# USAID Mid Point Project Evaluation of

# West Africa Rice Development Association

Project Number 698-0429

Conducted by

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## ACKNOWLEDGEMENTS

The West Africa Rice Development Association (WARDA) is a group of developing countries with a common interest---becoming self-sufficient in rice production. Not only are the political and social groupings dissimilar within this 15 country area, but the diverse ecological conditions need different farming systems. Climatic conditions vary from the highest to the lowest rainfall in the world. Rice is grown in the tidal mangrove swamps along the coast during the salt-free period; along the inland river basins in concert with the floods and; in the uplands where the farmers depend on the rainfall. Production in these ecological zones require high yielding rice varieties with a range of characteristics: 100 to 200 day growth period, adapted to various water depths, tolerance for, or resistance to specific conditions in each zone and, of course, they must produce quality grain.

This mid-point evaluation of the WARDA II project sponsored by AID not only looked at the project components, but also looked at the WARDA administrative management capability. WARDA, now in its teens, is having growing pain and is perhaps at its most critical juncture. WARDA needs the financial support of the Member States and in return needs to trim its operations to match available resources. WARDA has capable people on its staff who have the intellectual ability to draw on a range of resources to solve most of the technical problems of rice production. The next big hurdle will be to help Member States develop the effective national extension services, input supply systems, and price policies that will give the farmers the incentive to take full advantage of the technology being developed.

The team wishes to express its appreciation for the hospitality extended by WARDA headquarters and the thoughtful comments made on the draft report. The research teams at Rokupr and Mopti made our visits to those stations most enjoyable. Efforts to explain work underway were much appreciated and helped us to understand the complexity of the problems. We were greatly impressed by the professional competence of both the local and international scientists.

The Evaluation Team could not have done its work in the short four weeks without the tight scheduling and support provided by the USAID/Liberia Mission. The Africa Bureau, Office of Regional Affairs and USDA/OICD provided the very valuable service of assembling the team and providing all of the logistical support required for our travel to West Africa and return.

For the team members this evaluation was a very challenging assignment. We learned a great deal and hope that our analysis of the situation will have value to those who must live and work with the problems. Our comments and criticism are meant to be constructive.

It was not possible to complete the report before leaving Monrovia; therefore the final assembly of the report has been the responsibility of the team leader. I have tried to reflect the teams views; if emphasis has varied from that intended, the fault is mine.

Sincerely,

Donald R. Mitchell,
Team Leader

P.S. This report has been reviewed by WARDA officials, as well as concerned officers in USAID/Monrovia and AID/Washington. While all may not be in full agreement with the report, it was found to be reasonably factual.

Washington, D.C.
January 20, 1984

## Executive Summary

# USAID MID-POINT PROJECT EVALUATION OF WEST AFRICA RICE DEVELOPMENT ASSOCIATION PROJECT NUMBER 698-0429

Initiated in FY81, the West Africa Rice Development Association WARDA Project (698-0429), usually referred to as WARDA II, is a continuation of an earlier project designed to assist in the development of 1) a Mangrove Swamp Rice Research Station at Rokupr, Sierra Leone, 2) a Deep Water Floating Rice Research Station at Mopti, Mali and 3) a Training Center at Fendall, Liberia. A Technology Assessment and Transfer (TAT) component was added to provide the extension linkage to national extension programs.

The WARDA Training Center at Fendall, Liberia has trained 907 government employees from the member countries. Although an adequate assessment of the utilization of these trainees after they return home has not been done, it appears that a high percentage are involved in rice production programs. From all reports their performance has improved. The training courses are based on the IRRI model with local adaptations. Additional facilities are planned under the project to double the present capacity of 32. This project funds the training staff, facilities and a large portion of the operation costs. Other donors are funding specific training programs.

The Mangrove Swamp Rice Research Station at Rokupr, Sierra Leone, has been in operation since 1934. It became a WARDA regional station in 1975-76 when AID made its first grant for development of the station. A number of so-called traditional varieties now grown by farmers were earlier selections made by the station. The WARDA international staff work closely with Sierra Leone professionals. Poor communications and untimely funding by WARDA are major frustrations of station personnel. High yielding varieties, fertilizer requirements, pest, weed and disease control and improved cultural practices are in varying stages of development. While some of the research work seems redundant, plots are well laid out and meet internationally accepted standards. With an Agricultural Economist and Extension Agronomist in residence a good start is being made in developing packages of information for national extension programs.

The Deep Water Floating Rice Research Station at Mopti, Mali is a new station started in 1978. It has been under the leadership of an acting director since its beginning and has been plagued by cash shortages. The recent hiring of an experienced director is a positive action in improving station management. All research plots were lost in 1982 due to drought. It appears much of the current research is in jeopardy since the Niger River as of Oct 6, 1983, was about one meter below average expected flood levels. While the station has inadequate pumping capacity; with funds to buy sufficient diesel fuel, it could pump enough to save the research.

The station badly needs a larger pumping capacity. Identification of BH 2 and DM 16 rice varieties holds considerable promise for increased yields. Station personnel have made good progress in weed control by plowing after harvest and before planting --- line sowing also makes weeding easier. No TAT personnel are currently at Mopti. The Extension Agronomist is away on an academic program and the Agricultural Economist position is vacant. WARDA plans to fill these positions soon. Even so, station personnel are cooperating with Mali's Operation Riz personnel and have some 132 trials in farmers fields plus 30 local verification trials under the TAT program.

The TAT program is the newest project activity to get underway. There is sufficient information available for a good extension program in all the rice ecologies. However, a severe limitation is the absence of effective national extension programs in West African countries that can utilize the technology. Limited availability of input supplies for farmers and disincentive price policies further hamper the adoption process.

By far the most serious constraint on the implementation of the WARDA II Project is the overall cash flow problem of WARDA that has made it extremely difficult for station managers to continue essential work. Member countries have not made scheduled payments to WARDA to cover administrative expenses. WARDA has introduced

some austerity measures, but has not taken timely action to keep FY 1983 commitments within available funds. WARDA follows a policy of depositing funds into a single checking account and gives priority to headquarters operations in allocating cash. The AID projects at Rokupr and Mopti suffer from the overall cash shortage although project funds have been available from AID in amounts needed to cover essential expenses.

## Major Conclusions

1. WARDA is having serious cash flow problems that are adversely affecting field operation. WARDA has taken some action to reduce some and defer other expenses, but unless member countries make additional substantial contributions before the end of the year, WARDA's continued existence is uncertain. A major reconstruction of WARDA would be necessary to assure continuation of the WARDA II activities under WARDA.

2. WARDA's management of the funds provided for the project is not providing an orderly and timely flow of cash to the stations to provide effective operations. Station

personnel are extremely frustrated and often have to make trips to WARDA headquarters to beg for funds to do work planned under the project. AID funds have been available, but are being temporarily borrowed to cover other more urgent (in WARDA's opinion) expenses. AID may have to go along with this procedure until after the Governing Council meeting in December when WARDA hopes sufficient funds for administrative operations will be forthcoming. To do otherwise may force WARDA into bankruptcy.

3. Research and TAT at Rokupr in the mangrove swamp rice area is progressing very well. Improved rice varieties have been tested or developed at the station that have tolerance for iron toxicity, salinity and demonstrate high yield response to small amounts of fertilizer. Promising work is being done on power tillage that shows considerable potential of relieving the drudgery of soil preparation, particularly for women. There is sufficient research information available for an effective extension program. The research and TAT personnel need to be given the support necessary to do their planned work without the frustration of worrying about timely funding. Water and electricity are erratically available and WARDA must plan and take action to provide these essential services in continuous supply.

4. The Mopti station needs the services of an Extension Agronomist and Agriculture Economist to work on the TAT Program. Candidates have been identified and are expected to be on board by December 1983. Operation Riz located in Mopti appears to be an excellent host country institution for extending the technology to farmers.

5. The TAT program has made a good beginning. There are sufficient research results to launch an effective extension program. The limiting factor is the ability of national extension programs to utilize the technology as it is developed, multiply and distribute improved seeds and make sure inputs are available on a timely basis. USAID bilateral programs in member countries may be a good approach, but there are examples of other donor sponsored programs interfacing with WARDA specialists. Strong national extension programs capable of utilizing WARDA research results are essential if the member countries are to achieve their goal of rice self-sufficiency.

6. Under the project, upland rice research is seriously neglected. The project paper states that CGIAR is funding this work. To date their funding has been for the Bouake, Ivory Coast station that is in a low rainfall savannah area

and is not typical of the high rainfall areas where most upland rice is grown. Since upland rice is grown on some 60 percent of the total rice acreage by farmers who are very poor, it does need attention.

7. The project paper does not include institutional development as one of its objectives. Yet building two research stations and a training center, providing staff, and creating within WARDA a capacity to service field programs certainly fall into the institutional development category. We believe this omission is a serious flaw in project design. While the inclusion of institutional development as a project objective would not materially change the emphasis of work being done under the project, it would foster an attitude of developing institutional capability for doing research and extension rather than focus on the end products.

8. Despite the management problems of WARDA headquarters, the project is making satisfactory progress towards stated project objectives.

## Major Recommendations

1. The Deep Water Floating Rice Station at Mopti, Mali is developing good research facilities. An irrigation canal and large polders have been constructed but the canal is used only at times of flooding and the polders are in need of leveling. The station has several small pumps to pump water directly into the polders but these pumps, though inadequate running at full capacity, have not been fully utilized because of the shortage of funds to buy diesel fuel. It is recommended that pump specialist and/or irrigation engineer be contracted to analyze station water requirements and evaluate present pumping capacity. Clearly the station needs the capacity to pump sufficient water to irrigate the research polders and produce foundation seed. All research trials in 1982 were lost due to drought and 1983 trials are in jeopardy. The research work is too important to depend on the vargaries of weather and adequate funds must be provided on time to pump the required water.

2. The Training Center trainees are returning to responsible positions and their performance has reportedly improved. WARDA needs to establish a systematic follow-up evaluation of the training program. WARDA needs to develop plans for alternative (to AID) sources to fund the training beyond the end of the present project.

3. The WARDA program planning process does not effectively engage the full participation of field station and it does not achieve adequate integration of annual program planning and budgeting. An annual integrated program and financial planning review process, at each station, should be held, with headquarters staff spending adequate time at each field station to accomplish the task.

4. An in-depth study should be made of the mangrove swamp areas of coastal West Africa to determine the role of the mangrove swamp in the ecology of the region and assess the amount of area that might be safely cleared for rice production. A study of this nature would provide valuable guidance to the governments of these countries before the mangrove are destroyed.

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# INTRODUCTION

The WARDA II (698-0429) project is the second phase of an earlier project that was, with the exception of some residual activities, completed in FY 1980. A budget of $6.4 million over the 5 year life of the project initiated research activities at the Deep Water, Floating Rice Station at Mopti, Mali, the Mangrove Swamp Rice Station at Rokupr, Sierra Leone and the establishment of the Training Center at Fendall, Liberia.

The present project continues these research and training activities, but places more emphasis on the development and extension of production technology to farmers. The sector goal as stated in the project paper is:

> ....to increase the quality and quanity of rice production in the fifteen WARDA member countries in West Africa, moving toward regional self-sufficiency in rice production.

The stated project purpose is:

> To develop high-yielding varieties of rice, together with appropriate packages of improved practices, and to bring about the adoption of these varieties and practices by West African farmers through extension activities.

## Project Activities

Briefly the $12 million life of project budget provides financial support to WARDA over the five-year period for four discrete project activities. Funds are to be disbursed at the rate of approximately two million dollars per year. The proportion of funds alloted to project activities are shown in Table 1.

