prices in the market to compensate for lower yields. Also, particularly with wheat, there are areas such as the North Africa and West Asia where the straw in an important source of summer fodder and has value equal to or greater than the grain. This becomes a major concern for agriculture officers and development professionals anxious to promote self-sufficiency in wheat grain.

Yield Differences Between Recommended Varieties: As it impacts the seed business and the tendency to use retained seed, and the post harvest processing of retained seed the important issue is making certain the farmer is using a HYV. The concern here is that while there is a substantial potential yield increase when going from a traditional variety to a HYV, there is limited and progressive smaller potential yield increases with each release, and it is often difficult to statistically separate them and they can easily vary substantially from year to year as shown in the results of variety evaluation trial undertaken in Madibira, Tanzania (Table 4). Thus, the important thing is to have a HYV, but it is less critical to have the latest HYV. It may actually be preferred to have several HYVs being grown in a community. Smallholder rice farmers will often grow two or

Table 4. Two Year Yield Comparison of Rice Lines

Variety	Yield (t/ha) &Ranking ( )						
	1999		2000		Average		Difference (2000 – 1999)
Line 85	7.1	(3)	8.71	(1)	7.95	(1)	1.52
Subarimati	6.3	(5)	8.12	(2)	7.22	(2)	1.79
NARO TAC	6.4	(4)	7.27	(4)	6.84	(3)	0.87
PSBRc 28	8.6	(1)	4.73	(6)	6.60	(4)	-3.73
IET 1444	7.7	(2)	5.11	(5)	6.41	(5)	-2.61
Line 88	4.9	(6)	7.71	(3)	6.35	(6)	1.37

Source: Developing Smallholder Agriculture

three different varieties on their holding. This was reinforces by farmers interviewed during the field visits. The benefit of having multiple varieties is that if there is a breakdown in the resistance to a specific pathogen, most likely only one variety will be effected and the infestation will not wipeout the entire communities production.

Informal Varieties: In addition to formally recognized varieties that have been evaluated in the national variety improvement program and formally released, there can also be informal varieties even HYV in use in most country including Nigeria. These are varieties that individual farmers have acquired by any of a number of means, appreciated them for some characteristic such as grain quality, and started growing the variety and sharing the retained seed with their neighbors. While not an official release, there is little the seed authorities or seed companies can do about it. A couple examples would be the Zambia rice variety in southern Tanzania, including Madibira where it was widely used and accepted by the seconded government officers assisting with the project. This variety also was not recognized in Zambia. Thus, the best guess of it origin would be someone from Tanzania visited neighboring Zambia, saw the variety, appropriated some seed and returned to Tanzania where he started to produce it. However, by now he had forgotten the name and just started referring to it as Zambia. The same appears to have occurred in Nigeria as one rice farmer was growing a variety he called Cameroon. He had acquired the seed on a farmer exchange visit to Cameroon.

Another example would be the use of MexiPak wheat in Afghanistan. This is again a variety not recognized by the government, but popular with the farmers. It origin is actually a very early cross by the late Nobel Laureate Norman Borlaug working in Mexico prior to the Rockefeller Foundation project he headed evolving into CIMMYT. It was developed for use in Pakistan, but apparently leaked across the border into Afghanistan, was appreciated by the farmers, and has persisted for some 40 years. Often these informal unofficial varieties are the result of on-farm verification trials of promising lines, which the farmers observe, pinch a few seed heads and starting using them. The same can happen during a research station field day. It has to be recognized that once promoted in a field day or included in an on-farm demonstration a breeding line can be *de facto* released and subject to informal distribution. It also has to be recognized that to get to this stage the line must be being seriously considered for formal release, and cannot be a particularly poor line.

Lost Variety Identity: Occasionally variety identity can become completely lost. This has happened with soybeans in both Thailand and Malawi. In Thailand, the seed division only produces enough seed for 1/6th the area planted to soybean and normally cannot sell all of it. For the rest of the area farmers are expected to use retained or locally purchased seed. This has to be moved between provinces during the dry seas for additional seed increase as the viability of soybean seeds can rapidly decline in about six weeks during the hot dry season. With all that movement, the variety identity has been lost. In Malawi, where soybeans were leveraged into production by development projects some 10 years ago, farmer-obtained certified seed when they first grew soybeans, but then simply retained seed since then until the variety name became lost. In both cases from the processors' perspective, there is little variety difference and any soybean will do. Likewise from the producers' perspective, there must not be much physiological difference or even photo period sensitivity differences or the producers would demand variety identification.

Unfortunately, in Nigeria variety identification appears to be lost for most of the targeted value chain commodities, including cassava, sorghum, cowpeas and sesame. Only rice seems

to retain the variety identity, although some of the varieties are not recognized by the government and appear to be informal acquisitions by farmers. In other cases the material has just been retained for too many generation and is referred to primarily as local. Apparently the government is not promoting the newer varieties as effectively as needs to be done for farmers to be familiar with what is available and from where they can obtain at least a starter seed supply or cutting.

Other Quality Consideration

In addition to the genetic qualities expressed in the variety, other quality considerations are germination, cleanliness, pest damage, and sometime seed size. However, these are normally not a major concern, particularly for smallholders. Yes, if a seed does not germinate it will never produce a crop. However, usually even retained seed will have sufficient germination to produce a good full plant stand. Also, normally seed represents a relatively small investment and poor germination, particularly for manual planting operations can easily be compensated for by increasing the seed rate. Germination can also be fairly easily tested for within farm. The simplest method would be the "rag doll" method, in which 100 seeds are laid out on a piece of cloth in a 10 x 10 matrix. The cloth is then rolled up and tied off at the ends, after which it is soaked in water, allowed to drain, and kept moist for three days. At that time the cloth is opened and the percent germination measured. Certainly not an official germination rating, but more than adequate for most farm operations.

Cleanliness is a manner of having the seed free of all chaff, clods, stones, but most importantly weed seeds. For large mechanized farm operations this can become a major concern, but for small farmers it is not as critical. The inert material of chaff, clods and stones are not a major problem and can often be easily removed by manually screening the seeds. Weed seeds are another problem as they need to be winnowed out, but this is a common practice within smallholder villages and normally done before sowing. Of particular concern would be unwanted varieties such as red rice in the seed. Red rice is a noxious weed in rice worldwide. It is actually true rice plant that has a red colored grain, which when exceeding specified limits can severely degrades grain quality. The problem is that it shatters easily and thus volunteers in subsequent fields. However, the seed is normally fairly distinct with awns or other color variation separating it for the main variety so that with care most of it can be manually removed, either by rouging after flowering but prior to harvest, or during storage when preparing to sow. Again this is possible for smallholder producing up to three hectares of rice, and requiring 150 kg of seed. It will take some time, to do this but can be done in a couple days prior to planting. Odd varieties of cowpea are often easily removed by close examination paying attention mostly to color and bean size.

Categories of Seed

As a variety is developed and begins the process of multiplication for dissemination to farmers, the seed that is ultimately used goes through four categories. These categories are identified primarily by the degree of supervision used in producing them to assure they remain genetically pure. However, they are all well over 99% pure or at least should be, at least until they are distributed to the farmer where supervision on production ends. However, given the limited operational funds available to support agriculture programs including variety improvement, how effective the supervision is for each category may be questioned. The categories are: Breeder Seed, Foundation Seed, Registered Seed, Certified Seed, and then Retained Seed.

Breeder Seed

Breeder Seed is seed that comes directly from the breeders or variety improvement screening programs when most introduced varieties are selected from international nurseries. The latter appears to be the case for many crops in Nigeria including cassava, cowpeas, sorghum and rice.
This seed is in reasonably small quantities and may represent only the F5 of F6 generation from the initial cross. It is produced under direct supervision of the breeders and then turned over to a seed program for future multiplication. Often there can be several lines for which breeder seed is being produced for which only one will be selected for advancement as a released named variety with the rest ultimately discarded.

Foundation Seed

Once a variety is ready for release, the governmental seed unit or other authorized entity assumes responsibility for the next step and the breeder seed is grown out as foundation seed. This is normally for only one generation and simply a means of getting enough bulk to advance the seed on to registered seed. This is done under the close supervision of the seed authority. Typically for most grains, the multiplier is approximately 50; that is, for every kilo of breeder seed, about 50 kg of foundation seed results. Thus, a half hectare of breeder seed will yield a ton or more of foundation seed that can then be used to produce 50 tons of registered seed.

Registered Seed

Registered seed is the next stage in the seed release process and now most likely the variety has been released but cannot be widely produced because the seed production has not caught up with the release. Registered seed can be produced under contract with farmers but under very close supervision. Registered seed is usually produced for one generation, but can be done for more to supply the needs for certified seed production.

Certified Seed

Certified seed is what the farmers are expected to use to grow their crops. This seed is usually produced from registered seed by contract farmers. They are then required to go through a strict certification process which normally involves three field visits. The first is early in the season to check for isolation that would avoid cross contamination from other varieties. The second is in the middle of the season to check for uniformity of the crop in terms of height, tillering and other physiological factors that can be easily observed in a field inspection. The third is at the end of the season when a sample is taken for germination and other laboratory tests. This is generally an international accepted standard procedure.

In Nigeria, the procedure is on the books, but the program is grossly under-staffed and under-funded. Typically, a state will have only one seed officer and one seed certification team. Thus the task is virtually impossible to do, and it is difficult to see how even a fraction of the often 0.5 ha or smaller seed increase plots can be effectively inspected the required three times, let alone the laboratory work done, even if the grower is assisting with essential

transportation, etc. Also, it is unlikely that the ₦100 (US$0.67) official charge per certificate can actually cover the costs for visits, analysis and issuing certificates. Thus, it has to be considered that a substantial portion of the certification is on the honor system, with perhaps an appropriate gratuity extended to the underpaid but overextended certification team. Also one of the larger seed companies retains a seed certification team on its premises and provides all the support services they need to make certain they get certified.

The same problem of extensive underfunding of variety development and seed production from breeder seed to registered seed faced by Nigeria appears to be common to many other African countries including Tanzania, Malawi and Ghana. Thus a financially collapsed public sector variety and seed development may be more the norm than the exception.

Retained Seed

Retained seed is seed that is retained by farmer for planting. It is also known as informal seed and market seed. It is largely condemned by the seed industry and seed support services, but it is used on an estimated 95^{+}% of the agronomic crop land, including all of MARKETS value chain target crops. While there are no quality controls on retained seed, it can be of fairly good quality. For self-pollinated crops there should be little, if any, genetic deterioration with each generation. With a little care and training, it is possible for farmers to preserve the quality of their seed. This mostly involves rouging out the off types and being careful in selecting heads for seed preservation (Fig. 3). This can result in maintaining close to a certified seed genetic quality and perhaps result in no noticeable yield loss. In Tanzania, where they were also having similar problems with certified seed, the Madibira Smallholder Agriculture Development Project (MSADP) did an evaluation of the seed maintained by the project compared to the same varieties maintained and distributed by farmers within the villages. The result was no difference in yield (Table 5) with the project seed averaging below average for all three varieties. The next consideration would be to assure reasonable storage conditions but this again does not appear a problem as many smallholders retain most of their crop in kind and will sell it to meet immediate cash needs over a prolonged period of time. The need to preserve the grain over this extended period will also preserve the seed.

