Winrock International
Nigeria Farmer-to-Farmer Program

Improved Quality of Rice Processing (NIG 225)

Consultant Report:
Richard (Dick) Tinsley[1]
Professor Emeritus, Colorado State University

July 2011

[1] *http://lamar.colostate.edu/~rtinsley/Author.htm*

Table of Contents

List of Figures

List of Tables

List of Acronyms

AADIL	Adamawa Agricultural Development Investment Ltd.
AAMA	Adamawa Agricultural Mechanization Authority
ADP	Agriculture Development Project
CGIAR	Consultative Group for International Agriculture Research
FtF	Farmer-to-Farmer
IITA	International Instituted for Tropical Agriculture
INGER	International Network for Genetic Evaluation of Rice
IRRI	International Rice Research Institute
ITCZ	Inter-Tropical Convergence Zone
SME	Small and Medium Enterprises
SMFB	Standard Microfinance Bank, Ltd.
SOW	Scope of Work
WASA	West Africa Seed Association

Executive Summary

An FtF consultancy to evaluate the value chain for rice and recommend how to enhance the quality of the final milled rice was conducted during the first half of July 2011 in Yola, Adamawa State, Nigeria. It was sponsored by the Standard Microfinance Bank Ltd., on behalf of Adamawa Agriculture Development and Investment Ltd.

The consultancy noted that in Yola rice was grown mostly in an intermediate deep water environment similar to that found in the Central Plains of Thailand and the Mekong Delta of Viet Nam. That is rice is grown in tracts of land subject to uncontrolled flooding of a meter or more during the latter half of the rainy season. This required the use of tall, but erect varieties of rice that could withstand the flooding. Also, the farmers were using a similar method of cultivation as under similar uncontrolled flooding in Viet Nam that emphasized no bunds to retain water, nor puddling to reduce infiltration, land preparation by contract tractors, and dry seeding. The rice is then hand weeded until flooding controls the weeds. This tends to be a rather casual management of rice that results in limited use of fertilizer and limited yields. From a paddy quality perspective it results in paddy not picking up as much mud as elsewhere in Nigeria and West Africa and thus no need for expensive destoning prior to milling, the cost of which has to be recovered by discounting what the farmers can receive for their paddy.

There were two value chains associated with rice depending on if the rice was parboiled or raw. In both cases the value chain emphasized out-sourcing the value added with clean sales to traders and then wholesale transporters that moved most of the paddy from the farming community to the town where it was either sold to parboilers or contract milled and sold to retailers.

As for grain quality, the raw paddy appeared to have only a limited amount of foreign material, somewhat above the internationally accepted 1%, but not sufficient to require extra processing. The real problem was in available mills. These were simple single pass, single stage mills that resulted in some 70% broken for raw rice and 50% broken for parboiled rice. This is unacceptable and results in a 30% discount in the retail price of the final rice compared to imported rice, as well as additional rice being lost in the milling process as part of the mesh being discharged comprising not only ground hulls and bran, but also finely broken rice. The broken rice in the discharged mesh was estimated to be about 10% of the original paddy or 20% of the recovered milled rice. Thus the most urgent need to improve rice quality would be for AADIL to facilitate the import and sale to village and town millers of single pass two stage rice mills that can process raw rice with only 14% broken. These are suitable for small and medium family enterprise and commonly used in most of Asia as well as parts of Africa, and should ultimately improve the farm gate or village value of paddy.

Other ways to improve rice quality is to shift to combine harvesting, possible with the small combines now widely used in rice growing Asia and designed to operate in small fields commonly used by smallholder rice producers. Such combines often result in a cleaner harvest that will increase the rice recovery by 10 to 15% compared to the hand harvesting and whacking threshing, that typically leave considerable grain on the discarded straw and shattered across the field with handling. This extra grain recovery could easily cover the cost of the combines,

particularly if paid for in-kind at 15% of the crop, leaving the manual harvest costs as an increased profit for the farmers.

If combines are not available it would be possible to have limited improvement in paddy quality with simple manual winnowers as the traditional winnowing as part of communal drying floors often only move debris around between neighbor piles of paddy without most of it clearing the drying floor. Such winnowers could be associated with the initial traders and provide an opportunity to clean the paddy and obtain up to 10% bonus price.

Other concerns that AADIL might want to take a close look at are;

1. The use of "Estate Mode" to manage their farmer groups. This has a poor history of success going back over 100 years with the Gizeria Scheme in Sudan.

2. Look at how much of the value added for rice in terms of parboiling and milling should be undertaken by AADIL or the farmer groups they are working with, or outsourced. At present it appears that most of this is outsourced.

3. The basic business model that is based on the cooperative model. While this may be socially ideal, it tends to be administratively too cumbersome to be financially competitive, too inconvenient for cash oriented farmers, and outside a reasonable basic financial management strategy that emphasis retaining good in kind as long as possible, but requiring immediate cash when marketed and reluctance of the farmers to relinquish control of their goods without a clean sale, as happens when goods are consigned to project. As a result this business model usually attracts only a small percent of the potential beneficiaries as active member, and then they will side sell most of their produce to private traders leaving the project with very limited economic impact.

4. Look at way to facilitate the acquisition of the machinery needed expedite the farming operations or enhance the quality of the rice. This would include tractors for contract tillage, combines for contract harvest and two-stage single pass rice mills. However, these all need to in the hands of individuals who are drifting out of farming to become full time farm service providers. They should not be under any form of joint ownership such as public sector organizations, parastatal companies or farmer organizations. Under these forms of joint ownership the equipment will only survive for a limited service life usually from $1/10^{th}$ to $1/3^{rd}$ the manufacture designed service life.

5. Take a careful look at how microfinance can operate at community level to help finance the capital equipment costs mentioned above that will facilitate an enhance the production potential of the farmers. This could necessity in some major policy changes for microfinance programs, but generate additional synergy within the smallholder communities.

Improved Quality of Rice Processing (NIG 225)

Consultant Report:
Richard (Dick) Tinsley
Farmer-to-Farmer Volunteer
July 2011

Introduction

This Farmer-to-Farmer (FtF) volunteer consultancy appears to have been formally requested by the Standard Microfinance Bank Ltd. (SMFB) on behalf of Adamawa State Rice Farmers as represented by Adamawa Agricultural Development and Investment, Ltd. (AADIL), who became the primary coordinator for the consultancy. The primary objective was to evaluate how to improve the post-harvest processing of rice to obtain higher valued milled rice for in-country consumption with potential for export. This included both parboiled and raw rice processing. It was also assumed that the processing would be done locally through village or town based family operated Small and Medium Enterprises (SME), rather than large agro-industrial scale. However, other aspects of rice production were also looked at. The consultancy took place in and around Yola, Adamawa State in Eastern Nigeria near the Cameroon border (Fig. 1) during the first half of July 2011.

This also represented the consultant's second consultancy in Nigeria. He had previously been in Nigeria with the West African Seed Association (WASA) Project. During this consultancy he traveled through much of Nigeria looking at post-harvest practices of several crops including rice. He was thus familiar with the village based family SME that handled the parboiling and milling of rice in other parts of the country, but not Yola. The daily activities of the consultant are included as Appendix A.

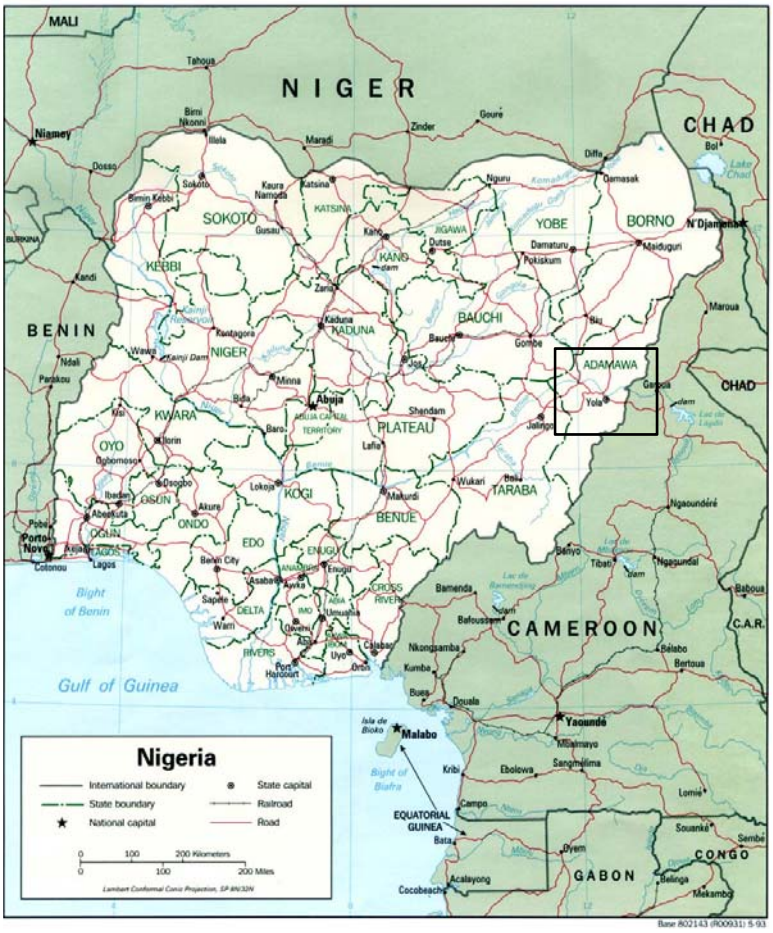

Fig. 1. Map of Nigeria with Adamawa State, and Yola in box.

Time of Consultancy

The consultancy took place during the first half of July. This corresponded to the early rainy season when most of the field activity was planting or weeding the rice in anticipation of annual flooding expected from mid-August through October. Thus it was not possible to observe harvesting, threshing, drying, winnowing and gleaning, the initial harvest and post-harvest activities, normally done at the farm level, rather than being out-sourced. However, it was mentioned that the harvesting activities were mostly manual, and would be similar to those done in neighboring Ghana (Fig. 2). The process included cutting with a sickle or machete, then

Fig. 2. Typical manual harvesting of rice in Ghana. Involving cutting with a machete (a), laying on the ground with potential to pick-up mud clods (b), threshing by whacking leaving 10 to 15% rice remaining(c), then drying and winnowing on communal drying floors (d), while gleaners cleaned up the remainder (e).

stacking in the field with high potential for picking up mud, particularly if bunds were used to retain water and water was still ponded in lower parts of the paddy. This was followed by manually hauling the cut rice stalks to a threshing area with ample opportunity for shattering losses, the threshing by a whacking that typically leaves 10 to 15% of the grain still attached to

the straw. The paddy would then be transported to a drying floor for drying and wind winnowing. Meanwhile people would return to the spent straw to glean any remaining grains from the discarded and abandoned straw. This is a particularly arduous means of obtaining a day's supply of rice.