TABLE 1

Project Budget by Activity and Expenditure Category ($000)

| Activity | Budget US $ | Percentage | Percentage of Project Activity: TA/Personnel | Commodities | Other[1] |
|---|---|---|---|---|---|
| Mopti | 2671.5 | 22 | 65 | 7 | 28 |
| Rokupr | 1439.2 | 12 | 49 | 14 | 37 |
| Training Center | 4371.5 | 36 | 70 | 5 | 25 |
| Extension Liaison | 3636.9 | 30 | 63 | 8 | 29 |

[1]Less than five percent of total funds are to be used for construction.

## Research

Major emphasis at the two rice stations is to screen varieties collected from world-wide resources, do some breeding work and develop improved cultural practices for the appropriate ecology. Selected varieties and cultural practices are then tested in WARDA member countries. As shown above, the largest portion of the funds are for personnel, both local and international professional staff as well as laborers at the stations. About a third of the funds are for operational costs of the stations.

## Extension

The Extension Liaison functions, a new dimension of the project, takes the technology developed at the stations, puts it together in a package appropriate to local conditions and assumed to be profitable for farmers. For this purpose an Extension Agronomist and an Agriculture Economist are stationed at the research stations. Within WARDA this project activity is known as Technology Assessment and Transfer (TAT) and is headed by an Extension Specialist.

## Training

The Training Center at Fendall receives a major portion of its financial support from this project and conducts training courses in various phases of rice production primarily for government personnel in the 15 member countries. Courses are largely patterned after

rice production training conducted at IRRI. Since trainees come from both Anglophone and Francophone countries, all courses require French/English and English/French translations. The above project activities are coordinated by WARDA headquarters staff located in Monrovia, Liberia. The research activities fall under the leadership of the Director of Research, extension under the Director of Development, and training under the Director of Training. The AID project officer is located in Monrovia and works primarily with headquarters staff but travels as necessary to research stations and other country programs to monitor implementation.

## Evaluation Methodology

The project paper and project grant agreement required that an evaluation program be established. This evaluation was undertaken at the mid-point of project implementation. Objectives of the evaluation, as stated in Monrovia 03660, are as follows:

- evaluate progress towards attainment of project objectives;
- identification and evaluation of problem areas or constraints which may inhibit such attainment;
- an assessment of how such information may be used to overcome such problems;
- evaluate, to the degree feasible, the overall development impact of the project;

The evaluation was undertaken during the four week period from September 19 to October 15, 1983, by a six-person team composed of the following members:

Mr. Donald R. Mitchell, Team Leader

Mr. William A. Carlson, Program Management/Administration

Dr. Reeshon Feuer, Rice Agronomist, Extension

Dr. D. K. Das Gupta, WARDA Research Agronomist (Rice)

Dr. Anoop S. Sandhu, WARDA Extension Specialist

Dr. Ben Jackson, Plant Breeder (Rice)

The above team was fortunate in having the assistance and administrative support of both the out-going and in-coming USAID project officers, Dr. Sidney Bowers and Dr. Mark Smith.

The evaluation team collected information primarily through interview of the many people involved in the program, and relied on statistical information provided by WARDA and the USAID Mission. Field visits were made to the training site at Fendall, Liberia, the Mangrove Swamp Rice Research Station at Rokupr, Sierra Leone and the Deep Water Floating Rice Station at Mopti, Mali. Visits to farmer trials were made in areas surrounding the two stations.

## STATUS OF PROJECT ACCOMPLISHMENTS

The major thrust of this project is to continue to identify high yielding varieties as well as to develop or identify appropriate cultural practices for the mangrove swamp, deep water and floating rice ecologies of West Africa. This technology would then be extended to farmers through national extension services using information generated by a newly developed Technology Assessment and Transfer (TAT) program. Continued support is provided to the Training Center to train participants of member countries in various phases of rice production technology. In this section, Evaluation Team observations and recommendations regarding project accomplisments are summarized. For a more detailed discussion in each area, the readers should see the reports of team member specialists. (APPENDICES B-I)

### Research

#### Deep Water/Floating Rice

Background: The Deep Water and Floating Rice Research Station at Mopti, Mali is located some 674 kilometers from Bamako at the confluence of the Niger and Bani Rivers. The Niger originates in

Guinea and flows through the countries of Guinea, Mali, Niger and finally into the Atlantic Ocean near Port Harcourt, Nigeria. Most of West Africa's estimated 340,000 hectares of land with conditions suitable for deep water/floating rice are located along this river basin. Approximately 250,000 hectares of this land are in Mali, with Mopti near its center.

The production of deep water floating rice is a risky business that depends on the timing of the rains both in the area of production and the watershed at the head of the river. The rains need to be sufficient for the establishment of the seedlings during July so that plants are sufficiently developed to elongate when the river reaches flood levels in August/September. Conditions were not right in 1982 and the total crop was lost. In 1983 the rains came at the right time for good seedling establishment, but the flood waters had not arrived at the time of our visit (October 5-6, 1983) and a crop failure again appeared imminent. These conditions emphasize the need for hardy, drought tolerant varieties and cultural practices to permit survival until the flood waters reach the area.

Research Station: Construction of the present station was started in 1978 after it was decided to relocate from a higher site at Itembi, eight kilometers north of Mopti, a station established by the French Government in 1952 and transferred to IRAT in 1962. IRAT discontinued work at Itembi in 1976. The first WARDA research

reports on the newly located Mopti station cover the 1979 season. In addition to research at Mopti, variety trials and cultural practices are tested at substations located at Birnin Kabli, Nigeria and Niger-Kolo, Tillalsic and Gialtana, Niger.

The Mopti research station has 37 hectares divided into four polders. Approximately 25 hectares of this area are subdivided into shallow, medium and deep water research plots. The remaining area is used for the production of foundation seed. Physical facilities at the station include offices, library-conference room, laboratories, work area for threshing and seed processing, a seed storage room, machine sheds and an assortment of tractors, pumps, sprinkler irrigation equipment, tillage and planting equipment.

Research work at Mopti has not progressed as well as planned, partly due to the drought in 1982 and again in 1983. A large measure of the lack of progress can be placed on inexperienced management at the station coupled with inadequate administrative and financial support from WARDA headquarters.

Since its establishment in 1978, the station has been under the leadership of an acting director who, though academically well trained, had no previous experience in managing a research station. Under the previous project, AID had insisted that a U.S. research

scientist be appointed station director. Unable to locate a suitable person, AID relented and authorized WARDA to recruit internationally. WARDA preference was to find a qualified West African, but when unable to do so, hired Dr. Moolani, an Indian citizen with considerable experience in both teaching and research administration. Dr. Moolani was to assume leadership on October 10, 1983 after the departure of the evaluation team.

Inadequate pump capacity together with untimely releases of funds by WARDA headquarters to purchase fuel has resulted in both delays and failure of research experiments. A research station simply cannot rely on the weather to provide the needed water for research plots or the production of foundation seed. The station has six small diesel pumps that are costly to operate and were obviously not pumping enough water. Although the evaluation team did not include an expert on pumps, we unanimously felt that an adequate water supply must be available and that this could most likely be done with a permanent high volume pump installed on the Bani River. A major distribution canal has been constructed, but the headgates may need repair to keep them from leaking. The station needs the services of an engineer or expert on pump installation to recommend the correct size and design. Further, to make better use of the water, the polders need to be leveled and cross dikes constructed to provide various water depths.

Other improvements in the physical structure at the station include the construction of a sturdy fence to keep livestock out of the polders (the present fence is more of a visual barrier than a physical one). The present seed storage room is poorly designed, clearly does not meet station needs, and should be modified. Built with project funds, it is a small building standing alone and is subject to extreme solar radiation. Had the room been built inside an existing building, it would have been far more efficiently cooled. Electricity in the area is frequently off during the day when cooling is most needed

Technology Developed: Despite the problems of establishing and operating the station, two parts of a technology package — high yielding varieties and weed control — have been developed that will increase yields in farmer fields. Two rice varieties, BH 2 and DM 16, were developed earlier under French management and with continued testing by WARDA, show considerable promise. BH 2 is an early maturing variety adapted to shallow water zones. It is currently being grown by farmers, but seed supplies are inadequate to meet demand. DM 16 is a new variety, not yet available to farmers, of almost ideal characteristics since it combines good eating qualities with great elasticity of growth, making it suitable for all three water depth zones. In addition to high yield, DM 16 has drought tolerance equal to that of O. glabberima, the traditional deep water rice.

Foundation seed of DM 16 is being produced in 1983 under Operation Riz, the Malian national rice production program. Without a crop failure the earliest a farmer would be able to buy certified DM 16 seed would be 1985. A crop failure seemed almost certain at the time of our visit, thus delaying seed availability until 1986 or later. In addition, two Thai varieties (BKN 6986-105-P for shallow and medium depth and BKN 6323 for deep water) show considerable promise of high yield, but may lack drought tolerance. Most farmers in the 39,000 hectare controlled (diked) area of Mopti are growing an old Thai variety, Khao Gaew, in the deep and medium water zones.

Control of weeds, particularly wild rice, is a major problem for farmers. It has been found through research work, that plowing immediately after harvest while the soil is still moist and easy to plow brings the roots of the wild rice to the surface to dry out during the dry season. A second plowing at the beginning of the rainy season to prepare the seedbed greatly reduces wild rice and broad leaf competition. In addition, line sowing is recommended since it makes hand weeding easier.

Mangrove Swamp Rice

Background: Mangrove swamp farming is a rather unique system of rice culture that takes place in the tidal flats extending many miles inland along the many rivers draining this high rainfall

coastal area (100-200 inches annually). The large volumes of fresh water discharged into the long tidal marshes (mangrove swamps) during the wet season flushes much of the salt out to sea, making it possible to grow rice during the salt-free period that ranges from three to more than six months, depending upon the configuration of the specific tidal swamp, its fresh water stream volume and distance from the sea.

The typical mangrove swamp ecology consists of two parts: (1) the true tidal flats (originally with mangrove vegetation) that are inundated by each tide and (2) the associated swamp bordering the true tidal swamp portion which adjoins the uplands. The associated swamp does not receive tidal salt water inundation. Originally, it had a sedge and reed vegetation. Because nearly all the bordering uplands have highly weathered soils from acid material, varying amounts of soluble iron enters into the associated swamp as seepage zones. This creates iron toxic conditions for rice production, most severe adjoining the upland and in the seepage zones, becoming less severe towards the true tidal swamp zone. Rice varieties for the associated swamp zone must be tolerant of iron and aluminum toxicity as well as saline conditions.

It is estimated that approximately one million hectares of mangrove swampland is suitable for rice production. Of this amount, 214,000 hectares are currently under cultivation. Very little additional area is being cleared of mangrove, but several thousand hectares previously cleared are currently fallow. Mangrove swamp comprises seven percent of the currently used rice area in West Africa and accounts for twelve percent of the rice production. With the use of modern varieties, improved management practices and modest inputs of fertilizer and zinc, a 25 to 50 percent increase in production (currently two tons per hectare) is a conservative near term estimate. Whether this increased production will encourage the clearing of more mangrove swamp areas remains to be seen.