Fig. 3. Laotian Farmer Carefully Selecting Rice Panicles' for Seed (Photo Credit IRRI)

Table 5. Yield Comparison of Project and Farmers' Seed for 3 Varieties In Madibira, Tanzania

Subarimati		Zambia		IR 54	
Source	**Yield (t/ha)**	**Source**	**Yield (t/ha)**	**Source**	**Yield (t/ha)**
Project	1.72	Project	0.61	Project	1.44
Farmer 1	2.24	Farmer 4	1.11	Farmer 7	0.97
Farmer 2	2.01	Farmer 5	1.01	Farmer 8	1.68
Farmer 3	1.56	Farmer 6	0.42	Farmer 9	2.28
Ave.	1.89	Ave.	0.79	Ave.	1.59
Std. Dev	0.57	Std. Dev	0.57	Std. Dev	0.80

Use of Retained Seed: Smallholder producers are not the only farmers that extensively use retained seed. Even USDA farmers will use mostly retained seed for some major crops. In Colorado only between 25 and 30% of the millions of hectares

of wheat are planted to certified seed each year, leaving from 70 to 75% planted to retained seed. Similar use of retained seed is common through most of the major wheat producing states in the USA.

Improving Retained Seed Quality: Other than roughing out the off types as mentioned above, it is possible to do some simple activities to improve the genetic purity of retained seed. The easiest thing would be to simple inspect the seed and remove any seed clearly of a different variety. This is possible for rice and cowpeas, and to a lesser degree for sorghum, but the seed size in sesame is too small for this to be practical. For rice, most people familiar with the grain can easily distinguish the individual variety characteristics among six or seven varieties usually commonly grown in an area. Since rice retains it husk when threshed, there can be color differences in the hull, as well as present of awns, and the length and width of the grain. Agreed it could be a somewhat tedious task to manually remove all the contaminated varieties but it would be possible to remove most of them for a hectare worth of seed in one or two days. For cowpeas, it would be easier as the seeds are larger. Again this would mostly be on size and color of the individual beans. For sorghum, the only thing that might be noticed that would allow manual removing off-type seeds is the different color of the seed. Again this could be a good training program for WASA/Seeds to undertake for agro-dealers interested in going into quality seed business or directly with interested smallholders.

Seed Industry in Nigeria

The commercial registered seed industry in Nigeria is basically fragmented among variety of mostly small companies. They are mostly operating in the north around Kano and extending to Zaria. The biggest company is most likely Premier Seeds. It is an outgrowth of the USA seed company Pioneer that specializes in hybrid maize production. Premier Seeds continues this tradition, but also diversifies into other crops including open pollinated maize (OPM) which is also knows and composite maize. Discussion with them tended to become co-mingled between their hybrid maize work and other crops. Other seed companies were considerable smaller and mostly with a single manager, often someone coming out of the civil services, or from earlier development projects. These small companies marketed a combination of imported vegetable seeds and agronomic seeds including five of the six value chain crops of interest to WASA/Seeds. The imported vegetable seeds came from a multitude of countries including watermelon seed from Viet Nam. These seeds can be prepackaged or imported bulk and repackages into heat sealed vacuum packs of laminated plastic making a good quality pack (Fig 4). This would imply the equipment is available in Nigeria for doing quality handling of small packs of vegetable seeds. It is from these vegetable seeds that seed companies make most of their money on the open market.

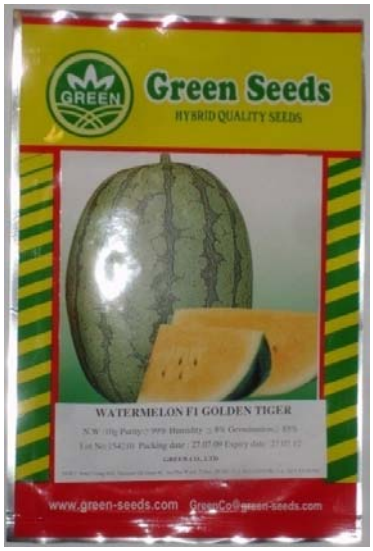

Fig. 4. Imported Vegetable Seed from Viet Nam Marketed by Seed Project Company in Kano.

For agronomic seeds the companies are expected to work closely with the government seed divisions to obtain the necessary registered seed to grow out into certified seed. They will then use a combination of their own lands, if they

have any, and contract farmers to produce the seed. For the contract farmers the degree to which this can be supervised can be a concern. While all this seed is labeled as certified and there is a recognized seed certification process established as explained above. However, as mentioned earlier it has a Herculean task to do with very limited staff and budget, thus it is possible for most of the certification to be on the honor system aided by some gratuities provided to the underpaid members of the certification team. This can bring into question the whole certification program despite the good intentions of all concerned, and possible logistic support the seed companies could provide the certification team. It was noticed that in a visit to a seed companies fields there were uneven fields of sorghum that were claimed to be F2 generations of hybrid being produced for fodder. It would seem strange for a seed company with only 10 ha for producing seed to commit any of it to a F2 hybrid for fodder (Fig. 5). To the extent the certified seed procedures are compromised the certified seed could be little better then retain seed informally sold in the markets.

Fig. 5. Uneven field presumed to be a F2 generation of Hybrid sorghum clearly segregating in seed production farm claimed to be grown for fodder.

While the seed companies can produce certified seed, there appears to be little demand for it. This is noted by Premier Seeds claiming that they have to reclaim 30% or more of their open marketed seed. That is a high percentage. Thus the biggest market for the certified seed for the agronomic crops is the government. It tends to use the oil royalties to provide subsidized inputs to farmers. Thus, it will buy large volume of certified seed that it will sell at a 50% discount. This brings the cost down to be comparable to the informal seed supply from retained seed. However, these programs may not always be effective; at the ADP office in Abakaliki there were some 250 50kg bags of rice seed intended for subsidized distribution (Fig 6). However, they were only able to sell 10% of the allotment from both the Federal and State governments because the supply came late, after most of the crop had been planted. Of major concern was the lack of clear variety designation (Fig 7). The bags clearly provided a place to have the variety identified to be printed in large (10 cm) letters but for most of the bags this was left blank. Not something you want if you are trying to promote certified seed of a specific variety.

Fig 6. Leftover rice seed from government subsidized distribution when late delivery resulted in only 10% being sold.

Fig. 7. Leftover "certified" seed for distribution as part of government subsidized distribution program but without any indication as to what variety it is.

One of the problems raised by a couple of the seed companies was that of outsiders counterfeiting their labels and marketing poor quality seed as theirs. This can be a serious legal issue that needs to be dealt with through the court system. However the courts appear very lax in handling this either on the criminal or civil side. This also could be a convenient means of dealing with poor quality seed that was certified through a gratuity system and not really up to expected standards.

As mentioned at the beginning of this section, all the seed companies appear concentrated in the North around Kano and Zaria. During the field trip to the south inquiries were made to each ADP to contact seed companies but there appeared to be no registered seed companies in the area. Also, driving through the areas, there were no signboard alone the road nor on shops in the village mentioning seed or other farm inputs. In Benue, one of the retired ADP officers was managing an informal unregistered seed business, mostly for rice. Also, one of the large organizations, Olam, who declined our request to visit even though it is or was supported by the USAID/MARKETS project, also appeared to deal in certified seed. The unsold unidentified surplus in the government's subsidized distribution system came from them (Fig. 6).

Overall the seed industry in Nigeria is fully capable of producing, processing and packaging quality seed. However, with the certification program more an on-paper phantom then an effective program, and with the bulk of the agronomic seeds going into a government distribution system with logistical and timing problems, and little concern for basic variety identification there is little real incentive for maximizing the quality on the bulk of the commercial seed production.

Intervention: This may be a major basically full time intervention in the intermediate two to five year term for WASA/Seeds to assist with the introduction of fresh germ plasma into smallholder communities and continue to assist with the maintenance of the retained seed within the communities. First, WASA/Seeds could substantially expand its current effort to link seed companies to agro-dealers for sale of "certified seed" to farmers by quietly and gently by-passing the government variety development seed multiplication programs, which are too underfunded to be effective, and in conjunction with the seed companies, particularly the smaller companies such as Seed Project Ltd. and Alheri Seeds Nigeria Ltd., encourage direct links to the IARCs in country that are actually doing the variety evaluation for five of the six targeted value chain crops. They could than obtain samples of three or four promising lines of each value chain crop, multiply them into variety evaluation kits of about one kilo of seed per line. This should not be too difficult as many of the small seed company owners are former government officers and have worked on development projects and still have informal contacts with the IARCs. The variety evaluation kits assembled by the seed companies could then be sold to the agro-dealers interested in expanding into the seed business and have enough land within their respective communities for growing out a seed increase plot for the three or four lines. This would allow the farmers an opportunity to observe the new material and determine if they would like to purchase seed for the following season.

It is a low risk intervention as only small quantities of seed are initially used. Those lines the farmers like can be quickly multiplied in the following season for further sale and distribution within the community. Those not appreciated will quietly disappear. Those lines the farmers like can fairly quickly blanket an area in three or four generation, as the Cameroon variety appears to have done, most likely starting with less than a kilo of seed. This liaison with the IRACs need to be done only once in three or four years, as the turnover in varietal

development is generally fairly slow. Basically this would become a genetic pump to put fresh seed material into the smallholder communities. WASA/Seeds need to make certain the seed companies maintain a vested interested, in terms of the expectation of future business, to make certain the material the produce for the genetic pump has the highest purity they are capable of, and is not treated the way they might treat seed going into the government subsidized seed distribution program. This direct contact with the IARCs involved with variety development to obtain potential material is exactly what a medium sized unregistered rice seed producer does in Benue, and he is a retired government officer retained by the ADP as a consultant.

Second, WASA/Seeds can further work with the interested seed producing agro-dealers and farmers to take an appreciative view of the community retained seed program and not simply dismissed it as poor quality in the hopes that there will come a time when certified seed will be plentiful enough for every farmer and every field. One thing that may need to be done to demonstrate this is some type of study similar to the one done in Tanzania comparing the retain seed with the same varieties available from the commercial seed companies (Table 5). It may also necessary to conduct some simple survey to determine how well farmers can identify the various varieties, what effort they are making to maintain the quality seed, and how much this can be improved with the facilities normally available to smallholder communities. This could lead to some farmer or community training programs that could help improve the quality of the retained seed as well as some simple cleaning equipment to assure clean seeds (Fig. 8).

Fig 8. Simple manually operated winnowing and seed cleaning machine that could be used for cleaning seed for retaining in the community or making certain produce leaving the community is clean of trash.

The same equipment could be used by any agro-dealers who become involved in buying targeted value chain produce including rice, sorghum, and cowpeas to assure a clean product is delivered up the value chain on contract to some SME processors as discussed later.

As with any variety introduction, this should have a long term positive cost/benefit ratio that will tend to snowball as the accepted lines become widely utilized including leaking into neighboring areas.

Hybrid Seeds and Open Pollinated Maize

Little mention has been made of hybrid seed. That is because all the value chain target crops are self pollinated so hybrid seed production is usually not undertaken. Hybrid seed are more often associated with open pollinated crops such as maize and sunflower as well as some high value vegetable crops. Hybrids represent a F1 cross of two well known parents that will produce an initial (F1) crop that is predictable uniform with an extra vigor that provides 15 to 20% higher yield. However, the seed should not be retained for the following season because the characteristic of the individual parents will segregate and the field will be highly uneven with low yield. Therefore, hybrid seed requires a continuous annual replacement of seed, which when servicing smallholder communities can be a major logistical problem that exceeds the capacity of many government institutions and many private companies to maintain. Thus for smallholder communities it is usually better to emphasize open pollinated or composite varieties of open pollinated crops.