The paddy that was observed was from the previous harvest in December 2010 or January 2011. However, it was possible to assess the grain quality of the paddy coming on the market that had been stored on-farm since harvest five to six months earlier. This would be in terms of post-harvest losses from weevils, rats, etc. It was also possible to evaluate the degree of foreign material including empty grains, chaff, mud clods and other material contaminating the paddy that has to be removed before the milled rice can be effectively marketed.

Rice Production

The predominant rice production system in Yola appears to be intermediate deep water rice. These areas have uncontrolled flooding of up to one meter for a period of up to three months a year normally in the last half of the rainy season when the rice is already well established. With this depth of water it is still possible to use erect rice plants, particularly if they have an elongation potential so the heads remain above the water while the floods advance, or will quickly elongate up to 10 cm/day to withstand sudden flooding. This is distinct from the deep water rice of Bangladesh where flooding is three or four meters and the plants are more vines then erect. The reason for the annual flooding was not explained, but most likely the accumulated concentration of seasonal rains overflowing rivers, and not snow melt from the Himalayas adding to seasonal monsoon rains that result in the annual deep flooding on the major river of South East Asia.

The rainy season in Yola and most of Nigeria follows the typical rains for the northern tropics. The rains beginning in May and continuing through a serious of surges of rain and lulls in the rains associated with the drifting depression of the Intertropical Convergence Zone (ITCZ). These rains can be highly variable from year to year particularly during the on-set and declining month as shown in the table in Appendix B. The variability during on-set and decline month will be 100% or more while the variability of mid-season months can be nearly 50%. The table is for Minna some 900 km west of Yola, but it is the closest location for which reasonable data is available. However, while Minna might be somewhat dryer then Yola, rainy vs. dry months and annual variability should be approximately the same.

This kind of rice production was common in the central plains of Thailand prior to the water control dams on the Chao Phraya River. It remains common in the Lower Mekong Delta of Cambodia and Viet Nam. It is interesting that the cultivation of rice is similar in all these areas. That is, the rice fields are not bunded to trap water nor puddled to reduce infiltration, but are cultivate dry, usually with large 4-wheel tractors, and the rice seed is dippled or drilled into the soil (Fig. 3) and covered which creates a serious drowning hazard if the fields are suddenly flooded and reduced soil conditions occur before the seedling emerge. The fields are then weeded until they naturally flood. After flooding additional activities are practically impossible until harvest. Once the flood recedes the crop is left to mature prior to harvesting. It is necessary to use taller varieties then in areas with full water control, and this is what the farmers appear to

be producing. Very little fertilizer is applied both because it would cause the tall plants to lodge and because effectively rice is being grown in a slow moving stream where any application would more likely drift to a neighbor field than be effectively applied to the owner's field. It is normally considered a more casual managed rice crop with limited inputs including labor and limited production. However, because of the limited labor inputs the returns to labor could be fairly reasonable, and farmers tend to be more concerned with the return to their labor over the return to their land i.e. yields.

Fig. 3. Intermediate deep water rice production system around Yola with overall view (a), dippling seed (b), and manually weeding (c).

Since this is normally not a highly promoted rice cultivation practice, it is interesting that the same methods were developed in such diverse areas as Nigeria and South East Asia. Since there would be limited farmer to farmer interaction between these areas, this practice most likely developed independently and thus represents the most effective culture practices for this rice environment.

There may be some extra benefits from this methodology in terms of paddy quality. That is with the field fully drained well in advance of the actual harvest, there will most likely be less mud in the fields so when the freshly cut rice is laid down prior to threshing, it would not pick up as many mud clogs that have to be removed through a destoning process, as is done in other parts of Nigeria as well as neighboring Ghana (Fig 4). Thus none of the mills visited had destoners and the observed quality of the paddy for milling would not justify this.


Fig. 4. Destoner used to remove mud clods and stones from rice, but costly and wastes considerable amounts of rice.

Improving the yield of this type of rice maybe possible, but will require acquiring special varieties tolerant to the deep

water conditions. The International Rice Research Institute (IRRI) headquartered in the Philippines, but with a worldwide mandate to improve rice production and does address the deep water rice ecosystem. IRRI's biggest impact is sharing genetic material for various rice ecosystems, including deep water conditions. This is done through their International Network for Genetic Evaluation of Rice (INGER). IRRI's deep water rice nursery is largely composed of elongating lines that have the genetic capacity to adjust their height to various levels of flood water. The deep water nursery should be obtained directly from IRRI by emailing irri@cgnet.org. They may refer you to the International Institute of Tropical Agriculture (IITA) headquartered in Ibadan, Nigeria. However, since the Nigerian variety improvement program for virtually all crops appears to rely mostly on collaboration with Consultative Group for International Agriculture Research (CGIAR) which includes both IRRI and IITA, you should be able to eventually obtain the nursery. It should comprise about 100 g of 20 lines being distributed throughout the tropical intermediately deep water rice growing programs. Once obtained the nursery should be evaluated under the deepest water conditions in the areas. The results may need to be submitted to IRRI for their research evaluation, but the seed of any desired lines can be easily multiplied within the area and when sufficiently bulked distributed to farmers. With a multiplication ratio of 1/50 this should take two or at most three years.

The official variety improvement program may protest this, but does not have the financial or manpower resources to undertake the variety evaluation or seed increase, etc. An example would be only a single seed certification team of a major state like Kano to verify the quality of seed. For international standard certification this requires three visits during the season plus a germination test at the end of the season. Something that is physically impossible for fields that are often less than 0.5 ha. Thus most of the seed certification has to be done on the honor/gratuity system. Also, the government does not have the means to enforce the use of clandestine lines, as noted by farmers in other parts of Nigeria producing a rice variety name Cameroon. This was most likely acquired during some informal family visits to Cameroon, and quietly taking back some seed from a variety they liked, but without knowing any formal name started referring to it as Cameroon. A similar situation happened in Tanzania with a variety referred to as Zambia, a variety name not recognized in Zambia.

AADIL

AADIL is a parastatal state government owned company engaged in private agriculture development by providing support services to various farmer groups engaged in rice production as well as maize, soybeans, livestock and aquaculture. It was developed largely to get around some of the meddling often imposed by the official agriculture ministry, etc. It intends to provide input and marketing support services. AADIL is supported by a group of consultants from Surinam, South America. In Surinam the group managed a 10,000 ha fully irrigated rice farm. While fully familiar with this type of rice production, they appear to have limited experience in other rice ecosystems such as the intermediate deep water environment found in Yola or some of the intricacies of working predominately with smallholder producers, such as appreciating they are fundamentally individual entrepreneurs, not forcing them to be collective farmers, limited operational resources available to implement the "innovative" rice production methods being demonstrated, there high preference for clean cash transactions, desire to hold commodities as long as possible before selling them, etc. The result is they have endorsed many ideal methods

that have been promoted well beyond their overall effectiveness in assisting smallholders, and may not be fully appreciated by the intended beneficiaries.

Like most agriculture development projects, AADIL works with organized groups of farmers. In this case there are 12 farmer groups totaling 480 individual farmers. This ultimately commands only 5 to 10% of the farm communities and rice tracks associated with their programs. They have made a major demonstration of the potential for multiple yield increases. This probably does a good job of demonstrating the physical potential of the area even under uncontrolled flooding. However, they may want to reflect on how much of the educational impact they claim, is the result of their preempting and facilitating access to a highly limited resources. In this case access to contract tractors for basic land preparation. The question being if, as mentioned in the seminar, the farmers have to wait up to a month for a contract tractor to become available, of perhaps not at all, how much of a drag would this make on the physical potential they demonstrated? Will it bring it all the way down to the current level of production and indicate the resources to manage the land are more limited than the knowledge of best management practices? That this would severely restrict the acceptance of demonstrated technologies resulted in a sense of confusion, as the assumption continues that knowledge was the only limiting factor to accepting the demonstrated production potential, and once the knowledge was acquired the acceptance was 100% discretionary on the part of the farmers, and failing to quickly accept was an indication of failure to fully learn or understand what was being promoted, and the need to reteach and redemonstrate.

Limitations of Agronomy

This really gets to the major limitation of agronomic research/extension/demonstrations. While agronomic small plot evaluations do an excellent job of determining the biological potential of a physical area, they do nothing to determine what operationally is needed to extend the small plot results to an entire farm or smallholder farming community. The operational needs being the labor or access to mechanization, etc. Unfortunately, the agronomist – researcher or extension agent – tend to assume these operational resources are all readily available and thus once the knowledge is extended the farmer has the complete discretionary choice to proceed to adopt the technology[2]. Sorry this is rarely the case and the failure to appreciate this has limited smallholder agriculture development for decades. Equally unfortunate and disturbing is that the evaluation of the operational resources needed to extend a clearly demonstrated technology appears to fall into an administrative void in agriculture development process. What discipline should have the mandate to take the lead in analyzing the labor and machinery requirements and availability to extend a demonstrated technology across a community? Or conversely inventorying what is available and determine how this will impact on how long it will take to complete various agronomic tasks such as land preparation, dippling seed, weeding, harvesting and threshing, etc.

For example in extending AADIL's demonstration of multifold yield increases, who within the AADIL organization should be responsible to determine what is needed for widespread acceptance of the demonstration. That is how much time should be allocated for crop establishment, then to get the entire rice track established in that timeframe how many tractors

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

will be needed for contract tillage. Compare this to the tractors that are available, the commitments they may have outside the rice tracts, and then given the available tractors how long will it take to get the crop established. AAMA, the prime tractor contractor, has only 30 of an original 200 tractors available to assist with 12 farmer groups and surrounding rice tracts. How many of the 30 tractors can AAMA commit to assist AADIL and how many have other commitments? Continue the analysis to determine how this will impact on recommendations and potential yields. This might include the caloric energy balance evaluation of how many calories people have access to relative to how many they are expected to exert for a full day of agriculture field work[3]. If the calories are limited, then how many hours can people be expected to work, and what will that do to prolong the time required to complete various tasks and the drag this can have on the demonstrated yield potential.