Research Station: The Mangrove Swamp Rice Research Station at Rokpur, Sierra Leone, was first established in 1934. Although it had been designated as a WARDA regional research station, Sierra Leone researchers work closely with WARDA personnel. The station appears to be well managed with excellent working relationships among WARDA and the Sierra Leone scientists. Funding delays from WARDA headquarters, coupled with difficult communications require the Station Director to travel to Monrovia frequently to plead for funds. Despite the funding delays the research had continued without serious interruption until September 1983, but current cash shortages and exhaustion of credit threatened to result in a close down of vital activities before the end of October.

Staff are housed on the station and there appeared to be adequate laboratory and office space. The major problem of the station is the shortage of water and electricity. As an economy measure, the town of Rokupr runs the generator only from 7 pm to 7 am. Consequently laboratory equipment, refrigeration, air conditioning, etc. cannot be run during the day. The water pump is very old, has a high failure rat nd does not have sufficient capacity for station needs. A continuous source of electricity and water is needed to provide adequate living and working conditions.

The research plots were exceptionally well laid out and clearly labeled. The station provided the evaluation team with a file identifying and explaining the different trials. The research scientists did an excellent job of explaining their research and were knowledgeable of co-workers' research. Access bunds are large and well constructed providing easy access to all portions of the experimental area, yet allowing free movement of seepage to associated swamp areas and free access of the tide to the true tidal zone experiments.

Technology Developed: Considerable progress has been made in the identification of high yielding rice varieties for the mangrove swamp areas. The development of the ROK 5 variety has provided a

rice with excellent milling and eating qualities, combined with a wide range of adaptability. Since it is tolerant to iron toxicity, it can be grown in both the true tidal and associated swamps. It is higher yielding that traditional varieties without fertilizer, but responds well to fertilizer. A long duration variety, ROK 10, has comparable qualities but does not have tolerance to iron toxicity, and therefore can only be grown in the true tidal area. The station is continuing work on the identification of short, medium, and long duration varieties suitable for the varying salt-free periods that will respond to small amounts of fertilizer and are tolerant of saline conditions and aluminum and iron toxicity. This is a big order, but the Rokupr station has several promising lines under development.

Fertilizer experiments have shown that the mangrove swamp soils with the high yielding varieties show the highest return per unit of fertilizer added at a rate of 40-40-0 per hectare. Lower rates (20-20-0) look promising, particularly when applied by the injection method (a knapsack sprayer with an injection nozzle to place fertilizer 6-8 inches in the soil). Use of small amounts of fertilizer on seed beds, response to the minor element zinc, and timing of fertilizer applications are under investigation.

Research on the use of power tillers appears very promising and has demonstrated increased yields by better, more timely soil preparation and improved weed control. Under traditional methods all soil preparation is done by human power primarily by women — there are no draft animals in the mangrove areas of West Africa because of the Tsetse fly. The use of power tillers would provide a tremendous labor saving resource that would especially benefit women. However, the capital expenditure will require some innovative financial arrangements before farmers will be able to utilize this technology.

Research is also being conducted on pest and disease control. Aside from the stem borer, insects do not appear to be a serious problem. However, the larger more destructive pests, birds and crabs, cause extensive crop loss. In the breeding program selection is being made for variety characteristics that are less attractive to these pests. For example, rice varieties with awns and a high flag leaf seem to be less damaged by birds than varieties where the grain is exposed. While varieties are being tested for tolerance to crabs, the age of the seedlings and location in the field may be more important factors than variety.

## Research Suggestions and Recommendations

The Evaluation Team was highly impressed by the professional competence of both the national and international staff at the two stations. They are dedicated to their work and are making progress

in the long arduous task of identifying technology to increase farmers' productivity. After reviewing the research program of the two stations, the Evaluation Team offers the following suggestions and recommendations.

## Deep Water/Floating Rice Research

### Research Recommendations

1. Aside from the overall financial management problems of WARDA, the greatest constraint to research at this station is the lack of enough water to conduct experiments and produce foundation seed. We are of the opinion that the several small pumps and the sprinkler irrigation system currently at the station are not adequate. Aside from the sizeable capital investment in this equipment, it will be more costly to operate than a single high volume pump installed on the Bani River. We strongly recommend that a competent pump specialist be contracted to thoroughly analyze the station's needs for water and to recommend the most efficient and economical method of delivering the required water. WARDA should then see that the proper installation is made so that another year of research is not lost.

2. The seed storage room is poorly designed and combined with the irregular electricity is not suitable for the long term storage of valuable germ plasm needed in the breeding program. We would urge the Station to modify the building to reduce the intense solar radiation and permit adequate control of the temperature and humidity.

3. A sturdy fence is needed around the perimeter of the station to keep livestock out of the research plots.

4. Since not all deep water rice is grown under semi-arid conditions, it is recommended that WARDA study the possibility of locating a sub station in a suitable high rainfall area.

5. With the arrival of the new Director, it is recommended the position of Deputy Director abolished and the incumbent, who has been Acting Director, should be transfered to another assignment. One of the Senior Research Scientists could be designated as Acting Director in the absence of the Director.

## Suggestions

1. Breeding work at the station may include the following:

    a. Initiation of screening tests for drought tolerance and elongation ability for the dry season period March-May when temperatures are warm.

    b. Generation of additional breeding materials to insure a steady supply of new experimental lines for the different environments.

    c. Initiation of some breeding work on O. glabberima through the use of ionizing radiation to produce non-shattering types.

    d. Inclusion of promising breeding lines in variety cross fertilizer tests to assess their responsiveness.

## Mangrove Swamp Rice Research

### Recommendations

1. Eliminate or reduce experiments where firm conclusions have been reached.

2. WARDA must give serious attention to the need for water and electricity and develop plans for a continuous supply of these services at this station. The present irregularity of service handicaps the efforts of research scientists and needlessly complicates the lives of those residing at the station. A way to alleviate the chronic shortage of water and electricity, would be to authorize the Rokupr station to acquire a pump, stand-by generator and a sufficient reserve supply of diesel fuel to supply water and electricity during periods when the GOSL generator is down.

3. It is recommended that a system that rewards performance needs to be developed and instituted that will compensate local professional staff through increased salary and/or better living and working conditions. The difference between the pay scale and amenities (especially housing) provided WARDA staff and local personnel at both stations needs to be studied carefully and steps taken to narrow the disparity. The differences create a serious moral problem and undermine research efforts. Local staff seconded to WARDA report they can never be anything more than a research assistant even though they may do more productive work than the international staff who are paid substantially more salary and provided better housing. This

problem will become more acute when those persons sent abroad for PhD training return to their home posts and find they are still research assistants even though they are expected to provide major leadership in their specialty.

## Suggestions

1. Continue experiments where firm conclusions have not yet been realized, as for example in the following areas:

    a. Need for the minor element zinc.

    b. Determine the residual effect of several years application of phosphate.

    c. Determine how much less crab damage occurs on farmer fields adjacent to tidal river banks than under station conditions, and how far into a field from typical crab infested banks that crab damage occurs.

2. Establish applied research trials on selected farms to determine the extent of stem borer injury keyed to dates of transplanting, age of seedlings and levels of fertilizer.

3. Try mutagen breeding to select for non-shattering and tolerance to iron toxicity, possibly using CP 4.

## TECHNOLOGY ASSESSMENT AND TRANSFER

The Evaluation Team concludes that sufficient research has been done to provide information to initiate an extension program. This is not to say the job of rice research in West Africa is complete — far from it — however, a body of knowledge does exist to make an extension program feasible. Rice varieties with desirable characteristics have been developed for most ecologies in West Africa. Many of these HYVs provide higher yields without fertilizer than traditional varieties, but respond very well to small inputs of fertilizer. A number of cultural practices have been identified that will increase yields. The major problems in implementing effective extension programs include: (1) the lack of effective national programs in member countries, (2) the absence or erratic availability of fertilizer and other imported inputs, and (3) price policies that provide disincentives to increased rice production. Until these obstacles are overcome, we cannot expect that WARDA member countries will achieve their goals of rice self-sufficiency.

The value of agricultural research is largely unknown until it is put into practice by farmers. The Technology Assessment and Transfer (TAT) component of the project is to provide the link between researchers through national extension services to farmers. This project activity was to start in 1981, but implementation did not actually begin until 1982.

Major WARDA activities include: conducting a socio-economic survey; identification of a technology package; adaptive on-farm trials; and designing and testing extension education strategies to be adopted by the national extension services.

Mopti: Even though there are no TAT personnel currently stationed at Mopti*, the Evaluation Team was pleased to find a very positive and cooperative relationship between the WARDA research staff and the Operation Riz staff. Approximately 12,500 farmers farm 39,000 hectares of land in the water controlled polders growing only deep water and floating rice. About 150 extension workers (25 have received training at Fendall) are employed by the Mali Government in this program. Farm trials are jointly planned and implemented on farmer fields. One to four kinds of applied research trials are undertaken in each water depth zone, including: variety, row versus broadcast, phosphate levels and source, seeding, timing of sowing and nitrogen levels.

Rokupr: The TAT program at Rokupr is progressing very well under the very capable leadership of an Extension Agronomist and Agricultural Economist. We visited two villages where on-farm trials were being conducted and were impressed by the apparent good

*The Extension Agronomist is on academic leave and the Agricultural Economist position is vacant. WARDA has identified individuals for these positions and expects to have them on board by the end of 1983.

working relationship between TAT personnel and local extension workers, some of whom had been trained WARDA's Training Center at Fendall, Liberia. We also visited the Northwest Integrated Agriculture Development Project (NWIADP) at Kambia, a project being funded by the EEC, which provides a variety of services to farmers in a 6700 hectare area (2400 hectare of mangrove swamp rice). The NWIADP personnel were looking to WARDA to provide the technical answers to rice production problems. It was a very good example of the type of relationship where host country officers are working with their farmers, while the WARDA/TAT and research specialists provide technical information.

Although the team did not visit other countries, we were told that both stations had outreach programs in other countries with similar ecologies. In most cases this involves the stationing of an extension person in the country or it is served by station personnel making periodic visits to local extension officials.

There are many ways of evaluating research and extending this information to farmers. While members of the Evaluation Team have many years of experience in working with small rice farmers, we do not pretend to have all the answers. We do, however, feel that the WARDA on-farm trials used to evaluate research are larger than necessary to demonstrate the particular practice. A trial that utilizes 20 percent of a farmer's land (0.4 hectare out of 2.0 hectare) is a sizeable demonstration. WARDA's reasoning for this large of an area is to conform to an area equal to an average size

field and would therefore be large enough to generate economic data to evaluate the practice. There are methods of sampling from much smaller plots that would provide sufficient data for rigorous analysis. Furthermore, the use of small plots enables the extension worker to reach many more farmers and is an effective method of spreading improved varieties.

Our experience indicates that a plot of 5 X 10 meters would be sufficient to introduce, at minimum risk, low-cost technology to small farmers. A pair of plots provides excellent comparison of two practices. The yield from a 5 X 10 meter plot would provide enough seed to plant a quarter of a hectare the following season. This system offers a very inexpensive program for introducing new varieties and technology to help the governments achieve their goal of rice self-sufficiency. For a more complete discussion the readers should see the report entitled "Technology Assessment and Transfer Program," by Anoop S. Sandhu, WARDA Extension Specialist, and "A Critique of the Technology Assessment and Transfer Program," by Reeshon Feuer, Professor of Soil Science and Extension Agronomist, Cornell University. Both were members of the Evaluation Team.

## Technology Assessment and Transfer
## Suggestions and Recommendations

While recognizing that there are many approaches to conducting extension programs, the Evaluation Team makes the following suggestions:

1. Extension Specialists should continue to become thoroughly acquainted with the very best varieties for a particular ecology and how they respond under different conditions. They should know, in depth, the soils of their area, the deficiencies and fertilizer requirements, as well as the weeds, pests, and diseases of rice. They should be in constant contact with researchers to discuss problems with them, and should learn from research trials.