Open pollinated maize varieties are maize varieties that have been continuously selected for uniformity until a uniform stand is obtained. Typically this will require four or five generations. It yields are about 85% of an F1 hybrid, but the yield is stable and the seed can be retained for multiple generations with little decline in quality

Value Chains

For the purpose of this report, WASA/Seeds considered the value chain of the five crops mandated by MARKETS leading from production to consumers or as far up that chain as producers' are interested and that interest is financially to their net benefit. These value chain crops are cassava, rice, sorghum, cowpeas, and sesame. It is understood that the value chains were selected based on potential for an industrial use of the crop. The value chains are also projected as fully independent and not associated with other crops. This may need to be modified to comply with the typical other enterprises that farmers are involved with along with the targeted value chain enterprise. For example, many cassava farmers also produce yams, often on the same mound (Fig. 9). In these areas, it might be best to evaluate cassava and yams as a single value chain. This would be similar to the experience in Malawi where the soybean value chain was the primary concern but farmers and agro-dealer were usually working with maize, and groundnuts along with the soybeans[8]. Similarly, few, if any, farmers produce cowpeas in large quantities but usually small amounts as a secondary crop enterprise. Thus, the value chain of cowpeas would need to consider the other crops the farmers are producing.

Fig. 9. Typical mound containing both cassava and yams.

Also, it was noted that some of the value added activities taking place in the rural communities were often labor intensive such as converting cassava to garri or parboiling rice. Thus, a careful analysis should be taken whether the farmers should be directly involved in the added value or if it should be outsourced to a Community Based Family Enterprise (CBFE), as elaborated upon below, that is specializing in the value addition and has invested in the necessary processing equipment. This really refers back to the earlier discussion indicating that rural labor may be scare and many farmers are maxed out in terms of the limited amount of calories in their diets. Therefore, they have to optimize their time, effort and energy. In this case taking time for value added may be at the expense of additional production, and the decision has to be made as to where farmers will get the greatest return for their day's effort, adding value or producing more crops?

Cassava

Cassava is perhaps the most widely produced and consumed crop in Nigeria. However, it is basically a pure starch crop with little additional nutritional value and normally is not considered a high value crop. It represents the greatest amount of calories per unit of labor and as such is a HIV/AIDS mitigation crop. That is as the HIV/AIDS epidemic reduces the available labor in rural areas, either from people becoming infected or parents dying and their dependent children being return to villages to be raised by uncle and aunts, cassava offers the best prospects of at least providing enough calories to survive. As a root and tuber crop it has a short shelf life once it has been lifted and thus it needs to be quickly consumed or processed

[8] http://lamar.colostate.edu/~rtinsley/ValueChainAnalysisSoybeansMalawi.pdf

into something non perishable. In most countries, cassava is a secondary staple crop that is normally lifted and quickly consumed directly or dried, pounded into flour and consumed similar to the maize portage of East Africa. In Nigeria, it is such an important staple crop that more is lifted than can be quickly consumed and thus it is processed into garri. Garri is a shredded and dried form of cassava that is non perishable. It is also the cheapest from of caloric energy available in Nigeria and the only widely consume staple that will provide 5000 calories per US$1.00 needed for an impoverished person to work in the field all day.

Fig. 10. Cassava flower from which viable seeds are produced.

Cuttings: As a crop, cassava is a long season crop that normally is grown for at least a year before the roots are lifted and it is processed or consumed. It can be grown indefinitely with the roots simply getting larger the longer it is left to grow. It is also a tough crop that can be produced on the poorer quality soils including very sandy soils that do not hold enough moisture for other crops. While it does produce viable seeds, the seeds are in limited supply so cassava is normally propagated by cuttings (Fig. 10). The seeds are essentially used only for breeding. The vegetative propagation does assure continued genetic purity, even more so than a self pollinated crop. However, in Nigeria the same fields can be planted to the same material for 20 or more year so that any variety identity will be lost. This was pointed out during the tour by the manager of one of the hotels, who was also a cassava/yam farmer. She mentioned that they actually produced three or four different types of cassava based on root qualities for garri, flour or just plain cooked cassava, but did not have any formal variety name associated with any of them. There are some cassava cutting sold in local villages markets and represent some movement of genetic material, but again this appears to be done without any variety identity (Fig. 11). Within a given area most farmers will most likely recognize the root quality from the displayed tops, but not a real variety identity.

Fig. 11. Load of cassava and sweet potato cutting going either to or from a local market.

There is a varietal improvement program for cassava in Nigeria, but as with so many other agriculture support programs, it is so under-funded that for the most part the work is left to IITA, the CGIAR sponsored IARC with the world wide mandate for working with cassava. IITA is mandated to work with the national program and provide them cutting of promising lines, for verification and dissemination. This has historically worked very well for most IARCs and the distribution of their respective genetic materials to national programs and on to smallholder beneficiaries. However, since IITA is actually headquartered in Ibadan, it is possible for individuals to visit the center and they will normally allow such visitors to have some cuttings. It happened that one individual had obtained some improved varieties directly from IITA and was able to clearly state the variety

name or breeding line ID. However, while IITA lines were superior in yield, the root quality was better suited for flour than garri.

This illustrates the extent some innovative farmers will go to obtain additional material. However, it also indicates how little most farmers are aware of what could be available through the agriculture support services. Thus, there is a major need to disseminate information on the types of improved materials are available and where they can be found including going directly to IITA. The ADPs do have a program of distributing cassava cuttings but this is done through clusters of contact farmers who are members of a group, and not the general public. While there may be 20 members in a group, since each group is from the same community, the spatial distribution is only 1/20th what it could have been if the contact farmers were more scattered. With cassava, one of the tasks of WASA/Seeds could be to promote an enhanced awareness among farmers of what improved planting materials are available, what processing the variety is most suited for, and from where cuttings can be obtained.

Processing Garri: Most of the cassava produced in Nigeria appears to be processed into garri. This is a dried shredded form of cassava with considerable longer shelf live then cassava roots. Since garri is the cheapest source of food energy available in Nigeria, garri production might better be considered a preservation process than a value added process. Garri production is a fairly labor intensive and time consuming process, involving pealing the roots, shredding the roots, dewatering through compressing in hydraulic or screw down type press, re-shredding as the material became caked during pressing and finally "frying". The "frying" is actually a dry frying without oil and primarily completes the drying process to greater dryness than possible with simple sun drying, as well as providing some level of cooking. This then results in a course material that can be eaten as is, or re-hydrated and mixed with sugar or other condiments.

Traditionally garri making has been a family activity, mostly done by women. However, it is gradually being mechanized, particularly the shredding process. This result in a capital investment that cannot be justified by most smallholders and the processes is progressively being outsourced to members of the community in what are CBFEs. The question is "what is the most cost effective means of producing garri within a community". Should it be done by the farmers and their families in the traditional manner, should it be done by a group, or should it be done by CBFEs. The answer depends on who has the most time to devote to the process. If, as mentioned earlier, the growers are already overworked with the management of their land and the complex of crop and animal farm enterprises they have undertaken, then any diversion for value addition to the cassava can only be done at the expense of additional crop or animal production, either cassava or other farm enterprise. In this case, the grower is better off selling the cassava to a CBFE in the business of making garri.

During the field visits several situations were identified. These included a facility for custom processing of individual's cassava into garri as well as par-boiling and milling rice (Fig. 12, 13). The equipment was there for lease to anyone interested, but the mechanical equipment had to be operated by the owner. A FAO supported cassava processing facility as part of a women's income generation project that was mostly abandoned and locked (Fig. 14, 15), with a CBFE 100 m down the road actively processing cassava to garri at full capacity (Fig. 16,17,18,19). The latter had all the necessary machinery in working order with a very careful eye on the operational costs, particularly the fuel cost. The couple was fully occupied with the operation of the facility. They grew some cassava and purchased other cassava from their

neighbors. They even collected the leachate from the dewatering press to dry into laundry starch.

Fig. 12. A cassava & rice processing facility for custom use of equipment for individuals to process their produce

Fig.13y. Cassava Shredder inside the facility in fig x for custom use by farmers in processing cassava

Fig. 14. FAO funded cassava processing facility for women's income generating project, now virtually abandoned waiting for government assistance for minor equipment repairs.

Fig. 15. Cassava processing equipment in FAO funded facility mostly sitting idle

Much of the equipment used in making garri appears to be readily available in Nigeria. Most of the grinding, pressing and frying equipment can easily be fabricated in country while most of the engines are imported but from mass production and off the shelf. The most common country of origin appears to be India. Since electric power is so unreliable in Nigeria all the processing facilities rely almost completely on small diesel or gas engines.

Medium Term Projections & Interventions: Over the medium term of two to five years the continued outsourcing of garri production will most like occur until hand shredding of cassava will disappear in the same manner of pounding maize. Most likely this will be mostly through the CBFE including many owned and managed by women. It is unlikely that this will be done through cooperatives or at least not sustainable as shown by the FAO women's income generating facility now mostly locked. The big problem could be the need for mechanical equipment for shredding the cassava, and maintaining mechanical equipment under communal ownership has always been difficult. This would represent an opportunity for MARKETS to facilitate the process by working with individuals within the community to develop reasonable work plans and the help arrange micro financing, etc. Since this is

spontaneously taking place it can be readily assumed the cost benefit ratio is favorable. The difficulty here might be that if MARKETS waits too long the opportunity could be lost.

Fig. 16. Small community enterprise for processing cassava, with considerable lower capital layout then the FAO facility 100 m away. Note the jar catching the leachate from the dewatering press. This is dried as laundry starch.

Fig. 17. Some of the equipment used for processing cassava and rice by family enterprise in Fig. 16

Fig. 18. Packaging equipment owned by the family enterprise for weighing, sealing or stitching packages.

Fig. 19. Sealed package of cassava laundry starch with small individual label.

Rice

In Nigeria, rice is the third staple food in the diet, after cassava and yams. It is sufficiently in demand that imports are required mostly from Thailand and Viet Nam. Nigeria does have all four ecological types of rice, including flooding rice similar to Bangladesh and Cambodia, deep water rice similar to Central Thailand, normal paddy rice, and upland rice. However, the vast majority of the rice is the normal paddy rice, locally referred to as swamp rice, or shallow swamp rice. When irrigation is available it is mostly irrigated, but it can also be rain-fed.

Seed Requirements: Rice, unlike other targeted value chain crops, tends to maintain varietal identity. This may be because it shows up in the grain quality and can have market value. Thus if you ask most farmers to name the varieties they are growing, they can easily do so. This includes recommended varieties, traditional local varieties, and some informally imported varieties. As mentioned earlier one farmer even mentioned Cameroon as a variety. It is also an indicator that when it is important farmers can easily keep track of varieties. Farmers will typically grow four or five different varieties on their farms. This is usually good as it maintains some degree of genetic diversity and prevents a complete wipeout if one

variety has a breakdown to its resistance to a given pest or pathogen such as rice blast fungus. The farmers also normally keep their different varieties separated and not mixed. Though there will be some contamination between the different varieties, this will normally be minor, and not seriously impact the retained seed.

As with the other varietal improvement efforts in Nigeria, the rice improvement effort is poorly funded. The result is that most of the effort is left to collaboration with WARDA, which in turn works closely with IRRI in the Philippines, and IITA. Thus the national program mostly does final verification of the imported material and then periodically makes a formal release of named varieties. These releases occur about once in five years. The government does sponsor a subsidized distribution of "certified" rice seed each year. This is at nearly a 50% discount to the commercial "certified seed" price which brings it in line with the market rice. The government sales provide the registered seed companies the major outlet for the certified seed of selected agronomic crops, in this case rice. The quality of seed, even though certified, may be in question as well as the timing of the distribution. As noted in the entrance to one ADP, there were some 250 bags of unsold certified rice seed that had arrived too late for effective distribution, so that the ADP only sold 10% of the allocated seed (Fig. 6).