Typically if this analysis was undertaken it would explain why crop establishment could take up to eight weeks to complete and virtually void major recommendations, particularly if emphasis early planting. It might also indicate that the stereotypical of African men loafing around the village in the afternoon, may be more from hunger and exhaustion, having consumed all the calories they had access to, rather than lazy in need of motivation. It might also indicate that stimulating smallholder agriculture may be easier by concentrating on facilitating access to additional resources to manage land, then harping on technical knowledge the farmers lack the means to fully utilize. In reality this is a 40 year oversight in the development effort, that needs to be corrected if there will be major impacts on improving smallholder agriculture, and meet the Millennium Development Goals of 50% reduction in rural poverty.

Estate Mode

AADIL is trying to manage their farmer groups in what is called "Estate Mode", and they have arranged the group members to have contiguous land holding. That in itself is interesting as normally to get contiguous holding takes some extra-legal effort including *rites of eminent domain*, that a parastatal company may have the right to but could be something the farmers resent. "Estate Mode" is when the project takes over the land for a group of smallholders, allowing them to retain title of the land, but doing most of the management for the farmers as if it were a consolidated farm, while billing them for the services with costs and overhead expenses including interest deducted from harvested goods prior to the farmer receiving any residual payments. This always sound good from an efficient land use perspective, but has a very poor record of success, now dating back over a century. This goes back to the British effort in developing the Gizeria Irrigation Project for producing over a million hectares of cotton at the confluence of the two Nile Rivers in Khartoum, Sudan. It became one of the biggest development debacles in history, and has remained such for over a century.

The biggest concern is that, while it is possible to increase the land use efficiency, there are some distinct advantages to some members relative to others. This is because there is a well-established declining production function with time of crop establishment. Thus as the imposed management moves over individual farmers property lines, the farmers who are fortunate enough to get their land established first will have a distinct advantage over those less fortunate whose

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

land is done last. Moreover, the less fortunate ones with the late crop establishment know who is responsible for their misfortunate, and it is you, the project. Thus the early farmer is your friend and invites you for tea, while the late farmer feels discriminated against and could easily take some adverse action.

With AADIL the "estate mode" management is so far restricted to organizing consolidated access to contract tractors for land preparation, through the Adamawa Agricultural Mechanization Authority (AAMA), a parastatal mechanization company. This may only involve a couple days per farmer group and would not have a major impact on yield potential. However, if in the future the spread within a farmer group become a week or more the potential yield differential with time of planting of planting could become a problem. Thus AADIL should only proceed with the Estate Mode with a full appreciation of the limited success it has had in the past. Perhaps, it might be better to simply rent the land from the farmers on share cropping basis and then hire the farmers on a cash bases for any labor inputs needed and do this across the entire consolidated farms representing the 12 farmer groups. With AADIL providing all the inputs the standard share cropping arrangement would be 70-30, with AADIL getting 70% of the crop and the farmers 30% for the use of the land, plus any causal labor inputs they can arrange with AADIL. The 30% of the crop plus casual labor opportunities could provide a reasonable income with minimum risk. The alternative would be for the farmers to simple move on to other opportunities they can generate from non-rice lands or crops, or even off-farm opportunities as was reported done in Gizeria. The 70 – 30 sharecropping agreement is one of the three fairly standard sharecropping agreements used universally across both the developed world such as Colorado as well as the developing world such as Nigeria. The other sharecropping agreements being 50 – 50 in which both tenant and owner share in the production costs and split the crop or 30 – 70 in which the tenant get 30 percent mostly for his labor and the owner pays for all inputs and gets 70% of the crop.

Chisel Plows[4]

AADIL is also highly committed to using chisel plows for land preparation. This may be appropriate. Chisel plows are simple means of disturbing the soil. They can go deeper than the more common disc plow, and are the most common contract land preparation through Egypt and much of the Middle East, where the shortage of tractors make it necessary for each contractor to complete the service as quickly as possible to move on to the next client. However, chisel plows do not really turn the soil over to bury and kill the weeds as can be shown with the dippling and weeding in Fig. 3 b&c. Thus, the simplicity of plowing and lack of completely turning the soil may result in some extra weeding, and any economic comparison of the benefits of the chisel plows compared to other plows such as disc plows may have to be on the combined plowing and weeding, etc.

Support Services

Also, AADIL is planning to provide support services to its members in terms of production inputs and marketing of rice. The idea of doing this is to get bulk discounts, etc. This has been

[4] *This discussion is largely based on telephone interview with Normal Illsley, Agriculture Mechanization Specialist*

the backbone of the agriculture development effort for many years. However, while I will agree that the self-managed support services are socially ideal, desirable, and have been highly promoted, they have rarely worked effectively. Generally the administrative procedures are just too cumbersome so the additional overhead costs will exceed the bulking benefits, and the operations particularly when involving consignment sales too inconvenient for most smallholders, who prefer to hold their produce in kind as long as possible, but want immediate cash when finally sold. The result is that few beneficiaries will actually become actively involved and even those will side-sell the bulk of their goods to competing private traders, even when they are presumed to be legally obligated to use the project services[5]. However, this obligation is really unenforceable. The net result is such support services usually account for a very limited market share and have only a minimal impact of the overall economics of the community they serve. Typically, particularly when credit clubs are involved, an honest farmer will simply consign to the cooperative sufficient goods to cover any loans and side-sell the remainder. This is really an astute business decision on the part of the farmer as it avoids the risk of having his crop confiscated to cover a neighbor's defaults, and any delay in payment will be an internal manner to the organization. If only consigning enough to cover the production loan rather the produce is allocated against the original payment or the delayed dividend payment is of no concern to them. They have full filled their obligations and can move on with their business. It is possible to list 14 or more concerns where the cooperative business model will lose its envisioned competitive advantage to private traders[6]. How many of these will apply to AADIL effort? AADIL might want to carefully review this list to see how many apply to their business model and how they can avoid any that would reduce their competitive advantage.

The problems and difficulties with the cooperative business model is often covered up in reporting that virtually always overlooks the basic business parameter that will separate a sustainable program that has the prospects of surviving without external assistance, from those that are mostly a show of the donors good intentions but will collapse as so as external assistance ends. Reports also tend to report only aggregate contribution that when prorate to individuals will highlight how minimal the market share is, and often attribute the overhead costs as a direct financial benefit to the farmers, which is basically dishonest.[7]

Full Water Control

Finally AADIL is planning a build levees around a 750 ha plot in Gurin to prevent flooding and thus establish full water control in order to produce the more typical higher yielding puddled paddy rice. Again I am not certain how they will do this particularly the land where the levees will occupy again without some form of compensation or use of *rite of eminent domain*. Again, while the full water control rice production may result in some substantial yield increase, it will also be at considerable additional costs, both capital costs in constructing levees, canals and drains, as well operational costs, particularly the pumping costs that could go both ways, with pumping water in during the early season and pumping water out during the flood period. Thus it needs a careful cost benefit analysis with more emphasis on return to labor than return to land.

[5] *http://lamar.colostate.edu/~rtinsley/Cooperatives.htm and linked additional pages*
[6] *http://lamar.colostate.edu/~rtinsley/LossCompetitiveAdvantage.html.*
[7] *http://lamar.colostate.edu/~rtinsley/DeceptiveReporting.htm*

Rice Value Chain

In Nigeria there appear two value chains associated with rice, one for raw rice and the second for parboiled rice. This value chain runs from the producer to the in-country consumer (Table 1). It does not extend to exports as with all the imported rice, the potential for exports are limited.

Some points to be noted in the value chain are:

1. All transactions are for immediate cash. The most noticeable is the initial sale to village traders operating with limited physical overhead (Fig. 5). The cash sale immediately terminates any continued interest in the value chain on the part of the farmers.

2. Farmers tend to hoard their paddy as long as possible before selling it in response to immediate cash needs. This could be part of an overall financial management strategy in which sticky fingers in the "cookie jar" are a bigger concern than post-harvest losses[8]. A strategy that makes consignment selling to bulk commodities difficult to accomplish or be appreciated.

3. When there is either a large labor component such as parboiling or high capital costs such as milling, the farmers opt to outsource the value added activities, either through direct cash sale as with parboiling or contract as with milling. The distinction between the two could be associated with the time

Table 1. Comparison of Value Chain for Raw vs. Parboiled Rice

Step	Raw Rice	Parboiled Rice
1	Farmers Produce Paddy	Same
2	Farmers store rice in homestead as long as possible, until they need cash	Same
3	Farmers sell paddy to local trader, who pays cash and hold paddy for up to one week	Same
4	Local trader cash sell paddy to wholesaler/transporter who transports paddy to town	Same
5	Wholesaler/transporter cash sell paddy to Wholesaler/distributor	Wholesaler/transporter cash sells paddy to parboiler
6		Parboiler proceeds to parboil the paddy
7	Wholesaler/distributor outsources the milling of the paddy to rice	The parboiler proceeds to outsource the milling of the parboiled paddy to milled rice
8		Parboiler sells milled paddy rice to wholesaler/distributor
9	The wholesaler/distributor sell milled paddy to retailer	Same
10	The retailer sells milled rice to consumer	Same
End of Value Chain		

Fig. 5. Section of a village used for buying paddy from farmers for sale to wholesale transporter these are all independent traders but keeping their overhead low with no physical facilities.

[8] http://lamar.colostate.edu/~rtinsley/FinancialStrategy.htm

involved and potential for the owner to oversee the activity. Since parboiling takes at least a day that would effectively prevent the owners from overseeing the process unless they were to camp out in the parboiler's yard, it is a cash sale. While the milling can be done quickly while the owner waits the job is on contract.

4. The question for AADIL is, if they are going to get involved in parboiling, should it be something they should become involved in directly or outsourced which will end their involvement in the value chain.

Parboiling

Parboiling is a process of briefly cooking rice paddy prior to milling. The process takes about two days and thus is not something a smallholder owner is willing to consign to a processor and thus most parboiling is done through a clean cash transfer of ownership. Parboiling involves overnight soaking the paddy and then about 30 minutes of heating (Fig. 6). That is just enough to bring the water to boil. A paddy is then redried and sent to be milled. Typically the 200 lit

Fig. 6. The parboiling process including loading the paddy (a), removing the floating debris (b) and then bringing the paddy to a boil (c).

barrels used for parboiling various villages around Yola will hold about 1.5 80 kg bags of rice. There are larger containers that can process about 10 80 kgs bags of rice per batch (Fig. 7).