2. Arrange for adequate breeder seed production of improved varieties from which National Programs can produce foundation seed.

3. Interface with national extension programs whenever possible. The work with Operation Riz in Mali and the Northwest Integrated Agriculture Development Project in Sierra Leone are excellent examples of the cooperation needed.

4. A large number of small on-farm trials (5 X 10 meter plots) is preferred to the larger plot trials. There is little need for plots that demonstrate the farmer technology -- concentrate on the improved technology.

5. Although the research efforts in this project are largely focused on deep water/floating and mangrove swamp rice, there are far more farmers in the upland areas that need assistance. TAT efforts should be directed at these farmers whenever possible.

## Training Center

Since 1973, the WARDA Training Center has trained 907 persons from its 15 member countries in a variety of subjects related to rice research and development . Participants of WARDA courses occupy a large number of middle and upper level rice research and development positions in member countries. Another 250-300 trainees will likely be trained during the next two years, thus raising the number of trained personnel to 1150 to 1200 against a number of 1300 as stipulated in the AID Project Paper.

The dormitories attached to the training center can accomodate a maximum of 32 trainees. It is hoped that with the addition of dormitories and expanded dining facilities by the end of 1984, the

class size could be increased to 50 or more. The course curriculum is constantly being revised, as recommended by teachers as well as trainees. In its 1983 revision, emphasis on extension and communication was increased considerably. A new course of six-week duration, funded by the Swiss Government, on Extension Methods and Communication is being organized in March-April, 1984 at Bouake, Ivory Coast.

The center has a Chief of Training, three Training Instructors and two Interpreters/Translators. Since trainees come from both Anglo-phone and Franco-phone countries, continuous interpretation of training lectures has to be done in both languages. The Center draws guest lecturers from the WARDA headquarters, the College of Agriculture of the University of Liberia, as well as from WARDA's Special Research Stations. Thus, the quality of trainers is reasonably good. However, the Center urgently needs an additional translator/interpreter to translate lecture notes and other training materials into both languages for distribution to the trainees. The project has funds for the position. WARDA has advertised for the position, but has not selected a person. The training methodology emphasizes both theory and practical application. Students are required to undertake individual and group projects in which they can actually grow rice and organize field days around their plots. However, trainers mostly depend on lecture method. It would be better if the trainers were encouraged to use more teaching aids. Training manuals need to be prepared for each course.

Discussions with the officials of the Ministry of Agriculture, in Sierra Leone and in Mali, indicated that they are fully satisfied with the quality of training their staff members have received from the WARDA Training Center. A reasonable number of former participants of WARDA training courses are working in rice production projects in both the countries visited by the team.

## Training Center Suggestions and Recommendations

While the training program enjoys considerable success, the Evaluation Team would like to make the following suggestions and recommendations:

## Recommendations

1. Efforts should be expedited to hire the additional interpreter/translator as soon as possible.

2. AID should offer to finance a special evaluation study of the extent to which the Training Center graduates are engaged in training rice research and extension workers upon return to their home countries, the quality of training, the numbers trained and the employment of trainers in relevant rice related development work. Such a study might be done under direct contract with USAID, or by employees of the WARDA Department of Training.

3. The Training Center should establish some means of keeping in contact with its graduates. A newsletter with technical information would be a good way to continue the training process.

4. In cooperation with WARDA, AID should commission a special study of the long-term training needs of the member states, which would include an identification of the role of in-country training in meeting their long-term requirements. WARDA needs to develop plans for alternative (TO AID) sources of funds beyond the end of the present project.

## Suggestions

To help the Training Center overcome some of the difficulty it has in translating training materials, the following alternatives should be explored:

a. The WARDA should utilize the savings resulting from the delay in filling the authorized positions to employ contract translators to reduce the backlog of training materials.

b. AID should explore the possibility of utilizing excess PL 480 foreign currencies to obtain translation services (in countries where the currencies and translation capability exists) to assist the Training Center in reducing the translation backlog.

c. The team understands that IRRI has a capability for translating publication into other languages (including French) upon request and on a fee basis. CGIAR has a joint interest in both organizations and should be able to finance the costs of such translations at IRRI. These translations would have a special value to WARDA, but would obviously also have a world-wide value to Francophone areas.

2. The rice production course material should be reviewed by the key research specialists frequently so that the trainees receive the latest information. Having the researchers teach the trainees, as currently practiced, is a good way of incorporating such material.

## Administration and Management Review

The Problem: Although the AID project does not include institutional development as one of its objectives, AID management was sufficiently concerned about WARDA's management capability to include administration/management as a part of this evaluation. The project paper glossed over any potential management problem by stating: "As an on-going entity, WARDA has the administrative capability for the implementation of the project and all of its components."[1] In fact, the Evaluation Team is of the opinion that the capability of WARDA's administration to manage the Association's resources is the key to the success or failure of the project. While AID project funds were available to the extent needed, the severity of WARDA's 1983 cash flow crisis, affected all project activities.

The fifteen member states are the principle source of financial support for WARDAs administrative budget. Unfortunately, most of the member states are three years or more in arrears in making payments. At the time of the evaluation, member state contributions

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[1] WARDA II Project Paper, p.46

were in the cummulative arrears of over $6.6 million, a shortfall of 38 percent. There are many reasons for the failure to meet these commitments. Officially, the reason given is a shortage of foreign exchange (payments are made in US dollars).

The situation had become so serious at the time of our visit that unless Member States significantly increase their contributions before December 1983, WARDA will not be able to continue salary payments to its current staff. It is already too late to reduce costs in 1983 to meet currently available funds. Under the circumstances the team had to face the issue of whether to evaluate WARDA's management and administration in terms of its long-run survival as a regional international institution, or whether to hew closely to the terms of reference for the mid-term evaluation and assess the impact on the specific projects funded by AID under the WARDA II project. It soon became clear that the long-run survival of WARDA could not be ignored, even though means are available to deflect the most serious short-run impact on USAID-funded activities during the remaining life of the project.

The time available for field review did not permit a comprehensive assessment of all aspects of WARDA management and administration as they bear on WARDA II, nor was such a review necessary under the

terms of reference. Rather, the focus was on administration and management as a (possible) constraint on project output and effectiveness. If all project outputs were judged to be forthcoming on schedule and within budget, then no serious management constraints to project success would exist. The problem of overall management efficiency and responsiveness could be viewed as the proper concern of the WARDA Governing Council, not as a matter of direct concern to USAID.

Effects: The WARDA cash flow problem should not, in principle, impact on the USAID-funded projects. The cash shortage exists only in funds provided by the member states to finance WARDA headquarters core operations. Funds are currently available through USAID/Liberia to pay all necessary and reasonable expenses for WARDA II activities through 1983 and beyond. Nevertheless, the policies and procedures adopted by WARDA management to deal with the cash flow problem have, in fact, impacted adversely on WARDA II activities.

WARDA headquarters has a policy of depositing all funds received, regardless of source or purpose, in a single consolidated checking account. Disbursements are processed as vouchers and bills are presented for payment, and no attempt is made to assure the integrity of funds source or purpose. Temporary deficiencies in

advances or reimbursements from donors or member states did not result in delays or deferrals in project or activity spending, since payments could be made from the consolidated checking account when due. Indeed, USAID funded projects benefited from this arrangement since USAID did not follow the practice of providing an advance of funds to WARDA but, instead, operated on a reimbursement basis. Until 1982, when a cash advance/reimbursement system was initiated, USAID activities were in fact being financed by interest-free loans from other donors and member states through the consolidated checking account.

Since the advance and replenishments are deposited in WARDA's consolidated checking account, they of course are "available" for paying bills for any and all WARDA activities, including core operations. As core funding became more restricted, WARDA II activities under the approved 1983 budget were gradually starved for cash to pay expenses already incurred — causing serious disruption in Special Project activities and forcing field managers and staff to adopt all sorts of expedients to maintain operations at survival levels. Debts were incurred up to the limits tolerated by banks and suppliers. Staff members paid official expenses out of personal funds just to keep operations going, hoping for early reimbursement. Fuel supplies were depleted to the point where essential life-support activities, e.g. water supply, electricity, etc. were reduced below safe levels. At no point did headquarters

officials assume responsibility for advising or directing field station managers on adjustments that should be made in operating plans or budgets. They continued to let field project managers operate on the vain hope that the "temporary" cash shortage would soon be corrected without need to restrict program operations. Not all of the problems identified by the team in the activities of WARDA II are due directly to WARDA's cash flow problem. But they have been made more troublesome and more difficult to resolve, as project managers have been forced to spend excessive amounts of time (including personal trips to Monrovia to plead for cash to pay the bills and debtors) in coping with the problems of maintaining minimum levels of operations without sufficient funds.

## Administration and Management Suggestions and Recommendations

To help WARDA adjust its management operation, the evaluation team offers the following suggestions and recommendations:

### Recommendations

1. The annual program planning and budgeting process should be integrated throughout the organization. Headquarters managers and professional staff should make a special effort to become personally acquainted with operating and financial problems and

opportunities at the field locations. An annual on-site station review, attended by senior officers and by professionals from WARDA headquarters should take place each year. This review should cover both the program and financial plans for the next fiscal year.

2. Station managers should be given an annual budget allocation representing full authority to obligate and disburse funds for all goods and services not reserved for headquarters purchase. Adjustments in spending levels during the year, where needed, should be made through adjustments in operating plans, not by unpredictable adjustments in cash advances or replenishments. Quarterly (or trimester) reviews of current operating plans and budgets with station managers should be instituted.

3. Adjustments in headquarters operations should be made to bring current commitments within a conservative estimate of available funds. Cash should be made immediately available to stations to liquidate aging debts, including bank loans, and sufficient cash advanced at the start of each fiscal year to cover three months' needs (an official policy that was not being implemented at the time of the review).

4. WARDA, perhaps with financial and/or technical assistance from CGIAR, should engage the services of a program-budget expert to assist in designing and installing a modern program and performance budget system that is fully integrated with WARDAs program planning process.

5. Both research stations require immediate infusions of cash to forestall interruption of essential services. It is therefore recommended that the following actions be taken:

    a. The new Executive Secretary and Director of Finance and Administration should give highest priority to the immediate cash needs of the field stations and in consultations and cooperation with USAID/Liberia, take immediate action to transfer sufficient funds to maintain basic station operations for the next three months. If necessary, the money should be delivered to the station managers by special courier from WARDA headquarters rather than depending upon unreliable means of conventional delivery or demanding that the field station personnel come begging to Monrovia.

b. USAID/Liberia should provide a temporary increase in its cash advance to WARDA, if necessary to cover the amounts due the stations for unpaid expenses already incurred on behalf of WARDA II activities — provided adequate assurance is given that the full amount of the increase will be delivered entirely and directly to the stations.

6. USAID should agree to assume full responsibility for funding, under WARDA II, the salary and related costs of the Directors of the Rokupr and Mopti Stations.

## Suggestions

1. To overcome the endemic problem of delays in communications in the West Africa region, WARDA headquarters should institute a regular courier service on a once-a-month schedule around the circuit of capitals where WARDA field activities occur. Field stations, confident of the regular arrival of a courier to the capital, can thus establish regular links to the capital to facilitate delivery of documents, reports and bank drafts. In Sierra Leone and Mali, the USAID missions could offer their services as a courier depository to facilitate services to Rokupr and Mopti stations.