Again, the vast majority of the seed used by the farmers was either retained or locally purchased in the communities. While rice is primarily a self-pollinated crop, it does have a 3% outcross rate, which is higher than most self-pollinated crops such as wheat with less than one percent outcrossing. Thus rice produced from seed that has been retained for three or four generation can begin to look fairly ragged with many off-type appearing above the normally short-statured canopy (Fig. 20). These can be easily seen from shortly after heading until harvest. Unfortunately, during the field visits the rice was just beginning to head--about two weeks too early to see the extent of off-types. Initially, the off-types are more an appearance problem than a yield loss, but in a few additional generations it could become a measurable yield loss. This can easily be avoided by farmer rouging out the off types of at least the area from which they plan to retain the seed. This is something that farmers can easily be trained to do, and would be something to include in as WASA/Seeds sponsored farmer or agro-dealer training program of best practices for seed maintenance. This could be a significant intermediate term innovation for WASA/Seeds, but perhaps with limited impact as training farmer on rouging out off-types appears to have been done with the farmers learning, but not practicing implying they do not see it as that important. This happened in Ghana.

Fig. 20. Off-type of rice protruding above and otherwise uniform stand. This is not enough to measurable impact yield and the rice seed could be retained for one or two additional generations.

Processing Rice: In Nigeria most of the rice is parboiled. Parboiling, particular volunteer parboiling is unusual in developing countries and first time encountered by this consultant in some 30 years. In Nigeria the parboiling and milling are done in villages near the rice tracks. Most of these would qualify as CBFEs The process is virtually the same across the country but the size of the combined operation varies according to the size of the rice tract served. It

is a process by which rice paddy is soaked in water overnight, than slowly and briefly cooked (Fig. 21), dried back down before milling (Fig 22 & 23). The process swells the grain, slightly loosens the husks, and allows some of the nutrient in the husks and bran to seep into the endosperm. In the process the grain will become slightly yellow, harder, and less sticky, which some people object to. The overall impact will be an increase in milling recovery from 67% to 75%, something host governments such as Sri Lanka appreciate in meeting the food security needs of the population. In Sri Lanka par boiling was mandated but with no quality control particularly the soaking water. This resulted in some highly objectionable taste. It also increases the nutritional values of the rice (Table 6) particularly some of the essential minerals and vitamins. The most well known form of parboiled rice in the west is Uncle Ben's Converted or Enriched Rice.

Fig. 21. Small vat used for parboiling about 200 kg of paddy and fueled by rice husks.

Fig 22. Drying field for parboiled rice prior to being milled.

In Nigeria there is also some cleaning and destoning processes (Fig. 24) as well, before the final milled product is ready for marketing (Fig. 25 & 26). The stone or more correctly the mud clods are really a reflection of the conditions under which the rice is threshed and dried at the farm level and can be rectified with some care and perhaps some mechanical threshing or combine harvesting. During destoning at milling about 10% of the paddy is lost with the expelled stones. Most of the equipment observed in Nigeria looks very old, possible suited more for a museum then continuing in operation (Fig. 27). However, the operators claimed the equipment is more recent, perhaps no more than 15 years old out of India. The ultimate quality of the rice is reasonable for local market but not superior or suitable for an export market (Fig. 28) However, since Nigeria is not self sufficient in rice and imports rice from Thailand, there is little opportunity to export rice. The Thai rice does command an ₦ 7.1/kg (US$0.05) premium price in the market with the overall price of rice comparable to the USA (Table 2).

However, as described above, parboiling can be a time consuming and labor intensive process that takes the most part of two days per batch. Therefore, just like the case of converting cassava to gurri, getting involved with the value added in parboiling has to consider relative to the opportunity to increase the yield of rice or other farm enterprises. It is also possible for farmers to concentrate on their field work, but hire out as a casual laborer for ₦1200/day (US$8.00) at the rice processing area when there is some slack in the field work as one farmer/laborer did.

Table 6. Selected Nutritional Values for Parboiled and Raw Rice

Nutrient	Units	Value per 100 grams	
		Parboiled	Raw
Energy	Kcal	374	365
Protein	G	8.11	7.13
Total lipid (fat)	g	1.04	0.66
Fiber, total dietary	g	2.20	1.30
Sugars, total	g	0.33	0.12
Minerals			
Calcium, Ca	mg	55.00	28.00
Phosphorus, P	mg	156	115
Potassium, K	mg	187	115
Sodium, Na	mg	3.00	5.00
Copper, Cu	mg	0.27	0.22
Selenium, Se	mcg	23.90	15.10
Vitamins			
Thiamin	mg	0.22	0.07
Niacin	mg	5.14	1.60
Vitamin B-6	mg	0.46	0.16
Vitamin E (alpha-tocopherol)	mg	0.03	0.11
Lipids			
Fatty acids, total saturated	g	0.29	0.18
Fatty acids, total monounsaturated	g	0.26	0.21
Amino acids			
Leucine	g	0.72	0.59
Valine	g	0.52	0.44
Arginine	g	0.71	0.59
Aspartic acid	g	0.87	0.67
Glutamic acid	g	1.52	1.39
Proline	g	0.52	0.34

Source: USDA National Nutrient Database for Standard Reference, release 22

As with the cassava processing there are several scenarios. In some cases the parboiling is on a custom basis where the rice remains owned by the farmer who, or perhaps more frequently his wife, accompanies the rice throughout the two day parboiling and milling process. This could largely be for subsistence stocks. It is unlikely the farmers would want to devote that much time to processing other than for their subsistence stock. At other times it is straight commercial operation with up to five cash transactions going from farmer to parboiler to miller and finally to wholesaler and consumer.

Fig. 23. Women loading rice into small single pass mill

Fig 24. Destoner being used to clean rice before bagging.

Fig. 25. Piles of milled rice waiting for buyers with women in background continuing to winnow the milled

Fig. 26. Quality parboiled rice in 25 kg bags and ready for market

Fig 27. An apparent ancient diesel engine commonly used for milling rice, that may actually still be manufactured in India

Fig 28. Close up of milled parboiled rice showing variation in color most likely due to uneven boiling plus a few stone or dirt clods. Not high enough quality for export markets, but easily removed prior to cooking at home.

A close review of the rice processing equipment would indicate that all the parboiling equipment is locally fabricated and readily available. However, the milling and destoning equipment appears out of day and in need of modernized. There is more efficient equipment available. Certainly, there are much more fuel and lubricant efficient diesel engines available including both water and air cooled engines. Also, the mills could be changed for some of the multistage single pass mills like those recently purchased and installed in Madibira, Tanzania (Fig. 29). Similar mills are also commonly used in Ghana. These mills will mill and polish raw rice with about a 12% breakage rate. This is twice the 6% international standard but usually adequate for local market. They also discharge the bran separate from the hulls so it can be recovered for immediate feed use. There are also much more efficient de-stoning machines that will not require reprocessing the outflow to recover most of rice kicked out with the stones. However, before committing to massive upgrades it needs to be reviewed in light of the impact parboiling has on toughing the grain and allowing rougher milling without increasing the breakage, as well as the impact on the amount and reduced nutrient value of the bran for feed. Thus as old and out of date as they look, they may be the most cost effective mills for milling parboiled rice. Usually when raw rice is milled with these mills the breakage is 60% or more.

Fig. 29. A simple single pass multi stage rice mill with a more efficient diesel engine privately obtained by an individual in Madibira, Tanzania after a 3000 ha irrigated rice scheme was constructed.

All the rice processing areas were highly active, but all the rice observed in the field was just approaching the heading stage. Thus, while it is possible this was very early planted rice, most likely the vast majority of rice being processed represents last years' harvest, just coming on the market. This is now 10 months after harvest and represents a tendency for farmers to retain their assets such as rice in kind for as long as possible. It may also represent an interesting financial management strategy for the rural impoverished. The strategy is that it is better to retain assets in kind rather than monetize them. This provides a hedge against inflation and takes advantage of any price increases with distance from harvest, although this would be comingled with the inflation edge. It also may represent a desire not to be tempted to spend money. This strategy could be in marked contrast to the development communities' effort to funnel assistance through the cooperative business model in which smallholders are expected to consign their crops to the cooperative that will bulk it up so they can get a higher price for the volume sale. However, this results in an early payoff, typically six weeks after being consigned, and the farmer then has to keep the cash in the proverbial cookie jar, where a sticky fingered husband can extract some to go to the nearest bar for some refreshment and possible some companionship, or teenage daughter could dip in to get her hair braided. When the assets are kept in kind one's temptations are reduced.

Medium Term Projections and Interventions: While initial appearances would indicate amble opportunities for interventions, identifying appropriate medium term, two to five year,

interventions may be more challenging for rice processing than for cassava where there is an established processing trend toward CBFEs for garri making. The rice processing appears in equilibrium with the production for each area and most likely will continue as production slowly expands. Much of the equipment appears old and out of date, but it also appears effective considering the impact parboiling has on the rice grain. It might be possible to facilitate some of the expansion or replacement of equipment, by working with individual operators or perspective operators to develop viable business plans and obtain the funding needed to establish or upgrade their businesses. The processing does require considerable capital costs particularly for milling and destoning as the machinery is relatively expensive and requires a substantial (22 hp) external power supply. The parboiling requires a lesser investment, just locally fabricated vats and drying mats. The entire rice processing system has evolved to meet the needs of the producers and processors and reflecting the overall business environment of Nigeria and most other African countries that emphasize small to medium size family enterprises over larger organizations. The reason could well be associated with concerns for supervision in an impoverished environment where pilferage is likely when the opportunity presents itself.

One part of the process that appears excessive and could be intervened is the continued manual winnowing at each stage in the process including the final product (Fig. 25). Some of this could be eliminated with simple seed cleaners as suggested earlier for cleaning retained seed (Fig 8). This should save time improve the final product.

The system produces an acceptable quality of rice with only a small discount from the imported Thai parboiled rice. The quality concerns are largely associated with the rather uncontrolled non-uniform temperature during parboiling that result in differences in color in the finish grain. This should not affect the quality, just the appearance. To overcome this would require quantum leap to large scale parboiling and milling. There are plans for joint government private large scale mill to be built in Ebonyi State. The capacity is listed as 300,000 mt/yr or approximately 100 mt/day, allowing for some down time for routine servicing each year. This would serve about 60,000 ha of rice with an estimate yield of 5.0 t/ha.

Fig. 30. A small combine used extensively for contract harvesting of smallholder rice in Asia and could be use in Nigeria. It would assist in reducing the stone and clog contamination in milling and reduce the costs for milling.

A more appropriate intervention might be to reduce the need for destoning and eliminate the need, costs and losses for one operation. The destoning is really more removing mud clods than actual stones. Most of the mud clods get into the paddy during manual harvesting and threshing when the rice is often laid on the ground, etc. The solution that could be introduced would be to mechanize the harvesting. The most effective for smallholder producers would be with small two meter head

combines that are common through Asia (Fig. 30). Such combines can work in fields as small as 1/6 ha and combine more than a hectare per day. These would have to be made available on a private contract basis as is also common through Thailand, and appear to be coming into Africa with support from Japan and South Korea. They cost about US$ 50,000 per unit. What the cost benefit ratio would be is rather limited, but they would have additional benefits beyond less stones and clods in the paddy. They will also greatly expedite the overall harvest process and the prospects of getting a second crop established, and increase the recovery of rice by 10 to 15%, which is usually enough to cover the cost of the combine.

The other intervention which is also common to sorghum and cowpeas is the tendency to include about 15% trash in commercial bags of produce. It is kind of a chicken and eggs circle that farmers started bulking up their bags with some straw, chaff, etc. so buyers began automatically discounting 15% plus recovery costs, and farmers responded by making certain bags contained the 15% trash they were being discounted for. It is an interesting problem that will be discussed later.