However, these tend to be associated with larger parboiling operations associated with town processing facilitated or large village committed to mostly processing rice. It is also noteworthy to observe that while a parboiling container is being filled, the unfilled grains and sterile spikelets will float to the surface and can be easily and conveniently removed. Perhaps this is better than the normal hand/wind winnowing.

Fig. 7. Larger vat used for parboiling rice and holding up to 10 bags.

During the parboiling process some of the bran will leach into the grain endosperm and thus increase the nutritional value of the rice a significant amount (Table 2). This is mostly in the amount of Calcium, Phosphorus, Potassium, and Niacin. This may attract some health conscious people but normally is not a major concern in buying parboiled rice over raw rice. This also results in some discoloring of the milled rice to a light translucent yellow instead of a translucent clear color. In the SOW some concern was expressed for the color of parboilded rice thinking it was distraction resulting from dirty water that would lower the price. However, it is a natural response to the parboiling and cannot be avoided and not the result of dirty soaking water. Finally, the parboiling will harden the grain and provide a higher, less broken milling recovery. This is something government officials, interested in maximizing the recovery of rice, are concerned with. In Sri Lanka this resulted in only parboiled rice being available. Unfortunately, the quality on the

Table 2. Comparsion of Nutrient Value for Par-Boiled vs. Raw Rice per 100g

Nutrient	Unit	Par-Boiled	Raw	Nutrient	Unit	Par-Boiled	Raw
Proximates				**Lipids**			
Water	g	9.9	11.6	Saturated	g	0.3	0.2
Energy	kcal	374.0	365.0	Monounsaturated	g	0.3	0.2
Protein	g	7.5	7.1	Polyunsaturated	g	0.3	0.2
Total Lipid	g	1.0	0.7	**Amino Acids**			
Ash	g	0.7	0.6	Trypotophan	g	0.1	0.1
Carbohydrate	g	80.9	80.0	Threonine	g	0.3	0.2
Fiber	g	1.8	1.3	Isoleucine	g	0.3	0.3
Sugar	g	0.3	0.1	Leucine	g	0.7	0.6
Minerals				Lysine	g	0.2	0.3
Calcium	mg	71.0	28.0	Methionine	g	0.2	0.2
Iron	mg	0.7	0.8	Cystine	g	0.2	0.1
Magnesium	mg	27.0	25.0	Phenyalanine	g	0.4	0.4
Phosphorus	mg	153.0	115.0	Tyrosine	g	0.2	0.2
Potasium	mg	174.0	115.0	Valine	g	0.5	0.4
Sodium	mg	2.0	5.0	Histidine	g	0.2	0.2
Zinc	mg	1.0	1.1	Alanine	g	0.4	0.4
Manganese	mg	1.0	1.1	Aspartic Acid	g	0.8	0.7
Selenium	mcg	19.9	15.1	Glutamic acid	g	1.4	1.4
Vitamins				Glycine	g	0.4	0.2
Thiamin	mg	0.2	0.1	Proline	g	0.8	0.3
Raboflavin	mg	0.1	0.0	Serine	g	0.4	0.4
Niacin	mg	5.0	1.6				
Panthothenic acid	mg	0.7	1.0				
Vitamin B-6	mg	0.5	0.2				
Folate, total	mcg	8.0	8.0				
Vitamin E	mg	0.0	0.1				
Vitimin K	mcg	0.1	0.1				

parboiling, mostly related to infrequent changes of soaking water, resulted in some very unpleasant smell to the rice on cooking. The hardening of the grain also changes the texture on cooking to more single grain less sticky texture that some people find objectionable. Ultimately, the bottom line for parboiled vs. raw rice is a matter of personal choice.

Rice Quality

Before evaluating rice quality it might be good to quickly note that, while at the agro-industrial scale rice can be milled and preserved for long periods of time sufficient to ship quality rice around the world as is done in Thailand and Viet Nam, on the more SME family enterprise scale rice is better preserved as paddy then milled rice. Thus for the most part instead of being milled near where it is produced and accepting a 30% reduction in the weight that has to be transported and leaving the bran and hull were the bran can be readily used for animal feed, paddy is usually ship to near where it will be consumed prior to milling.

That said, the primary purpose of the consultant was to evaluate rice quality and assess how it might best be improved. With the limited facilities and time available rice quality could only be determined visible for the amount of foreign material and degree of broken vs. head rice after milling with the available mills. This was done by meticulously sorting through a small volume sample and separating the head rice from the broken and foreign material. Some of this separation was done by hiring some of the hotel staff (Fig. 8). There were a total of 13 samples evaluated. These include two brought from the USA, one standard Thai Jasmine, and the other parboiled. There were also four paddy samples, representing that used for seed, prior to parboiling, and both raw and parboiled paddy prior to milling. The remaining samples were milled rice including both raw and parboiled rice milled in the village, the same being milled in town. In addition there was a sample of imported Thai parboiled rice and an extra raw rice sample from Cameroon, that was noticed in the Yola market as better quality (less broken) than the locally milled raw rice. Once separated the sample were spread out on colored sheet and photographed under similar natural room light condition. Flash photography was avoided as it caused extensive glare in the close up photos.

Fig. 8. Hotel staff assisting with separating head rice from brokens, etc

The visual comparison was roughly according to international standards which would be >1% foreign material for grains such as rice paddy, and >6% broken for milled rice.

Paddy Results

The paddy rice including that being used for seed looked better than expected condition (Fig. 9). True there was some foreign material in excess of the one percent internationally accepted limit,

but not a tremendous amount. Also, there was little if any indication of weevil damage. It was

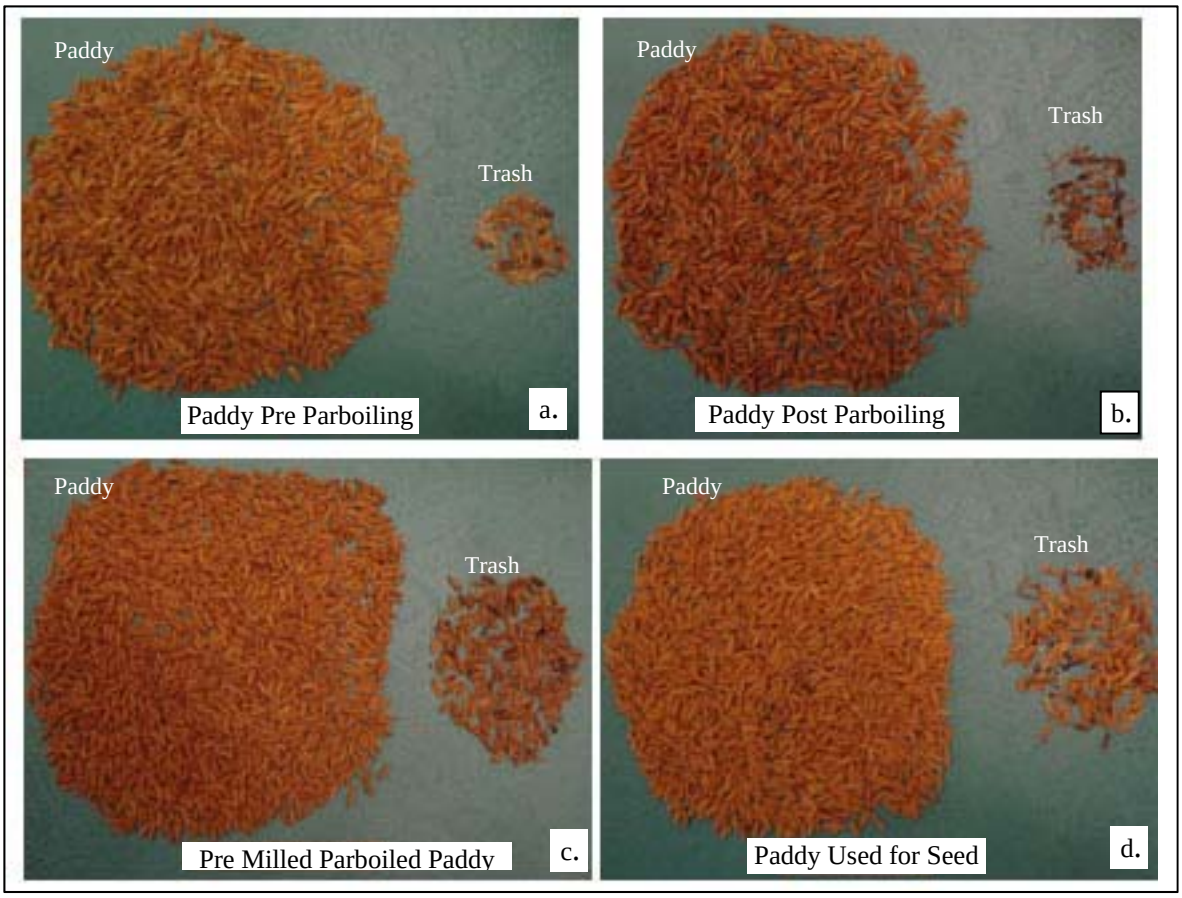

Fig. 9 Paddy samples showing degree of good paddy and trash for pre parboiling (a), post parboiling (b), pre milling of parboiled paddy (c), and paddy used for seed (d).

expected that the paddy was harvested in late December or early January and had been stored in the household since then, a period approaching six months. Typically one expects weevil damage to become noticeable at about three months of storage, representing three generation of weevils. There are some simple means of limiting weevil damage for relatively small quantities of paddy, typical of what a farmer would hold, but not feasible for large volume in a central warehouse. The simplest means is to periodically take a bag or two of paddy and place it in the sun on some form of flat basket. The weevils become uncomfortable with the sun's heat and go under the basket to escape, so after a few hours it would be possible to recover the paddy free or substantially reduced population of weevils (Fig. 10). Likewise, there was no indication of major rat damage. Thus it appears the farmers were able to maintain reasonable quality of paddy with

Fig.10. Vietnamese women demonstrating how placing grain in the sun can help control weevils by encouraging them to seek the shade under the basket.

home storage. Also, there were only limited amounts of mud clods, and certainly not enough to justify a destoning process prior to milling as shown in Fig.4. The need to destone prior to milling implies an extra costs for operating the destoning machine as well as loss of paddy both that representing the mud as well as some good paddy that will invariable be lost with the stones or mud. All of this has to be deducted from what farmers can receive for the paddy they market, and represents an overhead expense to the processor. The extent of contamination can normally be easily examined with as simple "grain spike" or "thief" that can be inserted into the side of a bag with minimal damage to the bag or grain, and retrieve a sample indication the amount of contamination that has to be removed (Fig. 11). Something most processors can accurately estimate based on pasted experience.