2. A study should be made, working closely with the appropriate ministries in the Member States, to assess the feasibility and cost effectiveness of establishing a regional radio communication network serving WARDA headquarters and all field stations and offices.

Scenario for the Future: For purposes of analyzing WARDA's future course of action, three scenarios were developed for possible courses of action, as follows:

OPTIMISTIC SCENARIO - Assumed that member states would provide enough funding for WARDA to continue operating at current, though somewhat reduced levels. Project activities would continue very much the same as at present.

COLLAPSE SCENARIO - Assumed that member states would not come to the rescue of WARDA and it would cease to exist as a regional international organization — an event that could happen before the terminal date of the current project. AID should begin now to develop contingency plans for reusing what can be saved from WARDA II project activities in the event of a demise of WARDA.

RECONSTRUCTION SCENARIO - Both of the above scenarios, while possible, seem less than probable. In spite of WARDA's problems and in view of its perceived potential, there seems to be enough vested interest in WARDA's survival by at least some member states and international donors to support an alternative

scenario. Considerable emphasis would be placed on the institutional development of WARDA to bring its management style more in accord with other International Agriculture Research Centers. Considerable restructuring would be necessary to tighten management and program effectiveness.

Whatever the outcome, WARDA is at a crossroads and changes in its administrative organization seem inevitable. It is perhaps fortuitous that WARDA's financial woes have come to a climax at the time of the CGIAR External Management Review, the TAC External Program Review, and the AID Midpoint Project Evaluation, which are to be followed by the meeting of WARDA's Scientific and Technical Committee and the Governing Council in early December 1983. From this detailed scrutiny, WARDA will have the opportunity to initiate changes that could not have been made prior to this chain of events.

## PROJECT IMPLEMENTATION

### USAID Monitoring

The team's terms of reference did not include an appraisal of USAID/Liberia's performance in designing or implementing the WARDA II Project. However, upon arrival in Monrovia, the Team was informed by James Purcell, the USAID/Liberia Program and Evaluation Officer, that the Team would be expected to evaluate not only the USAID-funded components of WARDA, but would also be expected to evaluate the performance of USAID in implementing the WARDA II Project.

Because of the short period of time available in West Africa, the overly-tight scheduling, and the pervasive logistical/communications/transportation problems inevitably encountered in accomplishing our task, the Team was not able to devote time to a comprehensive examination of USAID's project implementation processes. Priority had to be given to on-site examination of WARDA activities.

Since implementation began in FY81 the USAID Project Officer, Dr. Sidney Bowers has been monitoring project activities and assisting WARDA staff in implementation. Dr. Bowers is leaving at the end of his current assignment and Dr. Mark Smith recently arrived at post and has assumed the Project Officer role. Both have participated in this evaluation.

Considering the deficiencies in the WARDA II Project Design, and the divided responsibilities for project implementation (between USAID/Liberia and the Regional Affairs Office of USAID Africa Bureau), USAID's WARDA II project implementation has been reasonably successful. The deficiencies in attaining WARDA II Project goals and targets cannot be attributed to USAID/Liberia's project implementation efforts.

WARDA II Project monitoring has been diligent and persistent, and shows every sign of having been committed to the success of the project. While some in WARDA Headquarters have not welcomed the close attention and firm application of USAID's financial discipline, professional staff at the field operations (Fendall, Rokupr, and Mopti) have been quick to praise the concerned attention to their problems by the USAID project manager, and took many opportunities to express to the team their appreciation for the USAID project manager's assistance and support.

The principal weakness in project implementation stems from the organizational fragmentation of responsibility in the AID and AID's failure to deal with WARDA II's regional imperatives. WARDA has been supported by AID and other donors in part because it represents a supranational regional approach to an area-wide problem. Yet The Africa Bureau has failed to respond to the regional problem with a coordinated effort on the part of USAID country missions in the region. There was very little evidence of any joint planning, analysis or action on the part of the USAID country missions related to rice production.

One of the serious problems observed by the team in the WARDA II project design was the rather superficial appraisal of the capability and willingness of the national extension services to carry out their vital role in attaining the objectives of transferring WARDA produced technology to the farmers. Another problem is the facile assumption that once improved technology was available, the governments of the Member States would feel compelled to change national policies (such as price and subsidy policies) to facilitate farmer adoption of the technology. There is serious doubt on the part of many knowledgeable observers about the validity of these key assumptions. Clearly, WARDA itself has little direct leverage over these two key variables, and must rely primarily upon exhortation and faith. However, AID has at its disposal some means

to assist directly in promoting appropriate and necessary responses by Member States, though coordinated efforts to design and finance projects aimed at improving national extension capabilities and encouraging appropriate changes in national policies.

The team feels that the Africa Bureau, if it intends to continue to support WARDA II and WARDA's objectives, should exert leadership in engaging the collaborative efforts of the USAID country missions in analyzing these problems and designing projects for mission portfolios (or incorporating features in existing or proposed projects) that will supplement and complement WARDA II goals and objectives.

Expenditure of Project Funds

Implementation as measured by rates of expenditure of project funds is described in Tables 2 and 3. The slow rates of expenditures have been due to two factors beyond the control of USAID Project Management: an over optimistic implementation schedule designed for the project, and events which have led to a hiring freeze and to the slow transfer of project funds by WARDA Headquarters to its field activities. These two factors are discussed elsewhere in the evaluation report.

TABLE 2: PROJECT BUDGET AND EXPENDITURES

| Component | A<br>Life-of-Project Budget[1] | B<br>3 Year Budget CY81 Through CY83[2] | C<br>Cumulative Project Expenditures Through July 31, 1983[3] | D<br>Unexpended Balance Through July 31, 1983[4] (B minus C) | E<br>Unexpended Balance for life of Project[5] (A minus C) |
|---|---|---|---|---|---|
| MOPTI | | | | | |
| Salaries & Benefits | 1,558,200 | 787,400 | 451,133 | 336,267 | 1,107,067 |
| Consultants | 58,000 | 3,600 | 0 | 3,600 | 58,000 |
| Training | 120,000 | 105,000 | 0 | 105,000 | 120,000 |
| Commodities | 199,000 | 255,396 | 47,380 | 208,016 | 151,620 |
| Other Costs | 393,000 | 415,700 | 270,364 | 145,336 | 122,636 |
| Construction | 100,000 | 127,000 | 0 | 127,000 | 100,000 |
| Contingency | 243,300 | 52,100 | 35,351 | 16,749 | 207,949 |
| Sub-Total Mopti | 2,700,000 | 1,746,196 | 804,228 | 941,968 | 1,867,272 |
| ROKUPR | | | | | |
| Salaries & Benefits | 605,800 | 366,300 | 208,932 | 157,368 | 396,868 |
| Consultants | 25,000 | 10,000 | 708 | 9,292 | 24,292 |
| Training | 75,000 | 78,000 | 0 | 78,000 | 75,000 |
| Commodities | 201,000 | 133,400 | 80,000 | 53,400 | 121,000 |
| Other Costs | 401,700 | 255,000 | 184,010 | 70,990 | 217,690 |
| Construction | 0 | 0 | 0 | 0 | 0 |
| Contingency | 130,700 | 25,200 | 12,638 | 12,562 | 118,062 |
| Sub-Total Rokupr | 1,450,000 | 867,900 | 486,288 | 381,612 | 952,912 |

TABLE 2: PROJECT BUDGET AND EXPENDITURES (Continued)

| Component | A<br>Life-of-Project Budget[1] | B<br>3 Year Budget CY81 Through CY83[2] | C<br>Cumulative Project Expenditures Through July 31, 1983[3] | D<br>Unexpended Balance Through July 31, 1983[4] (B minus C) | E<br>Unexpended Balance for life of Project[5] (A minus C) |
|---|---|---|---|---|---|
| TRAINING CENTER | | | | | |
| Salaries & Benefits | 2,173,200 | 1,482,600 | 1,146,637 | 335,963 | 1,026,563 |
| Consultants | 159,100 | 41,200 | 17,145 | 24,055 | 141,955 |
| Training | 732,200 | 384,000 | 305,156 | 78,844 | 427,044 |
| Commodities | 228,000 | 61,000 | 24,427 | 36,573 | 203,573 |
| Other Costs | 296,000 | 165,900 | 114,956 | 50,944 | 181,044 |
| Construction | 339,000 | 500,500 | 21,626 | 478,874 | 317,374 |
| Contingency | 386,000 | 55,700 | 6,246 | 49,454 | 317,374 |
| Sub-Total Training Ctr. | 4,400,000 | 2,690,900 | 1,636,193 | 1,054,7077 | 2,677,307 |
| TAT (Extension Liaison) | | | | | |
| Salaries & Benefits | 2,291,600 | 981,300 | 357,095 | 624,205 | 1,934,505 |
| Consultants | 0 | 0 | 0 | 0 | 0 |
| Training | 0 | 50,000 | 0 | 50,000 | 0 |
| Commodities | 309,000 | 203,400 | 69,128 | 134,272 | 239,872 |
| Other Costs | 504,000 | 225,300 | 55,453 | 169,847 | 448,547 |
| Construction | 145,000 | 306,000 | 0 | 306,000 | 145,000 |
| Contingency | 336,700 | 93,800 | 5,837 | 87,963 | 330,863 |
| Sub-Total Training Ctr. | 3,650,000 | 1,859,800 | 487,513 | 1,372,287 | 3,098,787 |
| TOTAL[6] | 12,000,000 | 7,164,796 | 3,414,222 | 3,750,574 | 8,585,778 |

## Notes to Table 2

[1]Based on PP budget.

[2]Based on WARDA's latest budget for the project through CY1983, as set out in Voucher #14. This budget approximates that in the PP for the first three project years, although there are some changes in line items. Overall PP budget for first three years is $6,900,000 compared to $7,164,796 in WARDA budget for those three years.

[3]Based on cumulative expenditure totals detailed in Voucher #14, submitted by WARDA to USAID for the period ending July 31, 1983.

[4]Based on WARDA budget through 1983 (detailed in Voucher #14) less WARDA cumulative expenditures to date.

[5]Based on PP LOP budget less WARDA cumulative expenditures to date. While all items in column E could be expected to be greater than those in column D, several are not. This is because column E relies on PP budget projections, while column D relies on revised budget of Voucher #14, which has increased some line items above PP projections, while reducing others. In addition column and row sums for subtotals in column E are slightly different due to PP rounding of subtotal figures in column A. Subtotal in column E is the smaller of the two figures.

[6]The total LOP budget of $12,000,000 in the PP (reflected in column A) is $200,000 short of the sum of the subtotals for the four components, which sum is $12,200,000.

As can be seen from Tables 2 and 3, only 48 percent of funds budgeted for the first three project years (through the end of CY83) have been expended. While expenditures may accelerate over the next year, it does not appear that the full project budget will be expended by the project assistance completion date of September 30, 1984. The slow draw-down has been due to cash flow problems within WARDA resulting in a general freeze on hiring and reductions in travel and other operating expenses. (These problems are discussed fully in the Administrative Management section.)

Table 3: Cumulative Project Expenditures through July 31, 1983 as Percentage of Total Budgeted for CY81 through CY83.

| | Salaries & Benefits | Commodities | Other Costs | Total |
|---|---|---|---|---|
| Mopti | 57 | 19 | 65 | 46 |
| Rokupr | 57 | 60 | 72 | 56 |
| Training | 77 | 40 | 69 | 61 |
| TAT | 36 | 34 | 25 | 25 |
| Total | 60 | 34 | 59 | 48 |

Expenditures on commodities have proceeded at a much slower pace than those on personnel and on "other costs", which include travel, supplies, and maintenance. Expenditures on personnel for the three field-located components (Mopti, Rokupr, and TAT) have been significantly lower than the Training Department's expenditure of project funds. Overall, the Training Department has the most satisfactory rate of expenditure, and TAT the least satisfactory.