Sorghum

In Nigeria sorghum is a minor food crop blended with other crops, or even consumed directly. It is grown mostly in the dryer north were its drought tolerance gives it a competitive advantage over other crops, most noticeable maize. The MARKETS project included sorghum in their value chain with the expectation it would be used in the malt industry for beer making. However, Premier Seeds indicated that at least Guinness wanted a specific variety of sorghum for their malt. This would be very similar to COORS in Colorado specifying Moravian barley, contracting with farmers in the San Luis Valley of southern Colorado to produce the low yielding barley and paying them a premium to compensate for the lower yield and artificially low protein content. If sorghum is the main malt grain for the brewing business then the volume required blends itself more to contract farming with large producers than collections from smallholders. This would make it mostly a closed value chain that would be difficult to penetrate. There may be a spot market to make up for short falls in the contracted production, but most likely it will be limited and unreliable. However, the use of sorghum for brewing may be restricted to the Guinness Stout beer. This is more a specialty niche market beer. It clearly lists sorghum as an ingredient. However, the more popular Star beer, also produced by Guinness does not mention sorghum. If this is the case than the brewing market for sorghum may be fairly limited. Perhaps something could be arranged through the agro-dealers serving as purchasing agents for the brewers, but it will take some time to organize. It would be better for the agro-dealers to link the farmers to some of the Small & Medium Enterprise (SME) processing sorghum into finished consumer product such as Convenient Home Foods & Beverages in Kano.

As with most crops in Nigeria the development of new varieties is mostly deferred to collaboration with the IARCs. In this case ICRISAT. However, the availability of new varieties does not seem to be disseminated to the farmers. The sorghum famers interviewed were not aware of any improved lines, and referred to what they were growing simply as local sorghum. The local lines appeared extremely tall, approaching three meters and non-uniform (Fig. 31). This would compare to improved varieties that would not exceed two meters. It is unlikely such tall varieties could respond well to N fertilizer needed for high yields. The only distinction mentioned between varieties was the color of the grain between red, white, and yellow (Fig. 32) with the red commanding ₦ 30/kg higher price, at least in Kano (Table 2).

Fig. 31. Very tall "local" variety of sorghum and the farmer growing it.

Fig. 32. Red, Yellow and White sorghum in the market in Kano.

Interventions: Sorghum appears to move up the value chain as seed and thus there is no processing at the producer community level. Any processing will be done by the final purchaser just prior to consumption or blending with other good. It does tend to become involved with inclusion of 15% trash in sealed bags as mentioned before and addressed shortly. There is a need for major intervention in getting fresh genetic material available in sorghum producing communities.

Cowpeas

Cowpeas are the only legume included in MARKETS value chains. In Nigeria cowpeas appears to be a minor crop scattered throughout the country but with the commercial production concentrated in the North. Even in South the cowpeas in the market were grown in the north. For the most part cowpeas appear to be produced for subsistence use (Fig. 33) in relatively small plots distributed among other crops. They can be consumed as a fresh bean, dry bean or ground up into a paste that is boiled in a leaf (Fig. 34).

The varietal development work is done in collaboration with IITA, but again the information about improved varieties does not appear well disseminated. The only identity farmers refer to is color and size, and possible the color or intensity of the color of the radicle (Fig. 35). This is often black and reason for cowpeas in the Southern USA being referred to as Black-Eyed Peas. The colors identified being mostly white and brown.

Fig. 33. Field of cowpeas with typical late season weed infestation.

Fig 34. Women in village preparing cowpeas for boiled vegetable snack with a piece of fish included.

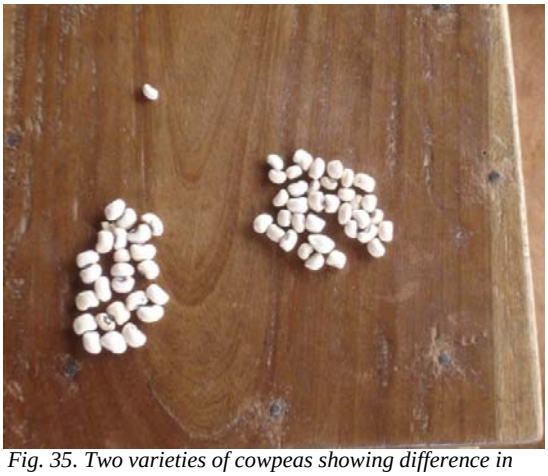

Fig. 35. Two varieties of cowpeas showing difference in size and distinctive "black-eye". These cowpeas were grown in the north but marketed near Ebonyi in the south.

Interventions: As with sorghum, cowpeas proceed up the value chain as seeds with no processing at the producer level. They could have the same trash problem in the marketing process that is a potential intervention. Again this will be discussed shortly. There is a need for some more clearly defined genetic material to be made available to the producers.

Sesame

The last value chain is sesame. It is mostly a confectionary crop used in candy, coating on bread and pastries. It is also an oil crop containing some 50% oil. The oil is of high quality and well flavored to be used in low quantities as a seasoning in some Asian foods. It is a major component in some traditional Middle East side dishes such as tahini. As a value chain crop it was anticipated that it would used as a oil crop with an oil processing plant run by Olam in Benue. A facility we were unable to visit as they needed permission from their headquarters in Lagos to approve a visit. As a crop it is really an ecological tough crop that is usually grown on very casual management (Fig. 36). That is it is short seasoned enough and has enough drought tolerance to be planted late in the rainy season after all the other crops are well established and then grow out to maturity in the dry season. Also, the casual management is simply prepare the ridges, sprinkle the seed and come back and harvest. The result is fairly low yields per hectare, most likely less than a ton, but fairly high returns to labor, and farmers are far more interested in their returns to their labor than to their land. However, the fields tend to be very small in the order of 0.25 ha or smaller, that

Fig. 36. Casually managed sesame field, with sesame grown on ridges with too dense a canopy to effectively hand weed.

would result in only one or two bags being marketed by individual farmers. This could rapidly change in areas if a major processing facility was established. But this would be in a restricted area that could economically reach the processing facility. Still given the manner in which it is grown it would most likely remain a small acreage crop to each individual producer. As with sorghum and cowpeas sesame is marketed as seed with no farm level processing.

In Nigeria there is no research on sesame, neither variety improvement nor other aspects. Thus the seed is left to that retained within the communities. The owner of one seed producing company, Seed Product, Ltd. was planning to travel to Sudan to get an improved variety for seed production and distribution.

Facilitating Value Chains

To facilitate the smallholder producers with their value chain enterprises there are several entities that work closely with them in providing essential support services that allow the producers to concentrate of their crop husbandry, leading to higher yields or better quality. Chief among these support service providers are the Community Based Family Enterprises (CBFE) as alluded to previously.

Community Based Family Enterprises

Community based family enterprises are those small enterprises that are indigenous to most smallholder communities. They are usually owned and managed by an individual family, since for some reason businesses in most developing countries have difficulty expanding beyond a single family operation, assisted as needed by causal laborers on a piece meal basis. Many of CBFE proprietors are former farmers that, for any of a variety of reason, have drifted out of full time farming and into support services. Also, many remain part time farmers and part time service providers. Since CBFEs are indigenous to the community they have long term vested interest in both remaining members of the community in good standing with their neighbors and remaining in business. They also deal with farmers as individuals respecting them as the individual entrepreneurs they are, and not trying to force them to some form of communal farmers as in the cooperative model. That means they have to offer their services at prices the community can afford, and under the general economic conditions mentioned at the beginning of this report that means their profit margins are limited, particularly when operating in remote areas where off tarmac transport cost can be triple the tarmac rates. It also means that the relation between the CBFEs and smallholder producers is far more symbiotic, with each equally dependent upon the other, than a predator-prey as is often envisioned. To the extent the relationship between producers and CBFEs is symbiotic, innovation that assist one can quickly impact on the other. Thus if the farmers are already overextended with their labor and energy as mentioned at the beginning of this report, the most effective way to assist them could be indirectly through the CBFEs providing support services, that will allow the farmers to spend more time managing their crops, increasing their production and net revenues.

The CBFEs enjoy the private sector business efficiency that allows them to almost invariable offer farmers the best financial deal available to them, even better than a farmer cooperative with their normally cumbersome business plan resulting in high sustainable overhead costs. They normally have the majority market of any support service they provide even when competing with a development project sponsored cooperative. They will have 100% share of

the independent producers plus all the side selling from the cooperative that is often over 50%.

Agro-Dealers: The primary examples of CBFEs are the agro-dealers though which WASA/Seeds are working, for distribution of "certified" seed from the seed companies. Unfortunately, in Nigeria with the government distributing fertilizer and subsidized seed the agro-dealers are virtually restricted to dealing with agro-chemicals such as insecticides, herbicides and fungicides (Fig. 37). They also dapple in black-market fertilizer and informal seeds without any variety distinction. In other countries such as Malawi, where CNFA also supports an agro-dealer program in support of value chain enterprises, the agro-dealers deal in the full range of inputs, including seed, fertilizer, and chemicals (Fig. 38) as well as being involved in the marketing with a possible particular demand to be representatives of small processors that would qualify as SMEs. This would be a good model for Nigeria to follow, and promote a wider involvement of the agro-dealers as the primary link between value chain producers and input supplies or market opportunity.

Fig. 37. Small cramped Nigerian registered agro-dealer handling mostly agro-chemicals and some informal seed, but not fertilizer or certified seed, nor commodity procurement.

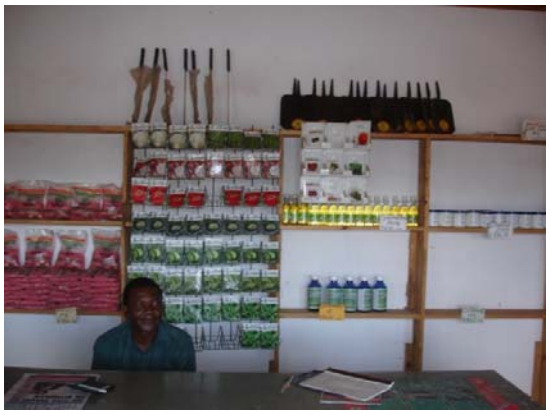

Fig. 38. CNFA sponsored agro-dealer in Malawi dealing in the full range of agro-inputs as well as purchasing and consolidating various produce from the farmers. This is actually a women owned and operated but assisted by her husband included in the photo.

For those agro-dealers who have land and continue to do some farming, they could become more involved in final seed multiplication and distribution to their community members. There may also be a good demand in representing SMEs such as Convenient Home Foods & Beverages and address the issue of deliberated included in bags of produce. It seems that the commodity buyers anticipate some 15% trash in the form of chaff, empty grains, straw, and stones and clods in a 100 kg bag of produce, and discount the price accordingly, including the extra costs associated with removing the trash. This was mentioned by Convenient Home Food & Beverages as well as by one of the ADP in the south. Thus, it is apparently a common practice in several African countries such as Tanzania where it is often associated with the in-kind informal loan repayments. As such it provides an unenforceable discount on the 100% nominal informal seasonal interest rates, and has to be anticipated in setting the apparent outrageous interest rate. Having 15% trash in a bag of produce requires additional labor and processing expense to rewinnow the produce and remove the trash, before the produce can be used. When included in informal loans the extra costs contribute to the apparent excessive interest rates. Intentional inclusion of trash in closed bags of rice also occurs in Ghana.

This could be a major intervention opportunity for WASA/Seeds. WASA/Seeds could assist the agro-dealers facilitating the MARKETS value chain to serve as buyer representative for some of the SMEs processors. The agro-dealers could arrange to purchase produce from the farmers within their community, make certain the produce is free of trash, and develop the trust with the processor that the goods are clean and command full price for the 100 kg bag, at a saving to processor and possible better price that can be passed on to the farmers when they deliver the produce to the dealer. This linkage is something WASA/Seeds or other part of the MARKETS project could facilitate. The agro-dealer network can most likely easily corner the market from the administratively far more cumbersome cooperative system MARKETS envisions serving as the primary marketing path for the value chain members. This could be a win-win situation all the way around. It would also be consistent with an overall financial management strategy of holding assets in kind as long as possible and market small quantities perhaps only 15 to 20 kgs over a prolonged period to meet immediate cash needs as was identified in Malawi.