Fig. 11. Simple grain spike or grain thief used to sample all kinds of grain to estimate the amount of foreign material that needs to be removed before processing.

Finally, considering the extent of empty grains float removed during the parboiling presoaking, it was expected that the paddy quality after parboiling but prior to milling would be considerable better. However, this did not appear in the visual analysis of paddy quality.

Parboiled Rice

Since most of the rice appears to be parboiled, the parboiled quality has higher priority than the raw rice (Fig. 12). The sample brought from the USA serves as the reference and shows minimum amount of broken or foreign material. This should comply or come close to complying with the international standard of >6% broken. Similarly the imported Thai par boiled rice is approximately the same high quality. In the market in Yola, the imported Thai parboiled commanded a 30+% price advantage. This should be more than adequate to justify improving the quality of milled rice. The parboiled rice milled in the village was considerable poorer than the imported parboiled rice with nearly 50% broken. Even that milled in Yola was at least 20% broken. This would normally be considered unacceptable, as reflected in the 30% discount in retail value for local rice compared to imported rice.

Concern was expressed that parboiling was discoloring the rice and resulting in it being downgraded. The thinking was that this was the result of dirty water used to soak the rice. However, as mentioned earlier the discoloring is a natural part of the parboiling process and represents some of the nutrients in the bran being leached into the endosperm resulting in increased nutritional value. However, the question is the discoloring seen in Yola typical of the discoloration associated with parboiling, greater or lesser. Thus a comparison was made between the various samples of parboiled rice (Fig. 13). This visual comparison did not show any major differences in color, if anything the local parboil had less discoloration that the USA or imported Thai. Also, the interview with PrOpCom upon returning to Abuja mentioned some darker grains with parboiling as an indication of a non-uniform cooking process. Again this was not apparent in the sample examined. PrOpCom is promoting improved parboiling vats based more on

steaming than actually boiling. Apparently, the local parboiling procedures in Yola are not a major problem regarding potential quality.

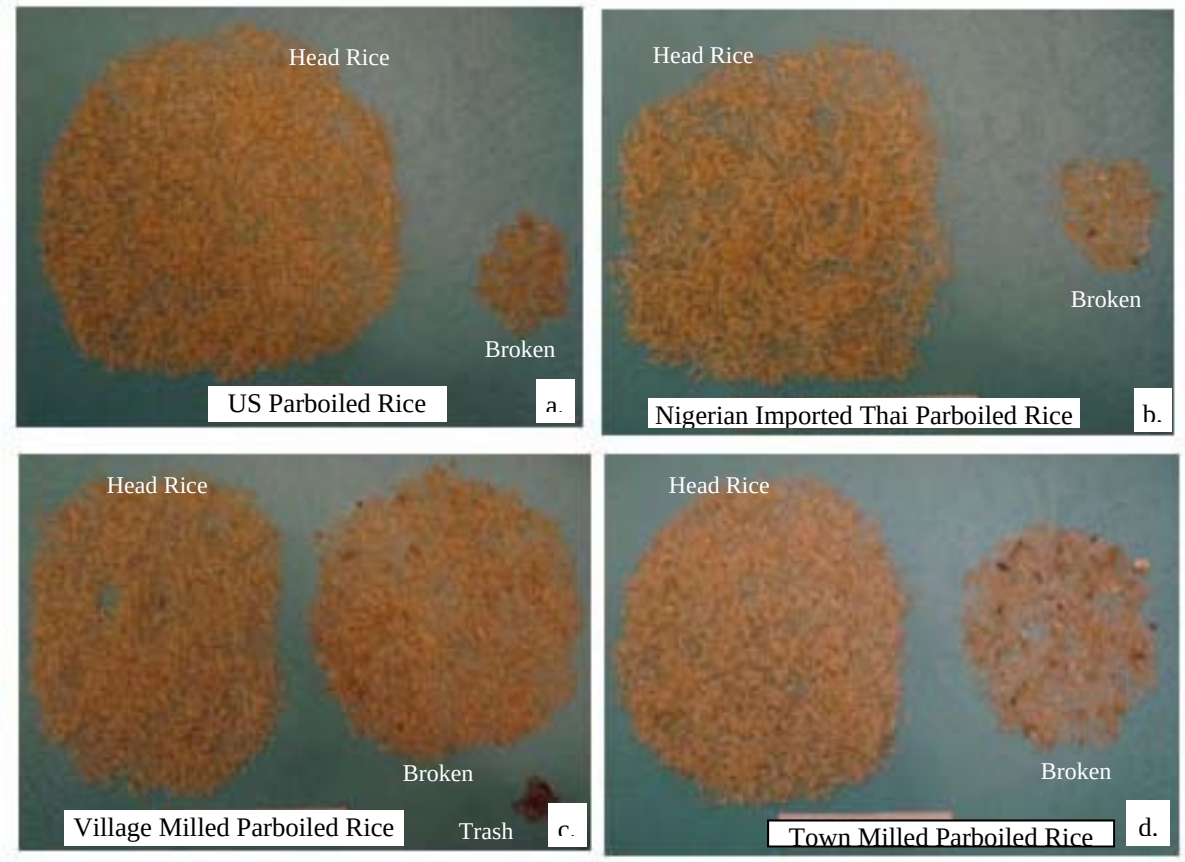

Fig.12. Samples Parboiled Rice from the US (a), Imported Thai (b), Village Milled (c) and Town Milled (d).

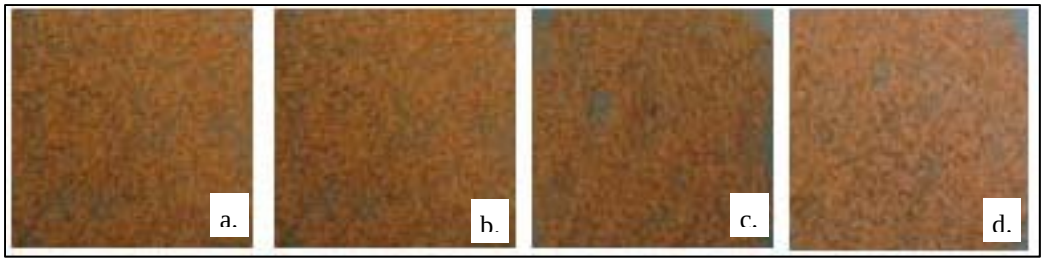

Fig. 13. Color Comparison for Parboiled Rice from the US (a), Imported Thai (b), Village Milled (c) and Town Milled (d).

Raw Rice

Finally raw or non-parboiled rice was examined (Fig. 14). The comparison involved Thai Jasmine brought from the USA as the international standard. This was compared with milled rice from the village and town mills as well as a sample from neighboring Cameroon. As expected, the Thai Jasmine rice appeared up to the international standard of >6% broken. However, the village milled raw rice had over 70% broken reflecting the difference in potential milling

recovery between parboiled and raw rice, as both came from the same mill and were milled sequentially with minor adjustment to the mill. Even that milled in the town had approximately 50% broken. The surprise was the sample from Cameroon that had only 20% broken. This is becoming marginally acceptable.

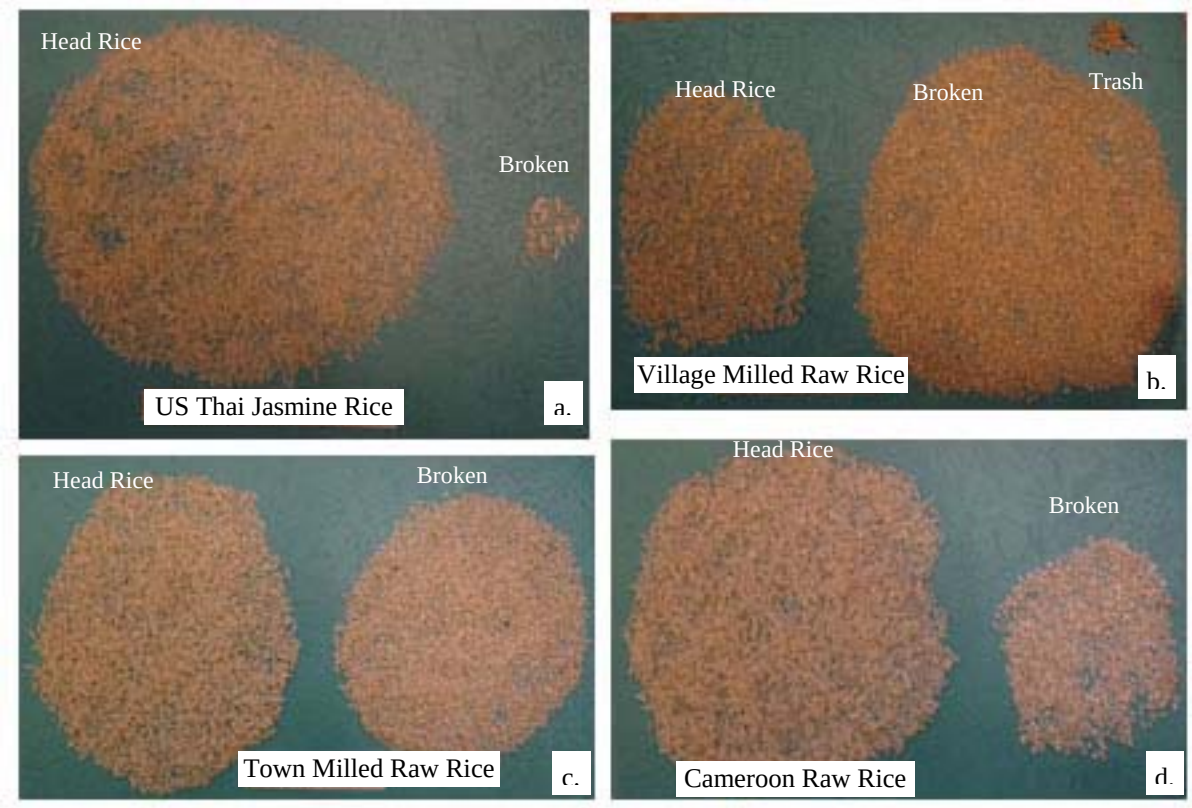

Fig. 14. Rice Quality for Raw Rice from the US, Village Milled, Town Milled and Sample from Cameroon

The ultimate conclusion from this analysis is the drastic need to improve the quality of the mills available in Nigeria for milling rice.