## Personnel

By far the most serious delay in filling a key position has been that of Director of the Mopti Deep-Water/Floating Rice Research Station. The station has been managed by an Acting Director since 1979. The new director who arrived in September had not yet taken

on the responsibilities at the time of the Evaluation Team visit, but was scheduled to do so October 10, 1983. This position has been controversial for several years with USAID insisting under the previous project to fill the position with a U.S. Citizen. Unable to find a suitable rice research specialist, USAID agreed to fund the position during the current year with CGIAR funding to be used in the future. WARDA preference was to hire a West African, but unable to locate a suitable candidate, agreed to hire Dr. Moolani, an Indian citizen with considerable experience in research station management. The Evaluation Team concludes that a major hurdle has been overcome and that station management will improve if WARDA headquarters will provide administrative and timely financial support. The team further feels that a full-time deputy director position is unnecessary and that WARDA should transfer the incumbant to another assignment.

Other key personnel needs are for an additional interpreter/translators for the Training Center. Two interpreter/translators are on the staff. The Training Center Director feels four persons are needed to do simultaneous translation in the classroom as well as the translation of course materials, but would be satisfied if the three budgeted positions

were filled. Of the eight extension positions proposed in the project paper for the TAT Program, only the Mopti Station is without extension specialists. The Extension Agronomist is on study leave and the Agriculture Economist position is vacant. However, WARDA has identified candidates and plans to have them on board by the end of the year.

Weaknesses in Project Design

While the Evaluation Team devoted most of its attention to the implementation of project activities we noted several defects in the design that should be called to the attention of AID management. These weaknesses are as follows:

— The project totally ignored the institutional development aspect of developing two research stations, a training center, an extension interface technology transfer program and by inference WARDA headquarter's ability to service these programs. Recognition of this fact early on, may have tempered expectations of accomplishments.

— Excessive optimism about project schedule, considering WARDA's capabilities and the inherent difficulty of implementing a complicated project in several countries.

- Inadequate attention to WARDA's organization and management limitations, and their impact on achieving project objectives.

- Fallacious assumption that Member States will respond to "technological packages" with appropriate incentive policies, and efficient input delivery systems, without any further action by WARDA and donors.

- Erroneous conclusion (based on inadequately analyzed and insufficient data) that most West African States have (or will soon have) adequate national extension systems to transfer the WARDA-generated technology (p. 37, PP). (By contrast WARDA documents on TAT acknowledge serious inadequacies in national extension systems, but WARDA expected that TAT would bridge the gap.)

- Failure to systematically analyze the absorptive capacity of Member States for trained rice research and extension workers, and the potential contribution of in-country training by WARDA-trained trainers, before committing large financial resources to doubling the through-put capacity of the Training Center.

## Environmental Impact

During project paper preparation it was determined that the project would have minimum impact on the environment. Within the strict confines of project activities we would agree with this assessment. However, a major portion of the technology is directed toward improvement in rice production in the mangrove swamp areas. The potential profitability to farmers coupled with policies of West Africa coastal countries to become self-sufficient in rice will likely result in increasing pressure to bring more of the mangrove swamp areas under cultivation. This could accelerate the clearing of mangrove swamp land and could have an adverse effect on the ecology of the area particularly marine life that completes its life cycle under the cover of the mangrove. It is estimated that mangrove swamps cover about one million hectare of land along coastal West Africa. Of this area slightly more than 200,000 hectare have been cleared. We believe an in-depth study should be made of the mangrove swamp areas of coastal West Africa to determine the role of the mangrove swamp in the ecology of the region and assess the amount of area that might be safely cleared for rice production. A study of this nature would provide valuable guidance to the governments of these countries before the mangroves are destroyed.

Progress in Achieving Project Purpose

The project paper states the project purpose (objectives) as follows:

1. To develop new high-yielding rice varieties and cultural practices for specified rice types of regional priority.

2. To actively seek the adoption of high yielding rice varieties and related cultural practices by West African farmers.

Despite the management problems of WARDA, progress is being made in the accomplishment of these objectives. Perhaps it would be technically more correct to state the project purpose is, "to 'identify' rather than 'to develop' high yielding rice varieties....cultural practices." The rice varieties recommended by WARDA have been tested, but were not necessarily developed by WARDA. For example, ROK 5, a variety well adapted to the mangrove swamp areas, was developed at the Rokupr station, but before it became a WARDA research station. Development of new varieties takes many years and WARDA plant breeders working cooperation with IRRI and other IARCs are making and testing crosses that appear to have characteristics that will ultimately result in high yielding

varieties suitable for release to farmers. WARDA has tested nearly 2,000 varieties from world-wide sources. The two stations are testing and developing suitable cultural practices, particularly fertilizer applications rates and methods, tillage practices, weed and pest control practices.

The second project purpose is related to the adoption of high yielding varieties and improved cultural practices by farmers in the region. This is a more difficult goal for WARDA to achieve. However, WARDA through the TAT program is developing components of technology appropriate to the various microclimates of West Africa. The adoption of new technology by farmers is dependent on the economic and social policies of the member state governments. Price policies and availability of input supplies are very important to the acceptance by farmers. The presence of a national extension service capable and willing to teach farmers the new technology is another essential ingredient to the widespread adoption of the technology. WARDA has very little control over the policies adopted by member states, other than the posers of persuasion.

Through its economic studies done in collaboration with member states, WARDA does contribute to policy development and formulation. In addition the training conducted at Fendall and the work of extension liaison personnel in the TAT program make a positive contribution to the development of policies and programs favorable to rice farmers.

Appendix A

# Information Appendix for AFR/W Executive Level Personnel[1]

Prepared by: Donald R. Mitchell, Agricultural Consultant

Date: October 14, 1983

Project: West Africa Rice Development Association (WARDA II)

Country: West Africa Region

Cost: $12 million grant over 5 years

I. What constraints did this project attempt to relieve?

This project was designed to help the 15 West African countries attack several constraints to increased rice production. Low yields are caused by a number of factors such as: weather extremes; soils low in nutrients and/or the presence of toxic substances (acid sulphate, iron, saline); pests (birds, crabs, and insects); lack of HYVs to fit a particular ecological niche; weeds; lack of animal

[1]This format is required of all Africa Bureau evaluations per instructions issued by AFR/DP/PPEA May 25, 1982.

or mechanical power for basic soil tillage; erratic availability of fertilizers and agricultural chemicals. Country goals to increase rice production are in conflict with price controls aimed at keeping rice prices low to urban consumers. Farmers' need for imported fertilizers and agricultural chemicals must compete for scarce foreign exchange needed to import other essential commodities. The project specifically supports research on improved rice varieties and cultural practices for 200,000 hectares of mangrove swamp and 340,000 hectares of deep water and floating areas.

II. What Technology did this project promote to relieve these constraints?

Research efforts undertaken by this project have focused primarily on the testing of some 2000 rice varieties collected from world wide sources. The Rokupr Station has developed one variety (ROK 5) and tested another (CP 4) that are doing very well in a variety of soil and growing conditions found in the mangrove swamp areas. A third variety, ROK 10 developed by the Rokupr Station appears very promising for the "true tidal" areas, the major portion of the mangrove swamp area. Short, medium and long



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duration photo-sensitive rice varieties are needed in the mangrove swamp areas to match the salt-free period that becomes shorter closer to the ocean and longer further inland. At Mopti a new deep water variety (DM 16) shows considerable promise as it combines drought resistance and growth elasticity in various water depths with a high yield of quality rice. Weed control by plowing both after harvest and before planting the next season has reduced weed competition in the deep water areas. In both areas, plant types are being selected for pest and disease resistance. Timing and age of seedlings at transplanting may also be a factor in pest and disease control. Fertilizer amounts and placement techniques are needed for the economic benefit of small scale farmers.

III. What technology did this project attempt to replace?

Traditional varieties of rice with high yielding types better suited to various ecological conditions. Transplanting or direct seeding in rows to make weeding easier. In deep water areas ploughing after harvest and before planting drastically reduces weed competition. Mechanical tillers show considerable promise in lowering human labor requirements in the areas without draft animals. However, innovative financing will be required for farmers to purchase or hire equipment.

IV. Why did project planners believe that intended beneficiaries would adopt the proposed technology?

Project planners believed that the farmers would adopt the new rice varieties and cultural practices because they obtain a greater return for their labors. Research was based on a sound understanding of farmers' constraints. It was anticipated that farmers would first adopt those practices that would result in increased yield with least cost. For example, adopting the ROK 5 rice variety in the medium salt-free duration mangrove swamp ecological zone enables the small scale rice farmers to increase their average yield per hectare from 2.0 to 2.5 metric tons of paddy without fertilizer . With modest amounts of nitrogen or phosphorus fertilizers, depending on specific soil zones in the mangrove swamp ecology, a further increase of 0.5 tons per hectare can be expected.

In addition, it was assumed that governments of the Member States would adopt price policies that would encourage rice production and that national extension programs would extend the improved technology to farmers. WARDA has little power other than persuasion to see that member governments adopt positive policies or strong national extension programs. Since the Technology Assessment and



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Transfer Project component has been underway less than two years, it is too soon to measure positive action on the part of Member States.

V. What characteristics did the intended beneficiaries exhibit that had relevance to their adopting the proposed technology?

In general the farmers of West Africa are eager for low cost technology that will increase their rice yield with the same or less labor input. In much of the area all tillage work is done by human power primarily women and farm size is generally limited by labor availability. They express an intense interest in labor saving methods, but lack of capital for investments in power tillers and other such equipment may limit adoption of some practices. In some areas power tillers owned on a co-operative basis are being tried.

Much of the adoption of practices developed under this project will need to be done through country programs. WARDA can develop the technology and serve as resource people for problems in rice production, but should not conduct more than trial programs as a means of testing the technology with farmers. The country programs must carry it to the masses of farmers.



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VI. What adoption rate has this project achieved in transferring the proposed technology?

It is much too early to tell. The Technology Assessment and Transfer portion of the project has been under way for little more than a year, primarily near the research stations in Mali and Sierra Leone. Where the new varieties of rice seed are available, farmers are accepting them and are showing considerable interest in trials being conducted in farmers fields. Currently the demands of farmers in several of the West African countries for the best new rice varieties is not being met although seed production programs by individual countries are underway.

VII. Has the project set forces into motion that will induce further exploration of the constraint and improvements to the technical package proposed to overcome it?

Yes, the establishment of the two research stations redesigned to continue exploring and testing rice production technology. The training center through the various training programs is doing an effective job in training a core professional staff in the member countries that can refine and spread the technology to farmers. More than 900 extension, applied research and seed production

persons of the 15 country West Africa region, including 200 who have graduated from the month rice production specialist course, have received training at the Fendall Training Center. WARDA faces problems common to regional organizations i.e., locating funding to support the training center and other regional programs to avoid its collapse when donor funding terminates.

VIII. Do private input suppliers have an incentive to examine the constraints addressed by the project and to come up with solutions?

This varies from country to country, but in general most governments in West Africa import and distribute fertilizer and other agricultural chemicals. The amounts are small and the governments attempt to control the price or use them in special project areas. As demand for the inputs increase it is very likely that channels for private suppliers will open.