Value added Processors: Another form of CBFE that appear to be rapidly expanding in Nigeria is the local value added processors that convert cassava to garri or parboil and mill rice. Since these are within the community any value added they generate will remain within the community. With the case of both garri making and parboiling of rice, the time and effort involved with the value added processing could make it more conducive for CBFEs than direct farmer involved. Involving farmers and spouses needs to be done with a very careful evaluation of what their opportunities are for increasing production on the value chain enterprise or any other enterprise they may be involved with. It may also be possible for individuals to have a hybrid involvement by concentrating on farm activities and do casual work with the value added enterprise when there is some slack in the farm field work, as a couple was doing at one of the rice processing facilities visited. These could be very astute business decisions maximizing income opportunities on virtually a daily basis, without any commitment to one activity other than the value chain enterprise.

It should be carefully noted that the farmers are not interested in maximize their returns from any individual farm or community enterprise, but maximizing their returns to all enterprises including casual labor opportunities, be that a targeted value chain enterprise, other farm enterprise both crop and animal, and off-farm casual labor opportunities. They will thus deliberately reduce the level of management on one enterprise to enhance the returns to another and actually can make some very intuitive but astute economic decisions in doing so, no calculator, computer or linear programs involved.

As mentioned before this could be a good intervention opportunity for WASA/Seeds or MARKETS to work with individuals in developing viable business models for post harvest processing of cassava, rice or other value chain enterprise, and then assist the individual in getting any funding they might require.

Contract Mechanization: Another CBFE that is often overlooked, if not completely dismissed, by the development community but could be critical to promoting value chain enterprises, is providing access, in contrast to ownership, of individually privately owned tractors for initial land preparation and perhaps some transport. It would also apply to any small combines suggested to reduce the stones and clod going through the rice processing. This is really the unrecognized reason for the success of the green revolution in Asia, as concurrent with the development of the HYV of rice and supporting technologies by IRRI, smallholder rice farmers, at their own expense, converted from water buffalo to rice power

tillers. This reduced the time needed for basic land preparation and crop establishment by 50% and allowed a much greater percent of the rice lands to be planted in a sufficiently timely manner to benefit from the green revolution technology. However, very rarely will this be acknowledged in promoting the green revolution success in Asia or the current effort to establish the green revolution in Africa.

For Africa the access to contract tractors for basic land preparation is slowly taking place. In the farmer visits the only farmer questioned acknowledge using a Fiat from the village at ₦5,000 (US$33) /ha. (Fig. 39), about the same as in the USA. This is about the same as it is in the USA. Like their compatriots in Asia this is being done without assistance from the development community, and might represent a lost opportunity for what might be an exceptionally effective project. Instead the development community tends to dismiss the idea of mechanization as beyond the capacity of smallholder and smallholder communities to manage. It is not certain how the development community figures all those stationary diesel engines powering all that processing equipment the CBFEs are using for value added to the value chains are maintained, or all the lorries plying the highway and byways are maintained. In reality the diesel engines in lorries are the same as in tractors, just with a different gear ratio. Perhaps the development community is recalling some of the early experience with public sector mechanization units.

Fig. 39. Private Fiat tractor available for custom contracting to smallholders and slowly becoming popular through much of Africa outside the development communities efforts.

These were total disasters, but they represent a government owned public sector involvement and not private individual ownership. Under public management tractors are lucky to get only 3000 of the 10,000 designed service life[9]. In Nigeria the ADPs do sponsor mechanizations unit (Fig. 40). Hopefully, they will be more successful than the earlier experience. However, the number of tractors at each ADP is barely sufficient to provide service to the political establishment that usually gets first priority, before any smallholders and cannot be counted for assisting any MARKETS value chain enterprises. In contrast, under individual private ownership tractors will most likely exceed the 10,000 service hours. This is easily noted through the Middle East, including Egypt, Pakistan, Iraq, Afghanistan, etc. where most of the land preparation is done by 65 hp tractors the most popular of which are the Massey Ferguson 165.

Fig. 40. Mechanization Unit at one ADP with tractors lined up but exposed to the weather, and with only about 400 hours on the meters.

[9] Personal Communication, Hershel Weeks, Iraq, INMA Project

For Africa with it primarily manual agriculture, contract mechanization is perhaps the only means of the substantially overcoming the possible 60% calorie deficit between the 2000 calories farmers may have access to and the 50000 calories they may require if they are expected to put in a full day effort undertaking a value chain enterprise as discussed at the beginning of this report. It may also represent the only means to increase the area being cultivated so the targeted value chain enterprises represent an expansion in area cultivated and not a substitute of one crop for another.

This could again be an opportunity for MARKETS to intervene with enhanced access to equipment and perhaps use some micro finance to help community members finance tractors or combines, etc.

Other CBFEs: In addition to the CBFEs listed above, there are others such as the maize mills that have virtually eliminated the time and effort women are required to devote to pounding maize across Africa (Fig. 41). In Nigeria the only pounding by women is pounding yams. The maize mills have substantially reduced domestic drudgery, providing spouses more time and energy for assisting with other activities including value chain enterprises. In addition there the small shops or kiosks (Fig. 42) that provide community members with the goods they cannot produce, and effectively saving the farmers the time to go and obtain such goods and services from large towns and cities.

Fig. 41. Community based private grain mill relieving much of the domestic drudgery of pounding and freeing women for other activities including assisting with value chain enterprises. The photo contains both rice and maize mills.

Fig.42. Small community kiosks in Zambia providing needed goods for community members so they don't have to make extra trips to town.

Assisting CBFEs: To the extent CBFEs are effectively facilitating the MARKETS targeted value chain enterprises, WASA/Seeds and MARKETS should assist them with their business model, and finding the funding to assist in making them viable businesses. The garri processor going into business close to the mostly defunct women's income generating club would be a good example where a investment would mostly likely pay off. Such funding might be found by developing links to Kiva and the loans they are generating to promote private enterprises in developing countries. Kiva loans usually require some NGO sponsor such as ACDI/VOCA but it could just as well be WASA/Seeds. Kiva is active in Nigeria but mostly in the south and facilitated by Lift Above Poverty Organization (LAPO).

Cooperatives

The alternative to the CBFEs is the cooperative model. This has been the development community's primary means of supporting smallholders for over 20 years. Socially they represent the ideal support system with the members' ownership and participatory management. However, these social ideals come at considerable costs in terms of a cumbersome business model requiring considerable time and effort on the part of the management, which quickly translates into overhead expenses that in order to be sustainable beyond donor assistance has to be recovered from the overhead costs or other charges to the members for services provided. Thus, in the economic environment outlined at the beginning of this report, in which consumer prices are a fraction of the USA prices, and private sector profit margins are limited, is the cooperative business model competitive compared to the competing private traders as discussed above[10]? Unfortunately, for the most part the cooperative business model is not competitive and vast majority of those introduced as part of development projects collapse as soon as donor funding and external facilitation ends. This was no better illustrated than the locked up FAO women's income generation cassava processing facility with the family enterprise 100 m away operating at full capacity (Fig.14 &16).

Host governments tend to promote the cooperative model, but this might be more as a means of supervising farmers than facilitating their needs. It is also why working through government agencies such as ADPs could provide a distorted sampling of farmers as ADP will most like direct WASA/Seeds to their members when as estimated by one ADP their members constitute only 5% of the farm population with 95% being independent. WASA/Seeds needs better representation of the total farm population.

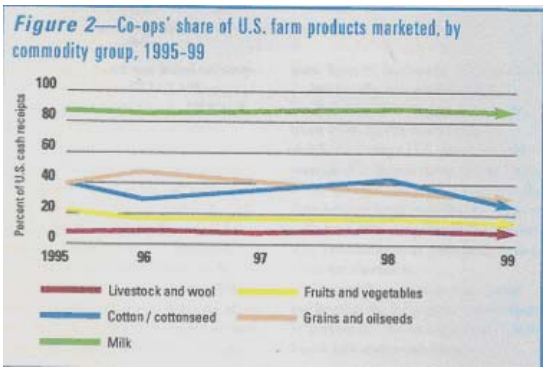

Fig. 43. Declining market share of cooperatives in the USA. Source: Rural Cooperative Magazine, Jan.-Feb. 2001.

Even in the USA the cooperative system is only marginally competitive with many cooperatives collapsing shortly after stating up. In the USA the agriculture cooperative system has been in slow decline in both members and market share for considerable time to the extent the USDA no longer track the membership or market share with the most recent data 10 years old. At that time market share was falling below 30%, with only the dairy cooperative having a majority share (Fig. 43), and even members were diverting business away from their cooperative to receive a better price from private dealers. Even though only marginally competitive in the USA, when moved to developing countries as part of development projects the cooperative model is substantially modified away from efficient management, most noticeable by including cub based credit programs.

The cooperative model is continually promoted in the development community by some questionable, highly non-objective procedures that could provide substantial exposure to civil action. First among these is frequent but not always vilification of the competing private traders including some of the CBFE discussed above, as being greedy and arbitrarily fixing

[10] *http://lamar.colostate.edu/~rtinsley/Cooperatives.htm*

prices, etc. This could easily have been promoted by host governments in an effort to promote their public sector institutions that have long been discredited as ineffective. However, if such comments cannot be substantiated they would constitute slander and exposure to civil action if someone chose to organize the private traders and file class action law suits possible in Washington, where most RFPs containing vilifying remarks originate. Many of the private traders can have such a small market volume that a 60% mark-up will still leave them impoverished (Fig. 44)[11].

Fig 44. Private plantain trader in Uganda who spent 14 hours covered 40 km twice to procure 100 kg of plantains which he hopes to mark-up 60% so he can earn $6.00 to support his family of six on the edge of poverty.

Second would be some deceptive, bordering on dishonest, reporting practices in progress report and periodical articles. Most common is overlooking the overhead costs of operating the cooperative, or at least the sustainable overhead costs, disaggregated from the facilitation costs, that would assure the cooperative could survive beyond donor assistance and external facilitation. When those overhead costs are projected as a financial benefit to the smallholders that they will never see without a donor subside, deceptive reporting becomes dishonest reporting, and that carries legal exposure. Overhead costs for operating a cooperative typically run around 30% and provide private traders amble room to compete to the financial benefit of the smallholders they serve. The total list of items that are often omitted from reports on cooperatives that would provide a indication of the potential for the cooperative to continue serving its member after donor funding and external facilitation have ended as usually clearly implied in the RFP and Proposals developed from the RFPs are:

- Clear auditable costs of doing business comparison between the cooperative and competing private traders.
- The sustainable overhead costs to operate the cooperative
- The membership in the cooperative as a percent of the beneficiary pool
- The extent of side selling of goods and services contracted for marketing through the cooperative that are diverted to the private traders. However, avoid the proxy for side selling that condemns the farmers for not honoring their contract obligations, when they are making an astute business decision to take their business elsewhere. This is an interesting ploy that effectively tries to blame the farmers for avoiding what is basically a horrendous business model.
- The total market share the cooperative generates
- Payment or projected payments of promised dividend, and dividends defined in the normal business term, not distorted, as sometime occurs.

In addition to the reporting concerns mentioned above the cooperative model emphasis on consignment purchase usually goes against the smallholder members desire for immediate cash payments and desire to retain assets in kind as long as possible.