Milling

Milling appears to be the primary problem with rice quality in Yola as well as the rest of Nigeria. It is virtually impossible for a single stage grain mill to produce high quality, mostly head rice needed to compete internationally or even locally against imported rice (Fig. 15). Two basic types of mills were noted during the visit. Small mills were seen in the village and larger mills in the town. In both cases they were connected to small diesel engines instead of the power grid as more typically the case anywhere except in Nigeria and reflects the overall unreliability of the power supply in Nigeria despite the abundance of oil resources. These mills appear to be simple grain mills perhaps designed more for grinding maize into flour than for milling quality rice. The result is that the milling recovery is low, perhaps as low as 50%, even for parboiled rice, and most of the rice is broken. Typically, a rice mill will have a recovery of at least 60% and more typically 67% for raw rice and substantially more for parboiled rice, going from 71 to 75%. With these simple single stage mills, the rice comes out one end and a mesh mixture of ground-up

hulls and bran the other side. It is highly possible that mixed in this hull/bran mesh could considerable amounts of finely ground rice and account for much of the difference in milling recovery. It is interesting that the mesh from the raw rice was recovered and fed to cattle, while the mesh from the parboiled rice was discarded in a big heap (Fig. 16).

Fig. 15. Single Stage Grain Mills Being Used For Milling Rice. One from the Village (a) and the Second larger mill from Town (b)

While the grain mills visited are not capable of producing quality milled rice, there are small capacity mills. that can producer reasonable quality rice in a SME family enterprise environment. These are typically two stage mills with the paddy flowing directly from the first stage to the second stage. The first stage is basically a rubber roller dehuller with the hulls blown out the side and discarded as there is little use for rice hull because of high silica content. The second stage a simple polisher (Fig. 17) with the bran being separated and available for animal feed. However, as animal feed rice bran has 20% oil and has to be rapidly heat fixed or used quickly to avoid becoming rancid. Such mills have a 0.5 to 1.0 t/hr capacity with over 60% raw rice recovery and costs about US$ 4,000. They are well suited from SME family enterprises that contract of small batch milling from individual processing their subsistence stocks or selling to local retail shops. Most likely they mill a substantial amount of rice in Asia aimed at the community needs, more than the export needs or even large municipalities. In an analysis of rice quality, similar to that described above, for rice coming from a two stage mill in a remote community in Tanzania, the rice had only 14% broken. Not really export quality but good enough for local use. This might be similar to the mill used for the Cameroon sample discussed above and explain the higher quality output.

Fig. 16. Goats walking over a pile of discarded mesh of hulls, bran, and finely broken grain from milling parboiled rice.

During the meeting with USAID there was discussion of a large 50,000 t/yr capacity rice mill being built. That is a big mill capable of producing high quality rice, even if it has to internally

Fig. 17. Two-Stage Rice mill in Operation in a remote are of Tanzania (a) and Diagram of its Operations (b).

sieve out the broken to meet the >6% international standards for broken rice. This is now on an agro-industrial scale and well above the SME village based family enterprise operations. At an optimistic average paddy yield of 5 t/ha this mill will command the entire production of some 10,000 ha, with no paddy available for local milling and subsistence consumption. Rather there are 10,000 ha of good paddy land within reasonable range of such a mill may be questionable in a country where rice is more a secondary staple crop and smallholder prefer to hold their substance stocks at home and mill it locally as needed. The 50,000 mt/yr breaks down to 1000 mt/wk, or 200 mt/day for a five day work week. At 80 kg/bag it will require 2500 bags/day. That is way too many to deal with individual bags as projected by USAID discussions as coming from some farmer groups. Thus most of the paddy flowing in will come from private traders who will be responsible for assuring the quality of the paddy and most likely there will be a blower and sieve as the initial phases of the mill to clean the paddy free of chaff, weed, and empty grains as well as stone and mud clods, etc.

Other Ways to Improve Quality & Recovery

Other than the major concern with the grain mills the other prospects, and perhaps an order of magnitude less important than the grain mills, would be reducing the amount of foreign material in the paddy. This would require mechanizing various aspects of the harvest, threshing and winnowing process. Manual harvesting described earlier just does not have the potential to remove all the foreign material to provide a clean bag of paddy with less than the industrial accepted 1% foreign material. Such verifiable clean bags of grain should command a 10% or more premium price from dealers, as mentioned in Kano a couple years ago when a processor acknowledged that he discounted various grains bought in the market by 15% in anticipation of the need to remove 10% foreign material plus the cost for removing it. He was not dealing in rice.

The concern with the tradition means of harvesting and processing rice is that hand cutting and laying the cut rice stalks on the soil prior to moving to the threshing area provides ready opportunity for the rice heads to pick-up mud clods (Fig. 2). While manually hauling the cut rice to the threshing area provides ample opportunity for substantial shattering losses. The whacking threshing has never been a complete task leaving some 10 to 15% grain on the stalks that later can be gleaned away by people scavenging the threshed and discarded piles of straw. The wind winnowing, particularly when done on a communal drying floor really simply only moves the light material from one pile to a neighbor's pile until it eventually works its way across the drying floor. Meanwhile no pile really gets fully cleaned.

Small Combines: For rice the best prospects to improve paddy quality would be to shift to some simple combines that can work in the small individual rice fields (Fig. 18). These combines are now common throughout much of rice producing Asia and harvest most of the rice, particularly the irrigated areas including most of the smallholder production. This is done on a contract basis rather than direct ownership by individual smallholder farmers. The owner/ operators most likely representing individuals who have quietly drifted out of farming to become combine contractors with a full time work opportunity. The shift to combine harvesting in Thailand could be a major reason many fully irrigated smallholders now cultivate five crops in two years, an increase from two crops per year. The combines typically have about a three meter head, and can easily combine a rai[9] ($1/6^{th}$ ha) in less than an hour. These combines originated in Japan, but should now be available from Japan, Taiwan, South Korea, Thailand, Viet Nam and other countries in South East Asia. However, care may be needed if considering Chinese machinery. In 2010 FtF consultancy to Ghana, my two hosts experienced serious problems with any machinery that originated in China. It just was not durable enough and basically had to be completely rebuilt. This included combines and planters.

Fig. 18. Small Combine Used Extensively in Asia for Harvesting Smallholder Rice Fields. They are Used in Thailand (a), Thai Manufactures but in Ghana (b) and from Viet Nam.

The price of the Viet Nam unit is estimated to be US$22,000. However, like all mechanical equipment the most effective means to provide them to smallholders would be through individual ownership, with the microfinance programs adjusted to support their purchase. At no time would it be recommended that equipment like this be under any form of joint ownership or joint use such as government mechanization unit, parastatal mechanization company or even farmer groups. Joint ownership and multiple operators will most likely result in reducing the service life to $1/3^{rd}$ the designed life, if lucky, perhaps to less than $1/10^{th}$. This may be easily seen from the small tractor units attached to many of the Agriculture Development Projects (ADP) and are mostly sitting idle with limited operating hours on them, or their hour meters broken (Fig. 19).

The combines normally do a much more complete job of harvesting virtually eliminating the prospects for gleaner to come in behind to clean up any left over grain. Thus shifting to combines will typically increase the recovered rice by from 10 to 15%, which is often what the in-kind

[9] *A rai is the traditional Thai land unit, most likely based on what a water buffalo could cultivate in a day*

Fig. 19. Tractors lined up outside ADP with limited hours of use and various state of repair.

where they should be inserted into the system. My suggestion would be at the local trader level that are holding paddy for the transport wholesaler. They have the vested interest in delivering clean bags of grain, but are still in direct contact with the farmers. Thus farmers bring bags of paddy for sale to the trader. The trader could make a quick inspection with a grain spike and if needed simply have the farmers run the paddy through the cleaner under the supervision of the traders, and receive a premium for their grain. This could also be used to remove foreign material from retained seed, or adding a sieve and remove some of the larger foreign materials.

combine charges will be. Thus, the farmer will realize the same yield, but without the manual harvesting costs. Also the paddy will be cleaner for not having been left on the ground to collect mud clods, and the blowers will typically blow the paddy clean of light material.

Winnowing Machines: If combines are not available there are simple manually operated winnowing machines that can at least remove the light weight foreign material from paddy (Fig. 20). The example comes from neighboring Ghana but is similar, if a smaller version, to those used extensively in Egypt. The question might be

Fig. 20. Simple hand operated winnowing machine from Ghana that could help clean paddy enough to command higher sale price.

Other Concerns to Consider

While this mostly concludes the discussion on rice grain quality, there are a couple additional issues the AADIL might want to consider as they proceed with their program. These are areas that the development community tends to emphasis, but the farmer/beneficiaries may be considerable less interested in and basically take their business elsewhere. Often this results in reporting that is more promotional then objective and contributes to an over-institutional commitment of ideas that are not really that effective in assisting smallholder producers.

Value Added vs. Outsourcing: In reviewing the value chain for rice or other commodities the basic idea is to maintain farmer involvement as far up the value chain as possible. This is really based on the questionable concept that farmers have surplus time to partake in value added activities and overlooking the additional overhead costs that may be incurred and exceed the value added benefit. Thus the questions become are farmers financially better off using their scarce labor resources to improve their production or quality of rice or other farm enterprise, and outsource the value added; or add value to what they have already produced and give up

opportunity for increasing yield or quality. There is also the possibility, identified elsewhere in Nigeria, of a hybrid in which the farmer would outsource the parboiling and milling to concentrate on additional farm activities, but when the on-farm activities were limited they would opt for a day of casual labor working for the parboil processor or mills. This should be an administrative choice for the farmers that maximize their individual's options each day. Within the rice value chain it looks like most of the time the value added is outsourced, particularly if considerable capital or labor is involved. For rice this was the case for both parboiling and milling. In the case of parboiling it was mostly by clean cash sale ending the farmers' involvement in the value chain, while the milling was mostly a contract service without change of ownership. As mentioned previously the difference could be the need to leave the rice at least overnight for parboiling, which farmers might be reluctant to do for security reasons, as they would have to leave their paddy with the parboiler at least overnight and out of their direct control vs. being able to simply observe the milling process and return home with recovered milled rice. The bottom line is to appreciate the farmers have multiple enterprise and opportunities on a given day, and will go to the options that offers the highest return for their labor on any given day and development projects need to respect their full line of prospects. AADIL might be advised to make careful and detailed analysis of the potential options to see when it is in the farmers best interest to either outsource or add value, and not simple assume that adding value is the best option.