IX. What delivery system did the project employ to transfer technology to intended beneficiaries?

The technology developed under this project will need to be channeled through the extension services in the member countries to their farmers. The Technology Assessment and

Transfer (TAT) system begun under the WARDA II Project, holds promise of speeding up the transfer of "profitable packages of technology" if emphasis is placed on least risk, minimum cost technology and TAT personnel interface with existing and developing national extension systems. West African governments import fertilizers and agricultural chemicals, consequently very little, if any, of these inputs pass through private commercial channels. Project designers did not anticipate development of new input delivery systems.

X. What training techniques did the project use to develop the delivery system?

The Training Center at Fendall, Liberia has trained 907 agricultural officers from the 15 member countries in rice production technology. Some 200 graduated from the six-month rice production specialists course. Graduate trainees have returned to their countries and are involved in rice production programs. The training courses are largely patterned after the highly successful IRRI and University of the Philippines programs with changes to meet local needs. At each of the research stations an extension agronomist and agricultural economist are located to work between research personnel and the extension personnel in the countries serviced by the WARDA research station.

Appendix B

# ASSESSMENT OF THE DEEPWATER AND FLOATING RICE RESEARCH STATION MOPTI, MALI

By Ben Jackson,
Plant Breeder (Rice)
The Rockerfeller Foundation, Bangkok, Thailand

This report concerns only the Mopti Deep Water Rice Research which was visited October 5 and 6, 1983. October 4 was spent in travel from Bamako to Mopti and October 7 involved the return to Bamako. It was not possible to gain a complete picture of the activities and problems in 2 days at the station but background papers, reports, conversations with station scientists and a short visit to a farmer field have done much to compensate for the brief visit. The remarks in this paper are entirely those of the author and represent his opinion and impressions.

## The Mopti Station

The station on the edge of the city of Mopti 675 Kilometers from the Capitol, Bamako, is accessible by paved all weather road. Approximately 7 1/2 hours driving time in a good vehicle are required to reach it from Bamako. Mopti is located at the confluence of the Niger and Bani rivers. The Niger originates in Guinea and flows through the countries of Guinea, Mali, Niger, and finally empties into the Atlantic Ocean near Port Harcourt in Nigeria. Most of Africa's deep water rice area lies along the Niger.

Mopti at approximately $14^{\circ}$ N Latitude is a part of the semi arid Sahael and receives about 500 mm average rainfall. But in 1983 rainfall has reached only 350 mm and no more is expected. Rain fall is vitally important for rice stand establishment in July in order that the plants can elongate when flood waters ordinarily arrive in mid August to early September. With such limited and variable rainfall, drought stress during the early vegetative stage is quite common. This emphasizes the need for hardy, drought tolerant varieties and cultural practices which will permit survival until the flood waters reach the area. Although this is not greatly different from problems of stand establishment in Asian floating

rice areas, the higher evapo-transpiration rates near the Sahara accentuates the problem. When this is combined with the extremely low rainfall in 1982 and 1983 (about 350 mm) and very low flood levels in both years, much of the floating rice is either not planted or lost to drought. During our visit, flood stage was very marginal despite October being the month of highest water level.

Construction of the present station was completed in 1979 after it was decided to relocate from a high site at Itembi, 8 km north of Mopti which had been established by the French government in 1952 and transferred to IRAT in 1962. IRAT discontinued work at Mopti in 1976. The first WARDA research reports on the Mopti station covers the 1979 season. Mopti's mandate is to serve the deep water rice research work for areas of Senegal, Sierra Leone, Guinea, Mali, Niger, and Nigeria which plants an estimated 450,000 ha of deep water-floating rice. Substations in Nigeria (Birnin Kabli) and Niger (Niger-Kolo, Tillalsic, Gialtana) are to be included in trials of varieties and cultural practices. However, the climate of Mopti is far different from the high rainfall conditions of Guinea, Sierra Leone, and Togo which have appreciable areas of deep water rice.

The Mopti station contains 46 ha whose experimental fields have been subdivided into 4 polders as follows:

| Polder Description | Maximum Water Depth | Area | |
|---|---|---|---|
| Shallow | 1.0 Meter | 14 ha | |
| Medium | 1.3 Meters | 5 ha | |
| Deep | 1.7 Meters | 11 ha | (includes a 0.8 ha tank for varying water depths) |
| Seed Multiplication | 1.0 to 2.5 Meters | 16 ha | |

Physical facilities at the station includes offices and laboratories for the scientists, some work room for seed threshing and processing, a combination library-conference room, machinery storage buildings and a seed storage room located outside the other buildings. The usual assortment of tractors, pumps and plows are available for research use.

## Research Work

### Varietal Improvement

Despite the severe constraints of drought and problems in supplying water to the experimental fields, progress appears to have been made albeit slower than originally envisioned. The experimental line DM 16 of Mali origin is especially promising with good stable yields under shallow, medium and deep water. Furthermore it has the desired slender grain and proper maturity. DM 16 is an O. sativa hybrid from the 1969 cross D52-37/Malobadian. Final selection was made in 1974. D52-37 is an early, shallow water type with good grain quality. Malobadian is a long grain floating variety probably brought from SE Asia but was introduced to Mali from Guinea. Experiment station yield data in kilogram/hectare from 1978 to 1981 are as follows: (Data supplied by Dr. Bangura)

| Variety | Shallow Zone | Medium Zone | Deep Zone |
|---|---|---|---|
| DM 16 | 3.38 | 3.16 | 2.73 |
| BKN 6986-38-1 | 3.65 | 2.68 | 2.52 |
| BH2 (ck) | Not seeded | 2.53 | 2.42 |
| Khao Gaew (ck) | Not seeded | 2.53 | 2.42 |

Khao Gaew is an old floating variety from Southeast Asia introduced by IRAT but is popular with growers. BH 2 is a Mali selection which is planted in the shallow zone. The BKN 6986-38-1 line was

introduced from Thailand and is similar to a dwarf high yielding variety under shallow water, but has the ability to elongate in deep water. A list of the 22 most promising varieties and experimental lines supplied by Dr. Bangura reveals that 9 are from the Thailand breeding program. It is not clear whether this is due to a similarity of environmental conditions or availability of Thai materials in the international tests. Earlier correspondence with Dr. M.A. Choudhury, WARDA breeder, indicated that selections from the Thai deep water breeding program are better adapted to Mopti conditions than those from other Asian countries. The latitudes of the two locations are similar ($13^{o}$ and $14^{o}$N), and the Thai floating rice parents used in crosses are frequently subjected to drought stress in the early vegetative stage and have long, slender grain. It is interesting that the same Thai lines have also shown promise under Thailand conditions. Efforts should be made to obtain more of the promising breeding lines from that country for inclusion in observation tests at Mopti.

The Mopti breeder and agronomist have also initiated a variety X fertilizer test to compare the response of the new deep water tolerant materials such as DM 16 with the old but popular floating variety Khao Gaew. This is to be commended since there are indications that a much better fertilizer response can be obtained from the newly developed material.

Varietal Improvement Needs

1. A screening test for drought tolerance should be initiated in March, 1984 and include all experimental lines and varieties available. Upland short row nursery beds should be constructed to prevent moisture accumulation in case of rain. The beds should be about 1 meter width. Single 1 meter rows of each variety or experimental line should be direct seeded and kept watered with a sprinkling can until the plants are 30 days age. The susceptible check IR 20 and drought tolerant check Leb Mue Nahng III should be included every 10 rows for making comparisons of the material. Two replications are needed to compensate for oil variability. Scoring should be done when IR 20 check appears to be dead or nearly so. After watering all entries for 2 weeks, a second scoring should be made to assess recovery ability of each line.

2. Elongation Screening tests in the dry season would be very beneficial to identify lines and individuals that are able to survive a specified water depth. Even $F_3$ and $F_4$ bulk populations could be included if there has not been an opportunity to eliminate the poor elongators due to shallow water conditions such as occurred in 1982 and 1983.

3. Early generation breeding material should be increased to at least 40 crosses per year to permit a continuous flow of new materials to advanced yield trials. As mentioned on page 25 of the 1983/84 report arrangements have been made with IRRI to have 20 crosses made and $F_2$ populations are expected by April 1984. Since drought is a major factor, at least one parent should posseses a high level of drought tolerance. The Thai varieties RD 19 and Khao Dawk Mali 105 might be considered as parents for drought. Both have long grain and photoperiod sensitivity. DM 16 appears to be a promising parent for crossing and should be sent to IRRI for hybridization if the cross cannot be completed at Mopti. For the large uncontrolled water area not under Operation Riz, varietal improvement should be aimed at O. glabberima which has inherently greater resistance to stresses such as drought, rapid increase in water depth, insects and diseases. It appears extremely difficult to improve on varieties for such low management areas by hybridization due to breeding up valuable linkage groups through recombination. For the short range goal, the use of mutation breeding seems to offer the best chance of improvement. It is suggested that a popular glabberima variety such as Kar be sent to IAEA in Vienna for treatment with mutagens. Perhaps 500 grams of seed would suffice. Upon its return, the seed would be

grown as a bulk population with selection placed primarily on the non-shattering character in the $M_2$ and $M_3$. Only plants that appeared normal in every way and which did not shatter easily would be saved for additional testing. Since shattering is a major problem with O glabberima, a non-shattering type might increase yield significantly.

4. The seed storage room should be put into operation soon to preserve breeding lines and valuable germplasm. The approach of adding a small air conditioned room in front of the present door appears to offer the best remedy. Even if this cannot be done immediately, the room should be put into operation to preserve the present germplasm. The doors could be locked and entry limited to the early hours of the morning or late afternoon.

5. All yield trials should include the most promising variety as a check. In the case of Mopti, this appears to be DM16. However, it was not included in the WARDA coordinated trial, observational trial and initial evaluation trials. This would serve as the standard of excellence and permit comparisons among entries in other experiments.

## Agronomy and Weed Control

The work appears to be progressing satisfactorily. A large number of studies are underway in both areas. These seem to be supportive of the research objectives and are aimed at answers to critical questions concerning deep water rice production. Perhaps greater emphasis should be given to fertilizer responsiveness of the new breeding lines since that is one of the principal objectives of the breeder in producing new types. In this case, perhaps four to six entries including DM 16, BRN 6986-38-1, BKN 6986-105-P and FRRS 4313 should be compared in shallow and medium deep water for their ability to respond to fertilizer application.

## Entomology

The entomology trials seem to be adequate and well planned. Basic information on insect species present, severity of damage and methods of control indicate that considerable planning has been involved. Additional training for the Entomologist is discussed under the subject of training.

## Transfer of Technology

The author did not go into detail on this subject since another person spent more time investigating the matter. The one on-farm site visited involved tests on fertilizer rates, dates of seeding and rock phophate versus triple super phosphate. These were well executed experiments even though the tests were under severe drought stress. The existence of Operation Riz Mopti with its 150 field workers in planting and caring for the tests appears to be of great value to the researchers who would otherwise would not have sufficient time to conduct the many trials.

## Significant Research Results

The two most significant research findings from the Mopti station appear to be as follows:

1. Identification of the experimental line DM 16 which performs well in shallow, medium and deep water.

2. Plowing land at end of harvest rather than to the beginning of the planting season. This procedure increased yields by 0.5 to 1.0 tons per hectare over a 2-year period.

The early plowing apparently contributed to higher yield by reducing the weed population through exposure of rhizomes to dessication in the dry season. Generally, the research projects are well planned and realistic. The biggest constraints to research appear to be in support services.