[11] *http://lamar.colostate.edu/~rtinsley/BananaTrader.htm*

In the end it might be better simply to work with the CBFEs from the beginning as when donor funding and external facilitation end, and the cooperative collapses, the CBFEs are the default providers effectively assisting the smallholders. After all they have been handling the bulk of the business while the cooperative was operating. Meanwhile, the continued emphasis on the cooperative model really represents a much higher overall commitment by the donor community to the means for assisting the smallholders than to the beneficiaries, and it is time to return the commitment to effectively serving the beneficiaries on their business terms.

Small & Medium Enterprise (SME) Processors

One item that WASA/Seeds and MARKETS might want to take a closer look at would be the Small & Medium Enterprise (SME) processors that are again usually family owned but not necessarily in the smallholder communities based. They are in the business of converting value chain produce into value added goods, if not directly to consumer products. Only one SME Processor was visited but it should be an example for others. The company was Convenient Home Foods & Beverages Ltd. in Kano. The company is in the business of flouring and blending cassava, sorghum, cowpea, baobab leaves, KCl. That actually covers three of the five targeted value chains. This is all blended into a flour known as Danwake Flour (Fig. 45) that is then mixed in water to form a heavy paste, molded into balls and boiled in water. It is a specialty food consumed fairly regularly. The company operates from a simple building that contains a small warehouse and the necessary grinding and blending equipment as well as the heat sealer to seal the flour into plastic bags (Fig 46).

Fig 45. Danwake Flour manufactured by a SME processor as an example of links WASA/Seeds could facilitate between producer communities and small processors.

Fig. 46. The grinding and blending manufacturing equipment for Convenient Home Foods & Beverages Ltd.

Another possible short and medium term interventions for WASA/Seeds and MARKETS could assist identify SME needing targeted value chain products and link these companies to appropriate agro-dealers who could assist in the procurement of ingredients more directly from the farmers. The need for such purchasing representation was mentioned as currently all ingredients are purchased on the open market, although clearly in need of more volume than normally sold in the open market. Also, the owner was the first person to mention the problem of too much trash in the bags that forced him to automatically discount what he paid to cover the amount of trash and the costs of removing it. A contract with a purchasing agro-dealer including a possible commodity purchasing float could allow the agro-dealer to more carefully supervise the collection to minimize the trash, pay a higher price to the farmer and

save the processor the extra cost of cleaning the material. That should be a win all the way around.

In working with the SME processors where financing is an issue, it might be possible to work through the KIVA small enterprise loan system with WASA/Seeds or MARKETS serving as a sponsor.

Disseminating Information To Smallholder Communities

With the government agriculture support programs financially stalled, it appears that one of the major innovations for WASA/Seeds will be informing the smallholder value chain entrepreneurs what improved seed sources are available and from where they can be obtained. This could be one of the more challenging and perhaps full time tasks for WASA/Seeds. Normally, information dissemination is the task of the extensions program. However, of all the agriculture support services the extension program is perhaps most affected by the overall financial stalling of the government. Thus there may need to be some major rethinking of the approach to getting information to smallholder communities. The traditional demonstration approach as envisioned in the T&V (Training & Visit, aka Talk & Vanish) system under its original definition, introduced by the World Bank several decades ago, really cannot be implemented or sustained over an entire country such as Nigeria, or most African countries.

The main question is, "is it really necessary to have an extension system that requires a clearly defined administrative link to each and every smallholder as implied with the T&V?" This is really based on the USA system when the extension service was introduced over 90 years ago. At that time most USA farmers lived on isolated homesteads and not in villages as is common in most developing countries such as Nigeria. When living in villages there tends to be considerable more internal communication and observation of neighbor's fields. Thus that individual link may not be as essential. Actually, about 35 years ago there was an article published, the exact reference is lost, but the content claimed that in smallholder communities it only takes one innovative person to make and maintain a community dynamic, and usually there was such a person in a community. This person could be a community leader, a community eccentric, or even an agro-dealer with a vested interest in finding new business opportunities. The example in the field visits was the farmer who brought back the Cameroon rice variety after a farmer exchange program or the individual who went directly to IITA to obtain fresh cassava cuttings. Thus, in the age of TV, the Internet, cell phones and other mass media how effectively can the mass media be used to convey information such as what improved lines of targeted value chain crops and where small amounts of seed or cuttings can be obtain to start the multiplication process. Then let the community innovators proceed to investigate, obtain the seeds, produce it for their own use. Within a generation or two it will be disseminated through their community, to the extent it is appreciated by the community members.

In Benue the ADP mentioned an NGO interested in reviving a radio extension program. This could be an effective method for WASA/Seeds to investigate. However, this could only involve government released varieties. On a more informal side, most of the seed producers, SME processors have email address, if not websites, and most likely the agro dealers or perhaps their children are becoming progressively more computer and Internet literate. Thus, with a little facilitation from WASA/Seeds email list servers and Internet websites could be a means of communicating with the agro dealers, seed companies and processors on what genetic material is available and where it can be obtained as well as which processor needs

what commodity. For seeds this could be a major concern for sorghum, where there appears to be improved varieties in the country, but the farmers are completely unaware of them. It would also apply to cassava and cowpeas. This again could be short to intermediate innovation by WASA/Seeds including hiring a full time staff for information services, and allow WASA/Seeds to quietly operate around the government.

Summary

The consultancy looked at a combination of post harvest handling and maintaining seed for replanting and the post harvest processing of produce for value added on the five MARKET value chain crops of cassava, rice, sorghum, cowpea and sesame.

With the government variety evaluation and seed management program completely underfunded to be virtually a phantom program, on paper only, the smallholders are really left to fend for themselves. Thus virtually 95% of all seed is retained from one crop to the next with no influx of new material. This has ultimately resulted in complete variety identification being lost. The only exception is rice where farmers continue to recognize varieties, including some informally acquired varieties from a farmer exchange program with Cameroon. To assure smallholder farmers get fresh genetic material of the five targeted value chain crops WASA/Seeds will need to work around the government and develop links between the IARCs that are involved in the different variety improvement effort, the seed companies particularly the smaller seed companies like Seed Project. Ltd and Alheri Seed Nigeria Ltd. to take material from the IARCs increase it and pack it into small kits of several lines that can then be sold into the agro-dealer network for multiplication and distribution to the farmers. It might take three or four generations but this genetic pump could easily blanket an area with new improved material. In implementing a program like this WASA/Seeds should closely look at the internet and email list servers to communicate with IARCs, seed companies and agro-dealers, all of whom already appear to be connected.

As for post harvest processing only two of the value chain crops have extensive value added post harvest processing that can be done at the producer community level. These are processing fresh perishable cassava into less perishable garri, and parboiling and milling of rice. Both of these are fairly time consuming practices. There are some capital costs for cassava in terms of shredders, hydraulic presses and “fryers”. For rice even more so as it requires vats for parboiling, mats for drying, and most of all mills and destoners with associated power supply, usually a standalone diesel engines. Since individual smallholder cannot justify this for themselves, the question what is the most beneficial way for this to be done within a community? Since smallholders tend to be overextended with the crop management any time committed to value added such as making garri has an opportunity costs in terms of increased crop production, be that targeted value chain crops or other crops in the farm enterprise system. For this reason the trend for cassava processing to garri is with Community Based Family Enterprises that are specializing in garri making. This is an opportunity for MARKETS to intervene to facilitate the process by working with individuals interested in going into the business with good business plans and access to the credit needed

for acquiring the necessary shredder with power source, press and “fryers”. Since women traditional do the garri making this is also an opportunity to promote women as the proprietors.

For rice the processing is well established, but there are still some opportunities for MARKETS to have some interventions. First among these would be upgrading most of what looks like highly antedated diesel engines and mills. However, the parboiling process has toughen the rice grain sufficiently so crude mills are doing an acceptable job. Other areas would be reducing the amount of stones that need to be removed. This is really an on-farm harvesting practice that may require the introduction of small contract combines. The other possibility would be winnowing machines to reduce the amount of time women are spending on winnowing the different stages of the process including post milling.

Sorghum, cowpeas, and sesame move up the value chain as grain and thus there is little if any post harvest processing. However, in moving up the value chain it has apparently become a tradition of sorts in Nigeria as well as other countries in Africa to deliberately or semi-deliberately include about 15% trash in the bags of product. The traders anticipate this and discount the bags for it. Thus, WASA/Seeds could work with some SME processors such as Convenient Home Foods & Beverages and agro-dealers, interesting in expanding their business from providing inputs to including commodity trading, to become purchasing representatives to procure commodities from the producers, make certain it is trash free and move this on to the SME processors.

All of this may result in a more community based program that considers value chain producers in a symbiotic relation with the different service providers forming the CBFEs.

Appendix

Nigeria Activity Log

Mon. 7 Sept.	Departed Fort Collins 6:00 am for Abuja, Nigeria
Tue. 8 Sept.	Arrived Abuja, Nigeria at 8:30 pm, checked in to the Valencia hotel
Wed. 9 Sept.	Initial meeting with WASA team and briefing on program by Banji Olarewaju and Ebenezer Aje. Started drafting notes for collecting information.
Thur. 10 Sept.	Continued drafting notes and made arrangements for travel to Kano.
Fri. 11 Sept.	Continued working on peripheral information, and drafting notes for future use
Sat. 12 Sept.	Worked around hotel helping Benj and Ebenezer make last minute preparation and budget for a training program.
Sun. 13 Sept.	Traveled to Keno and checked into Tahir Guest Palace
Mon. 14 Sept.	Met with Samuel Makinde & Christian Akpotor for substance discussion on program and allow them to put together a schedule. Also, made major effort to address banking problems without success. Some work still needs to be done.
Tue. 15 Sept.	Full day in field. First meeting was the office of M.L. Gwadabe president of the Seed Project Co. Ltd. He was in the commercial seed business. Claimed most of his profit came from vegetable seed which were imported in small packets, including some from Viet Nam. Mentioned that limited profit from agronomy crops because of retained or market seeds. Was interested in doing some certified seed production through either his 10 ha farm or out grower contractors. Also, mentioned that virtually no breeding or varietal improvement programs within the government, basically program financially stalled. What new material that was coming available was mostly via the CGIAR centers with Cowpeas coming directly from IITA that is headquartered in Nigeria, sorghum from ICRISAT, and rice from WARDA. Also, IITA provided fresh cutting of cassava but there was no seed distribution. There was no official government mandated source of new genetic material for sesame. It was all retained or individually imported from countries such as Sudan.

Afternoon was spent visiting Mr. Gwadabe's farm and surrounding contract farmers. This turned out to be a combination of looking at different demonstrations, screening and seed increase fields for certification. The fields looked ok. They were all rainfed and thus there was considerable within field variation that could make it difficult to effectively rouge out some of the off types. They did review the official certification process as a three stage visit. One to check on isolation, two to evaluate the removal of off types and three visible quality including moisture and germination. In also included a couple of F2 generation hybrid sorghum plots that were being grown out for fodder production.

Did stop by what was possible a government seed processing facility but no one was available to discuss and tour the facility. It looked like a lot of equipment, mostly for rice, but not certain if the equipment was operational. Did not look like as if it had been used in some time, perhaps years?

Wed. 16 Sept

Spent the morning in the office, while Sammy and Chris prepared for a pre-scheduled training program. Afternoon, visited the USAID Markets Program coordinator Ahman Markarfi and Abbas Sheriff. The markets program is basically an input supply program aimed to provide quality seed, fertilizer and crop protection materials to smallholder though a series of agro-dealers, etc. These are all crop specific aimed at targeted value chains. There was no concern in looking at marketing of farmer produce to fit into the value chain link to the processor. This was left to the cooperative system for which I render my normal opinion as a scandal.