The same preference for outsourcing value added was also noted in cassava value chain and conversion of cassava to garri, a dried less perishable form of cassava. During a September 2009 visit to Nigeria near Makurdi, Benue State, a FAO funded women's income generation cassava/garri value chain processing facility was sitting completely idle and appears to have been idle for months, while 100 m down the road and across the highway a small private women managed cassava/garri processing facility was going at full capacity (Fig. 21). While the family grew some cassava most of what they processed was purchased from neighbor happy to outsource the value added with clean cash sales, ending their involvement in the value chain. Most likely the women running the business was one time a member of the apparently defunct FAO sponsored women's income generating project. Unfortunately, this is all too frequently the result of well-intended projects that don't fully factor in the indigenous business model, and multiple farm enterprise the farmers might be involved in.

Fig. 21. A virtually abandoned women's income generation project for converting cassava to garri (above) with a private family business 100 m working at full capacity an indication a possible preference for outsourcing value added activities (below).

Basic Business Model: While AADIL is parastatel the basic business model it is working

on appears derived from the development cooperative model. This unfortunately is a highly promoted model, but may not be the most competitive and provide the farmers the financially best return and most convenient services. While I will fully agree that model is socially ideal, but it tends to be administratively cumbersome and inconvenient for most farmers primarily interested in clean cash transaction. Thus, the envisioned financial advantages can quickly disappear and the operational overhead a major burden that consume any financial benefits for bulk buying inputs or selling produce. The net result is that such models usually attract only a small fraction of the farmer/beneficiaries and even then they divert most of their service needs to the competing private traders, resulting in negligible total contribution to the community economy. This is then covered up in the reporting that completely overlooks the embarrassing business parameters that would separate projects that can be sustained beyond external support and facilitation, from what is mostly a publicity stunt of the donor's good intentions[10]. As previously noted, it is possible to numerate some 14 areas[11] were a cooperative business model will lose the envisioned competitive advantage so the profit margins of the private traders are less than the sustainable costs for the cooperative, and farmers are financially and convenience wise better taking their business elsewhere. It might be desirable for AADIL to review the list and see how many apply. The big issues are consignment selling where the farmers are more interested in cash sales and maintaining their goods in kind as long as possible, the use of credit clubs where farmers risk having part of their crop confiscated to cover a neighbors loan, and maintenance of physical facilities, etc.

Access to Mechanization: Another concern would be enhancing access to contract mechanization for basic land preparation. Currently this is a critical part of the AADIL's demonstration was undertaking the land preparation for the farmers. They did this by contract with Adamawa Agricultural Mechanization Authority (AAMA) another parastatal company in Adamawa. This effectively preempted the normal availability of tractors to smallholders and may have provided a service to its farmers more expediently then available to most of the farmers as mentioned during the seminar. Thus there may be a need for AADIL to facilitate an increase in the number of tractors available for hire in Adamawa. This might best be done by seeing if used tractors could be imported, reconditioned as part of a vocational training program[12] and sold to individual operating in smallholder communities. With the AADIL consultants' ties to Surinam and back to Europe they might have better access to the Massey-Ferguson and Fiat tractors than a project anchored in the USA with access mostly to John Deere, Case and Ford that are not as common in Africa as Massey-Ferguson and Fiat and thus not as reliable a spare part chain.

AADIL may wish to be careful in relying on AAMA. As a parastatal they may have serious problems maintaining their tractors and assure they will be operating when needed. In the interview and visit they claimed only 30 tractors of the estimated 200 they owned were operating. That left a question of what happened to the other 170 units. How many had been surveyed out premature or had been used for the full designed service life usually 10,000 operating hours. How many were in need of repair, etc. It was noticed none were under repair in the shop and the spare part store room was sufficiently full of dust to wonder if anyone received

[10] *http://lamar.colostate.edu/~rtinsley/Cooperatives.htm*
[11] *http://lamar.colostate.edu/~rtinsley/LossCompetitiveAdvantage.html*
[12] *http://lamar.colostate.edu/~rtinsley/UsedTractors.htm*

any spare parts from the store room for several months. Also such public sector organization tend to concentrate on providing services to other public sector groups like AADIL, larger farmers, and politically influential individuals, so they rarely have time to serve the less fortunate smallholder who are supposed to be the primary beneficiaries.

Micro-Credit: Another area that may need to be reviewed is the effective use of microcredit. For the most part micro-credit is largely used to finance production needs of farmers in terms of seed, fertilizer, crop protection chemicals, and perhaps labor or contract tillage. What it is normally not used for is to help with the large capital inputs needed to enhance and expedite crop production in terms of timeliness, yield, recovery, and quality and for which the equipment could partly serve as collateral. As mentioned previously in this report it would be possible to substantially increase the rice quality by acquiring two-stage single pass mills, or by obtaining small combines that can work within smallholder fields increasing both the recovery of rice and quality, or perhaps simple winnowing machines to further clean rice prior to selling and even increase the tractor density so more farmers have better prospects for the timely crop establishment that AADIL demonstrated by preempting the potential 30 day or more delay in getting tractor access. However, this mechanical equipment is too expensive for individual smallholder to purchase nor can it be justified by the amount of individual use. Thus this high capital equipment is best provided by individual who have drifted out of farming to become full time contract service providers. Thus the micro-credit programs might want to evaluate the services needed in the village or community to expedite the crop production both in terms of yield, timeliness of operations, and recovery of yield of smallholder farmers, and look at how it could assist individuals to acquire some of the needed equipment to expedite farming operations of the entire community. It might also look at additional loan, perhaps from a more limited provider, to fund the operating costs of the equipment such as tractors used for land preparation may have to wait until harvest for payments. These secondary loans would not be as essential for rice mills and combine as they can get an immediate in-kind payment for the services performed. They would only have to monetize it. The microfinance effort should look at promoting enhanced synergy between smallholder farmers and the service providers for the betterment of the community as a whole.

As mentioned earlier with mechanical equipment it has to be individually privately owned and cannot be owned or operated under any form of joint ownership such as government, parastatal companies or even farmer cooperatives. Under this joint ownership the equipment will only last a fraction of its designed service life. Thus there is a need for micro finance to accommodate this level of finance. It is recognized that this represents a fairly dramatic shift in use of microfinance and would require some policy changes.

Summary and Recommendations

The volunteer consultancy indicated that for the most part the quality of the paddy was in reasonable good conditions and certainly not in need of any expensive destoning effort. However the real problem with paddy quality was the quality of the mills being used to mill paddy. The mills were simple one-stage mills designed more to mill maize into maize flour rather than dehusk and polish rice. Thus the main recommendation for improving rice quality within a SME family enterprise environment would be to arrange for import and sale to appropriate private

millers single pass two stage rice mills that are common throughout the rice producing area of Asia and used extensively for local rice milling within the towns and villages. With the 30% price difference between local and imported milled rice, plus the increased milling recovery, the shift to improved mills should be easily economically justified.

Other means of improving rice quality and yield recovery would be to look at some small combines, also developed in Asia that now combine harvest most of the rice crop. These are track driven and capable of operating in moist paddies as small as $1/6^{th}$ ha, typical of paddies found in smallholder rice communities. While such combines are capable of both improving the quality of paddy harvested, in Yola where paddy quality is reasonable good, the biggest contribution would be a 10 to 15% increase in recovered yield, that would normally have to be abandoned in the field for gleaners to gather. If combines were obtain they need to be privately owned and available to farmers on a contract basis.

Additional quality improvement of paddy would be the acquiring manually winnowing machines to remove excess foreign material prior to selling paddy to traders and then command up to 10% increase in value.

Aside from issues of paddy and rice quality AADIL might which to consider the following:

1. Carefully review the history of the limited success of Estate Mode management of smallholders and make certain that it will be suitable for their program.

2. Similarly, review the history of use of public or joint owned equipment such as tractors, combines, and mill. Such joint ownership of equipment has been basically discredited by donors for about 40 years primarily because of problems with maintenance that could limit the service life to less than $1/3^{rd}$ the designed life.

3. Review the value chain and consider what parts should be managed by the farmers and what should be outsourced either with clean cash sales as for parboiling, or contracted out as with milling.

4. Review the basic business model for working with smallholders to make certain it is financially competitive, convenient, and consistent with their overall financial management strategy. Typically this business model is not and thus attracts only a small percent of the potential beneficiaries, and even then they will divert most of their business to competing sources, so that ultimately programs will have only negligible sustainable impact on host communities' economy.

5. Look at ways to increase access to tractors for contracting basic land preparation, and see if this would be more effective if worked through private individuals rather than any form of joint ownership.

6. Review the micro-credit/micro-finance program to see if it should be viewed on a community basis and assist in financing some of the capital inputs like tractors, combines, and mills that would help expedite the overall value chain and assure the farmers a higher return, even if declining to be involved in the complete value chain.

Appendix

Richard L. Tinsley

Rice Post-Harvest Farmer-to-Farmer Volunteer Consultant to Adamawa Agriculture Development & Investment Ltd.