Second afternoon visit was to Yahaya Yakasai of Convenient Home Foods & Beverages Ltd. He was a small entrepreneur involved in making a ready mix flour of cassava, cowpea, sorghum, balboa leaves and KCl. The latter was mostly for adhesion. The flour was then to be mixed with hot water into a paste that would be made into balls for boiling in water for 15 minutes. Sample of the flour were provided for later use. It was an interesting small enterprise fully contained. He had is owned grinding and blending equipment for post harvest processing. He purchased his raw material directly from the market as it was available. He would be interested in a more direct link to the farmers as offered by an agro dealer representative.

Thur. 17 Sept

Chris was tied up with training program so Sammy and I went to Zaria to visit two seed dealers, one modest and one large. The first one was Alheri Seeds Ltd and Steve Yakubu Atar. He provided and interesting discussion on small scale seed production mostly via out growers.

Mentioned certification was for only a nominal ₦ 100/field. That would not even cover the cost of visiting the field let alone the libratory and paper work costs. He did mention a problem with pirates using counterfeit labels for inferior quality material. He also mentioned limited demand and need to carefully balance production with demand or he would have to recall a large percent of his material and hold it for next season. Acknowledge he really stayed in business largely from government contract for seed under any of several subsidized seed distribution programs to farmers.

Second visit was with Premier Seeds Nigeria and A. Ogungbile and Olumide Hikunle. This was one of the largest seed companies in Nigeria that appears to be an outgrowth of Pioneer Seeds in the US. As such there major concern was production of hybrid maize for which they had their own research and development staff. This is consistent with the US seed industry where hybrid crop development is mostly handled by the private sector while the States concentrate on the self-pollinated crops such as wheat. They were involved with sorghum, cowpeas and rice. Again most of the production was though out growers. They were concerned with the self-pollinated crops that the informal retention and distribution was resulting in some 30% of their seed having to be recalled at the end of the planting season, reprocessed including additional germination test before it could be reintroduced the following year. They were also concerned with pirating of their label and selling junk material giving them a bad name. This is really a legal problem both from a prosecution and civil concern but the legal system to pursue this is very weak and ineffective.

Fri. 18 Sept	Spent the day around the office working on notes and communications.
Sat. 19 Sept	Accompanied Chris for a training program for agro dealers on plant protection safety, etc. After which we stopped by rice processing areas to see the quality of rice plus the par-boiling process. They only used one mill to mill raw rice, par-boiled rice and maize. The result was reasonable quality milling of par-boiled but mostly broken for raw rice.
Sun. 20 Sept	Day off and first Ramadan Eid day, remained in Hotel developing report
Mon. 21 Sept	Second day of Ramadan Eid, National Holiday, remained in hotel working on report.
Tue. 22 Sept	Third day of Ramadan Eid, National Holiday, remained in hotel working on report, and made arrangements for traveling to Abuja on Wednesday and on to Benue on Thursday.

Wed. 23 Sept	Since project vehicle was traveling to Abuja on Thursday, it was recommended I join the vehicle also, funding for Jerome was not finalized so still impossible to move on to Benue. Thus I remained in Kano. Did get a chance to visit the market and get the consumer prices.
Thur. 24 Sept.	We were supposed to move early in the morning to Abuja with project vehicle but delayed various administrative processes until after 2:00 in the afternoon mandating an after dark arrival. Virtually the whole week is lost. Finally, I quickly arranged to fly to Abuja on the evening flight, and return to Valencia hotel.
Fri. 25 Sept	In office in Abuja coordinating with Jerome on how to travel to the southern areas with departure Monday by project vehicle if insurance is done or by private car if not. Continued drafting report.
Sat. 26 Sept	I remained and worked in hotel with Benji trying to determine status of vehicle insurance and other items.
Sun 27 Sept	Day off but remained in hotel doing what was possible for report and collecting data from internet.
Mon. 28 Sep.	Reclaimed my credit card from ATM, spent morning in the office making final arrangements to travel to Makurdi, Benue state and travelled to Benue. Made initial meeting with Dr. Egbo, Program Manager ADP In the evening met with the hotel manager who was also a cassava and yam producer and provided considerable insight into her farming operation and lack of turnover in varieties for an estimated 20 years.
Tue. 29 Sept	Returned to ADP for extensive meeting with Fidelis Akosu a retired senior agriculture officer, recalled for consulting, but also a large rice and cowpea producer who is an unregistered seed producer. He provided considerable insight on the official agencies involved with seed, and some of the concerns with quality in marketed grains, either seed or grain. It appears buyers are anticipating some 15% junk, and that is what they get. He also indicated that his former links to government provide informal links to new germ plasma coming into the country from the various IARCs represented in the country. This he then proceed to multiply for his and his clients benefit. Next meet with three extension agents from the different zones but this was mostly for Jerome to get the farmers registered for his up-coming training demonstrations of post harvest handling of grain. They had little insight into any seed dealers or processors, but referred back to Mr. Akosu.

Returned in the afternoon to impose on Mr. Akosu for tomorrow visits to his contract in seed and processing for rice, sesame and cassava.

Wed. 30 Sept. Return to Mr. Akosu but he was unable to arrange to meet with Olim the main rice processors even though they were part of USAID/MARKETS project. However, did get a good look at cassava processing, first by a women's cooperative that looked mostly abandoned then only 100 m away a small family enterprise that had all the equipment and was full of activity. He was producing cassava but also buying additional cassava to process as well as having a rice mill for parboiled rice. Good example of one of my Community Based Family Enterprises.

Afternoon returned to the hotel and worked on the report, and prepared to move on to the next state despite finding out that not only was tomorrow national day but Friday as also been declared a National holiday.

Thur. 1 Oct. Proceeded to Enugu with minor incident when driver went wrong way around roundabout and clipped motorcycle, injuring one of the riders. Enugu was a compromise location between the next two states to visit, each about a hour away. We met with a contact friend of Jerome who then guided us in right people to contact in Abakaliki.

Fri. 2 Oct. Proceeded to Abakaliki, Ebonyi and meet with the ADP Program Manager, Mr. Sunday Ituma, for a good interview on seed and problems of the seed industry. Did see some rice seed from Olam, the organization we were unable to visit. The 250 bags were not labeled as to variety. These were certified seed purchased by the Federal Government for distribution to the farmers at a subsidized rate, but only 10% was actually sold because it arrived too late as most farmers had already planted.

Proceeded to visit a rice processing community. It was operationally similar to what was in Kano, but on substantially larger scale. Still the operation was mostly broken down to small individual operations. It did include some destoning equipment, and larger mills more like what was used in Madibira. They were powered by belt drives from some very old diesel engines with exposed valves and looked like they should have been in a museum. It looked like there were four separate operations with clean sales and change of ownership between them. These were the producers who would sell to the par-boilers who would sell to the millers who would sell to the wholesale dealers.

Returned to the ADP and visited a cassava variety demonstration just to get an idea of what to look for in separating cassava varieties.

Basically, it was the color of the stems, the number of leaflets per leaf, and flowering. Also, looked at some cassava mosaic screening, and remembered it could be a big problem and require a variety change if an infestation became too big as the only cure for viruses is variety resistance.

Sat. 3 Oct. Returned to Enugu for two nights with the expectation of taking time off on Sunday by remaining in the hotel to work on reports before proceeding to the third southern state on Monday. Did stop at a market to see if there were any agro-inputs available but found none. However, did run into a women selling rice that had seen us the day before visiting the rice processing area. Big problem with AWOA responses so couldn't really determine what was going on.

En route did try to read all road signs and shop signs looking for some type of agro-dealerships or other inputs, but found none. Very surprising!

Sun. 4 Oct. Remained in Enugu as rest day, but continued working on report.

Mon. 5 Oct. Proceeded to Awka, Amambra state and meet with the Program Manager, Mr. Imoka Leo, and members of his staff, including Nwenkwo Linus, Daniel Odoemenan and Robin Nnanwube. Made arrangements for the specialist on cassava and rice to accompany us tomorrow for field visits to a rice producing and cassava producing area. The latter to involve some contact farmers who were provided some selected cutting of new cassava lines. There were actually 15 groups of farmers representing 15 communities with perhaps 20 farmers per group. Net result would be limited distribution.

Tue. 6 Oct Responded to request for courtesy meeting with the agriculture commissioner at 10:00, but did not meet until after 11:00. Thus instead of going to the field at 9:00 could not depart until 11:30. However, did get to look at some rice fields and noticed they were just heading and thus a week or two too early to determine degree of off types that would indicated genetic purity. Also observed some cassava and cassava/yam mounds.

Then we proceeded to a processing facility that was private and available for custom processing rice or cassava to milled rice or gurri. Not much activity, just some people pealing cassava for processing. Did run into a couple cassava farmers cum processors. They mentioned the use of IITA improved lines that apparently they had obtained on their own directly from IITA. However, they mentioned the IITA material was considerable better for making cassava four than Gurri.

Finally, we proceeded to a rice processing facility. It again appeared private and operating on custom in which people brought their rice, had it parboiled and milled before selling it or taking it back home. It did appear they were processing new rice although we had not seen any freshly harvested fields or any approaching maturity. Did talk to some farmers and they indicated they grew up to five different varieties, similar to Madibira. Two of these varieties were unknown to our ADP representatives. One was called Cameroon and appears an informal leak from Cameroon similar to Zambia was in Madibira. Thus there appears to be several informal rice varieties floating around and an indication of some informal farmer to farmer communications, across borders.

Wed. 7 Oct — All day travel to final state of Kwara, arriving after dark due the road being plugged for a couple hours and having to wait until it unstacked. Meet the WASA/Seeds pickup at filling station so we could provide it with gas, about 39 km from destination. Dismissed hired vehicle to return early morning to Abuja.

Thur. 8 Oct. — Meet with Ahmed Mohamad, Assistant Managing Director for Admin & Training of ADP, who guided us to several staff to arrange field visits for that afternoon and Friday. Afternoon field visit was with Hajia A.K Ahmen the women in Agriculture officer and visited women cooperative making gurri. Very busy with almost all phases visible including the “frying” which we had missed on other occasions. Missed out on seeing Sweet potatoes processing that the WIA leader hoped to show us.

Fri. 9 Oct. — Field visit to see if we could catch up on crops not seen before. Thus, we asked to emphasis sorghum, cowpea and sesame. This we succeeded in doing but only photos for cowpea and sesame as the farmers were not available. However, we did get some local processing of cowpea to a leaf wrapped and cooked bean paste. The cowpeas were brown instead of white as we had previously seen. There did not appear any variety identity of the cowpeas. The sesame was one field in flower but confirmed the idea that is was mostly a casual crop that was planted and harvested with no intermediate management. Thus yield per unit of land might be low, but yield per unit of labor might be high.

Finally did get to look at some sorghum. This was surprisingly tall, over three meters and very irregular. The only variety distinction was the color of the seed. It was listed as a local variety and the farmers had no idea of any perspective improved varieties and no variety improvement of sorghum was being undertaken by the ADP. We did

	talk with one farmer who acknowledge the availability of a Fiat tractor for contract use at ₦5000/ac. That about conclude the field visits return to hotel to find no power until 7:00 that evening, then a disco all night.
Sat. 10 Oct	All day drive back to Abuja, arriving in evening to find no hotel reservation and having to shift to Rockview hotel for one night, but was ultimately extended to Thursday.
Sun. 11 Oct	Remained in hotel working on reports and clearing accounts
Mon, 12 Oct	Work in office on report, and handled other business issues including paying balance to driver
Tue 13 Oct.	Continued working on report in office and hotel
Wed. 14 Oct.	Transmitted draft of report to Alexis and continued working on it.
Thur. 15 Oct.	Continue working on report, giving final briefing to WASA and IFDC staff, and departed for Accra, Ghana and ACDI/VOCA FtF assignment
Fri. 16 Oct.	Meet with Alexis Ellicott in hotel in Accra for final briefing, moved on to ACDI/VOCA Assignment

End of Activity Log