Winrock International Farmer-to-Farmer Program

Daily Log

Thursday 30 June	Departed Fort Collins at noon for Denver Airport and flight to Memphis, continuing to Amsterdam and Abuja. I experienced one hour thunderstorm delay on Denver taxiway, missed connection to Amsterdam, with next available connecting flight Monday 4 July. Airline accommodated with hotel and meal vouchers.
Friday, 1 July	Contacted Winrock and advised of the situation. Remain in and around hotel to see what options were available. I was eventually advised to continue with airline rebookings with departure on Sunday night for Amsterdam and continuing to Abuja on Monday. Renewed hotel and meal vouchers.
Saturday, 2 July	Still in Memphis again renewed hotel and meal voucher after which took time to visit the National Civil Rights Museum. It encompassed the Lorraine Motel were Rev. Martin Luther King was killed. It was a very enjoyable and educational afternoon.
Sunday, 3 July	Loafed around hotel and airport until evening departure for Amsterdam.
Monday, 4 July	Made the connection to Abuja and arrived in Abuja in late evening. Was met at the airport and taken to Rockview Hotel. Total time from departure Fort Collins to arrival at the hotel was 99 hrs, the second longest trip I had experienced.
Tuesday, 5 July	Daytime briefing with Mike Bassey on the program; reviewed and revised schedule prior departing for afternoon flight to Yola.
Wednesday, 6 July	Finally, I was able to start the assignment with initial meeting with Vazheparambil Francis of Standard Microfinance Bank Ltd, the official host. We then proceeded to Adamawa Agricultural Development and Investment Ltd. (AADIL) who served as the primary host. The meeting was attended by Jim Sulewiman, Dep. Managing Director, Glenn Faria, Consultant, Bello Abdullahi Abba, Senior Project Manager, Jacques Drielsma, Consultant among others. This was basically an organization

meeting to organize the visit. AADIL is parastatal corporation with the mandate to develop commercial rice production in the state. They are assisted by a three person consulting team from Surinam who were involved in a 10,000 ha commercial rice farm. They appeared to have limited experience with rice production outside of Surinam, or in working with smallholder producers, and are attempting to duplicate the rice production system of Surinam.

After the formal introduction we made a field visit to a demonstration area of paddy management using well water. This was followed by visit to a production area. This was basically a broad valley that would flood to a depth of one meter or more during the second half of the rainy season. This was thus a typical medium deep water rice cultivation system, similar to An Giang, Viet Nam or Karonga, Malawi. The basic cultivation was dry land preparation, dappling the seeds into the soil, followed by one or two weeding while waiting for the flood to complete the weed control. Collected 2 samples, Sample 1 was the seed being sown, and Sample 2 later that evening from restaurant serving white rice. It was supposed to be par-boiled imported from Thailand. The project was emphasizing chisel plows as opposed to disc plows for basic land preparation and then dappling the seeds. This would be followed by herbicide applications for weed control. The program concentrates on estate mode management of smallholder fields. That is doing the land preparation across property lines, which I find troubling and have never seen succeed as a sustainable means for managing smallholders. Perhaps if confined to contract tractor for land preparation it will be ok.

Thursday, 7 July

Today mostly occupied with field visits. The first was to look at some village cottage industry for par-boiling rice. In this case the vats were standard 200 lit drums and thus considerable smaller than in my previous visit to par boiling operations in Nigeria. I carefully noted the amount of empty grain and chaff that floated to the surface and had to be skimmed off. This amounted to about 1/3rd the volume of the paddy bags. This highlighted that par-boiling can be an effective way of cleaning a bag of paddy, more so then the normal wind winnowing. I collected 2 more samples for analysis. Sample 3 pre par boiled paddy and Sample 4 post par boiled paddy.

After visiting the par boiling process proceeded to visit some other rice producing areas near Gurin they plan to develop for fully controlled water by bunding off the entire 800 ha areas and install a couple low lift pumps to provide water.

Friday, 8 July

After a 3 hr drive visited a village to see village milling operations. Like all others it was highly fragmented with a large number of small mills connected by belts to small diesel engines. Some engines looking like they

should be in a museum. The end quality was very poor. The mills were used for both raw and par-boiled rice, with only minor adjustments to the screen and pressure plates. The raw rice had a recovery estimated to be only 50% compared to the expected 67%. My guess is that given the amount of broken, a considerable amount of finely broken rice was being lost with the mesh. I collected 4 samples. Sample 5 was raw rice prior to milling. Sample 6 was raw rice after milling. Sample 7 was par-boiled rice after milling and Sample 8 was par-boiled rice prior to milling. Noted the bran/hull mesh from the par-boiled rice was wasted while the bran/hull mesh from the raw rice was retained by the owner for cattle fed.
After observing the milling went to the marketing area. Here we saw stacks of paddy to be sold to traders every Thursday. They claimed each week they would sell some 80 tons of rice that would require 10 truckloads. This entire operation was for raw paddy that the traders would then sell to par-boilers or directly to wholesalers for milling and distributing to retailers. These village traders were only getting a 300 ₦ markup per bag they traded. They handled about 50 bags per week for a weekly gross income of 15,000 N (US$ 100). They were also suspected of being informal credit providers. The paddy coming on the market was really last year's rice that the farmers had held in their homes until now as part of a marketing strategy. There appeared to be considerable paddy still available in the village. Surprising the paddy appeared in good condition with limited evidence of weevil or rat damage.

Saturday, 9 July — Weekend so remained around the hotel working on activity logs, etc. I had a 2 hr interview with Francis concerning micro-finance as it applied to AADIL and in general, including my personal project of Tractor Roundup International (TRI).

Sunday, 10 July — Rest day spent around the hotel, but processed all samples to date including hiring some hotel staff to separate some samples. All were photographed. Dinner with Francis and wife.

Monday, 11 July — Unable to meet with AADIL staff so proceeded to purchase ticket for return flight. Afterward we visited the market to look at rice samples available in town. We collected samples of local raw and par boiled milled rice. This was noticeable better quality than in the village. Also collected a sample of raw rice milled in Cameroon. This was again better quality then locally milled rice. I had to pay some 80 ₦ for the samples without receipts.

Tuesday, 12 July — Visited one large farmer producing rice in another area subject to flooding. He was weeding it waiting for the flood water. He was pay 30,000 ₦ for 9 women to weed about 2 ha. It was expected to take about 4 days so they were getting about US$ 6/day. Next visited the Adamawa Agricultural Mechanization Authority that provided tractors for project to expedite and

	consolidate the land preparation. Met with Alh. Umar A. Boddoyi, General Manager. It was a parstatal company that looked very much like public sector mechanization. While they may have up to 30 of an initial 200 tractors operational, it is unlikely this will remain the case. Only tractors on the premises were disassembled for various reasons, but limited amount of work being done. The spare parts store room was completely coated with dust that looked like no one had taken any parts out for months. I was disappointed it was more public sector than private. Return to hotel to work on seminar.
Wednesday, 13 July	Delivered final seminar to AADIL and invited guests. Total 25 people of which 4 were women. Seminar was 50 minutes followed by 40 minutes of questioning/discussion.
Thursday, 14 July	Returned to Abuja. Supposed to be mostly day for relaxing but ended up with 2 ad hoc meeting. One with TomTimberg of the World Bank micro-finance program and the other with Rofiqul Islam of PrOpCom. The first meeting was on micro-finance in general and rice processing. The second was more detailed. They were looking at improved small scale par boiling equipment that emphasized more steaming than cooking. Claimed the current method left too much discolored grain. Not certain that could be substantiated with samples taken.
Friday, 15 July	Last day. Had informal meeting with USAID's Nduka Okaro to discussed the results of the visit. They mentioned a private effort to build a 50,000 t/yr parboiled rice mill. The mill would then work with some smallholder groups in marketing and assuring quality control of the incoming paddy. This would be an exceptionally large scale mill. At 5 t/ha it would take the entire output of some 10,000 ha of rice land. It would also need 1,000 ton per week or 150 ton/day. At 80 kg/bag this would amount to almost 1900 bags per day, more than one could convenient individually check for quality and rebag it conditions were not met. It would be interesting to see how much paddy was coming from smallholder farmer groups, and how much from private traders, and relative ease of working with each. That concluded the visit as in the evening flew to Amsterdam.
16 July	Returned to Fort Collins with no major incidents, arriving home at 6:00 pm.
	End of Activities log

Table A1. Monthly Variation in Precipitation for Minna, Nigeria (mm)

Year/Mont	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1962	0	0	0	120	130	180	150	410	330	220	30	0
1963	0	3	2	60	40	140	260	260	160	160	0	0
1964	0	0	4	70	120	120	229	292	533	122	2	0
1965		48	10	3	132	251	195	193	206	107	0	0
1966	0	0	0	71	129	231	145	140	300	145	0	0
1967	0	0	5	126	76	180	170	307	409	100	0	0
1968	0	0	74	150	94	253	253	209	172	81	0	0
1969	0	0	10	61	189	128	230	201	202	220	29	0
1970	0	0	10	14	66	98	173	345	341	69	0	0
1971	0	5	7	26	140	213	233	245	242	29	0	0
1972	0	0	47	31	227	83	316	427	187	51	0	5
1973	0	0	4	22	79	85	85	393	266	60	0	0
1974	0	0	5	8	120	120	287	210	252	128	0	0
1975	0	19	21	15	127	180	113	142	380	78	0	0
1976	0	86	0	44	141	189	142	183	154	242	10	0
1977	0	0	0	4	122	138	280	390	323	94	0	0
1978	0	0	17	204	262	123	201	397	249	121	4	0
1979	0	0	15	15	138	196	254	406	137	148	7	0
1980	0	0	0	7	239	130	203	249	149	141	0	0
1981	0	0	0	22	57	188	239	276	183	92	0	0
1982	0	0	13	99	45	137	288	353	160	104	0	0
1983	0	0	12	59	85	175	244	206	41	133	7	0
1984	0	0	3	54	81	116	188	163	170	57	0	0
1985	0	0	60	17	141	250	233	244	176	61	0	0
1986	0	0	39	15	86	183	221	243	315	83	19	0
1987	0	0	13	44	104	83	143	238	94	100	0	0
1988	10	0	0	57	94	135	175	309	382	36	0	0
1989	0	0	7	48	215	250	188	206	179	85	0	0
1990	0	0	0	107	199	94	198	181	187	141	0	0
1991	0	0	0	114	336	180	192	268	190	33	0	0
1992	0	0	1	158	176	162	196	231	230	46	0	0
Count	30	31	31	31	31	31	31	31	31	31	31	31
Sum	10	161	379	1845	4190	4991	6424	8317	7299	3287	108	5
Ave.	0.33	5.19	12.23	59.52	135.16	161.00	207.23	268.29	235.45	106.03	3.48	0.16
Std. Dev	1.86	17.84	18.52	51.53	69.10	53.18	53.47	82.01	103.56	50.82	6.48	0.91
CV (%)	557.09	343.53	151.50	86.58	51.12	33.03	25.80	30.57	43.98	47.93	185.96	565.98
	Ave. Total Annual Rainfall					**1194**						