With the appointment of the new station director, Dr. Moolani, management of the station should improve but a potential problem exists with the relationship between the former acting director and the newly appointed director. Loyalties among employees to the former acting director may exist and make it difficult for the new director to initiate changes. It seems that transfer of the former acting director to another program within WARDA such as Rokupr or Bouake would be desirable in order to permit the new director to take full command.

Training

The Entomologist should receive additional training. One possibility is that arrangements might be made with the IRRI to have the person work under the direction of its deep-water rice entomologist stationed in Thailand for three to four months.

One breeder and one weed scientist are pursuing PhD degrees at Louisiana State and the University of Arkansas respectively. Both areas are extremely important to the future success of the deep-water rice research program. The Agronomist, Mr. A.I. Toure, is scheduled to depart for Louisiana State University in December, 1983 to pursue graduate studies.

Even though there are PhD scientists on the breeding and weed programs at present, the return of the two persons presently in graduate training should considerably enhance the work since there is sufficient research required to employ two persons in each of these fields. The Agronomist position should also be similarly considered.

Experience has shown that there is a relatively high rate of turnover in research in developing countries and having more than one well-trained scientist in a discipline is highly desirable to avoid wide gaps in key research.

## Recommendations

### Urgent Priority Needs

1. A large water pump for experimental plots and seed increase is badly needed to conduct work during drought periods and perform some screening work in the dry season for elongation tests. The pump should be sited on the dike beside the Bani River and have sufficient capacity to deliver adequate amounts of water to at least the medium deep polder and seed increase field.

2. Land Leveling. Although some land leveling was done earlier, additional work is required in order to control the experimental plot errors. Items 1 and 2 were noted earlier by Jackson and Bowers in AID Project Impact Evaluation Report 44 pages D-13, D-14 in 1981 and are repeated here for emphasis.

3. The fence surrounding the station should be reconstructed to protect research plots from being destroyed by stray animals. Some examples of loss of research plots by animals were cited by the station scientists.

4. The cold room for seed storage should be modified to maintain the temperature and put into operation at the end of 1983. Otherwise, some valuable lines may be lost by poor germination.

5. Screening tests for drought tolerance and elongation ability should be initiated for the dry season period March-May when temperatures are warm.

6. Additional breeding materials should be generated to ensure a steady supply of new experimental lines for the different environments.

7. Some breeding work on O. glabbarima should be initiated through the use of ionizing radiation to produce non-shattering types.

8. Promising breeding lines should be included in variety X fertilizer tests to assess their responsiveness.

9. Not all deep-water rice is grown under the semi-arid conditions that exist in Mali, Niger and Nigeria. The breeding program at Mopti is naturally aimed at improvement for such an environment. However, large deep-water areas of Guinea and Sierra Leone are grown under high rainfall conditions. The results from Mopti may not be transferrable to these high rainfall situations. Therefore, it is recommended that consideration be given to the establishment of a sub station located near the Mangrove Swamp Rice Station at Rokupr which would partially utilize the personnel of the present USAID supported station.

Appendix C

# ON FARM TRIALS IN THE MOPTI TECHNOLOGY ASSESSMENT AND TRANSFER PROGRAM

By
Reeshon Feuer, Professor of Soil Science,
Extension Agronomist, Emeritus, Cornell University

## Introduction

The overall general objective of the West Africa Rice Development Association (WARDA) is to:

- Promote and increase the quantity and quality of rice production in West Africa. It is anticipated that this objective will be accomplished, in part, by:

    1. Encourage production by using rice varieties adapted to conditions of the 15 member countries, and the existing and prospective demands.

    2. Develop appropriate technology for the several rice management systems (known as "ecologies") in West Africa;

- upland rice
- irrigated rice
- inland swamp rice
- mangrove swamp rice[1]
- deep water and floating rice[1]

3. Screening of existing rice selections and varieties, as well as developing improved new varieties suited to specific West Africa growing conditions.

4. Explore, introduce and contribute to the national extension systems in each member country by making available the results of WARDA research and actively interface with national programs to promote adoption of improved appropriate rice production technology by small scale rice farmers of West Africa.

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1/The USAID-WARDA Project II is concerned with the research of mangrove swamps rice at the Pokupr Station, with deep water and floating rice research at the Mopti Station, and secondly with developing extension liaison with member countries, and partial support of rice training.

Deep Water and Floating Rice - Mopti

It is estimated that there are 340,000 hectares of deep water and floating rice production conditions. Approximately 250,000 hectares of this is along the Niger River Valley with the Mopti Research Station near the center of this broad valley. Mopti is in the 460 mm rainfall zone (1970 - 1981 average), which, because of its erratic quantity and timing each year, makes the initial sowing of seed for the 6 to 8 weeks of "dryland" seedling growth a high risk procedure. Likewise the expected onset, depth and duration of valley flooding from year to year varies. No crop was harvested in 1982 -- seedlings failed to establish , despite an adequate flood; in 1983 seedling establishment was excellent, but a very late and low flood (as of October 7, 1983) is likely to result in complete crop failure over most of the valley except in some of the "deep water" zones and in the limited areas of controlled irrigation.

Research results at the Mopti Station were likewise a complete failure in 1982 and appear likely to be severely limited in 1983 despite an excellent seedling establishment. Inadequate pumping capacity and lack of fuel for distributing water to the unleveled research polders are serious constraints. In addition, dividing the polders into 3 or 4 units would improve ease of management. The critical need is for a large capacity low lift pump and power source capable of providing sufficient water from the Bani River (Niger River connecting channel) to the 37 hectare research polders area through the distribution canal.



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The Mopti station was reorganized in 1976 under WARDA management and USAID I and II funding support. Because of extreme difficulties in organizing, equipping and securing personnel to this station 675 km east of Bamako, the capital city, no improved rice varieties are yet available. From prior work, when the station was under French management two excellent new varieties are available, BH 2 and DM 16. BH 2, a sativa cross of HK 98/Kading Tang, is an early maturing 140 day variety adapted to the shallow water zone 50 to 80 cm. Currently this variety is grown by many farmers, although seed supplies are inadequate to meet farmer demand.

DM 16, a sativa, is a 1969 cross of the early maturing, excellent eating quality, shallow water zone D52-37/Malabadian, the latter a long grain, deep water (floating) rice, has resulted in a new variety of nearly ideal characteristics. Selected in 1974, the new DM 16 has great "elasticity" of growth, that is, it is adapted to all three water depth zones; shallow 50 to 80 cm, medium 80 to 120 cm and deep or floating x 120 cm and deeper. DM 16 has a most attractive long grain, white kernel, and is of good eating quality. Yield is high, but more importantly, DM 16 appears to have drought tolerance almost equal to that of the traditional glabberima deep water rice.

DM 16 is not yet in farmers' hands. As of 1983 foundation seed is being produced by "Operation Riz", the Malian national deep water rice project in the Mopti area. If no crop failures occur, and such a failure is likely in 1983, deep water rice farmers can except to be able to buy certified DM 16 seed in 1985 at the earliest.

Two introduced Thailand improved deep water rice selections show considerable promise of very high yield, but may lack sufficient drought tolerance. These are BKN 6986-105-P for the shallow and medium depth zones and BKN 6323 for the deep water zone.
Locally in the Mopti region the 39,000 hectare controlled polder area of 12 polders, each 500 to 1,500 hectares in size, comprising 12,500 farmers, it is reported that 70 per cent of these farmers grow the Thailand long duration 156 day Khao Gaew in the deep water zones. Khao Gaew yields well without fertilizer. The early maturing 140 day, high yielding D52-37 variety also is widely grown in the shallow zone. D52-37 has good eating quality. The Cula variety yields well in the deep water zone but it is reported that farmers dislike its eating quality.

In the vast uncontrolled flooding zones of the Niger-Bani Rivers deep water plain only the low yielding, disease and insect resistant, highly drought tolerant, grain shattering glaberrima traditional varieties are grown.

**Fertilizer use:**

Soil pH of the flood plain are approximately 5.5 ± (dry soil). In the controlled zone only a few farmers use fertilizer, the Operation Riz Mopti modified recommendation based on WARDA station and on-farm trials is 100 kg (2 bags) of 16-20-0 (ammonium phosphate) at the time of sowing plus 50 kg (one bag) of 46-0-0 (urea) one week before flood, for a total of 39-20-0 per hectare, a reasonable application. No response to potassium has been found either on the clayey, silty clay or loamy fine sand alluvial plain soils.

There is no research to show what yield response could be expected from a more minimal input of 50 kg of 16-20-0, which is 8-10-0 at sowing and 50 kg of 46-0-0 before flood, which is 23-0-0, for a total input of 31-10-0 per hectare. No trial results of the residual effects of small applications of superphosphate were found. To develop least cost, minimum risk "appropriate technology" for adoption by low income, small scale farmers, such information is essential. In the uncontrolled flood zone fertilizers are not used with the glaberrima varieties.

Line Sowing vs. Broadcast Sowing

IRAT and Mopti Station and on-farm trials show that higher yields are obtained from line sowing in rows 20 to 40 cm apart which greatly facilitates weeding both hand pulling in the row and by hoe between rows. It was observed in several of the controlled polder areas that the majority of farmers used oxen pulled four row seeders to establish seedlings.

Plowing immediately after harvest while the soil is still moist and easy to plow brings the roots of the wild rices to the surface to dry out during the dry season. Then a second plowing at the beginning of the rainy season to prepare the seedbed greatly reduces wild rice and broad leaf weed competition.

Mopti Interface with Extension: Operation Riz-Mopti

This team member was most pleasantly surprised to see the excellent positive interface and cooperative endeavor the on-farm trials from the WARDA research group, as well as with the Technology Transfer (TAT) unit.

The Operation Riz-Mopti comprises approximately 150 people working with 12,500 farmers on 39,000 hectares of water controlled polders of 500 to 1,500 hectares each. Each polder has four units of three to four extension-applied research staff . Farm trials are jointly planned and implemented on farmer fields. From one to four kinds of applied research trials are undertaken in each water depth zone.

Although there are 132 such trials plus 30 TAT trials in place for 1983, field extension workers of Operation Riz Mopti (ORM) wished they could have more on-farm trials.

Variety, row versus broadcast, phosphate levels and sources, weeding, timing of saving and nitrogen level trials were observed. The 5 x 10 and 10 x 10 meter plot sizes seemed most appropriate for on-farm use. The much larger TAT type farm trials from which economic data of farmer practices is the goal seemed out of place. Because this was the first time a farmer carried out a certain practice, he would not necessarily perform at a normal rate of efficiency. Large sized trials increase the cooperator's risk, and, as TAT field workers learned in the mangrove swamps ecology farm trials. The farmer often allocated an unrepresentative, usually poorer and/or higher risk site to a large sized trial.

Although strict Mali national rice seed variety distribution policy requires that the yield of all selections, even those named but not-yet declared as a national variety, must be returned to the WARDA researchers or to Operation Riz in exchange for an equivalent quantity of a national variety, farmers are still anxious to see new rice selections tried on their farms. This certainly indicates the great interest deep water farmers have in new varieties.

RECOMMENDATIONS:

1) Continue with the excellent on-going collaborative extension interface on-farm trials with Operation Riz-Mopti in the controlled area stressing simple trials with small plot sizes of 5 x 10 or 10 x 10 meters emphasizing least cost minimum input using the stations' most promising variety, DM 16.

2) Develop a 10 x 10 meter plot with two 5 x 10 meter subplots, line sown with DM 16; one subplot without fertilizer, the other subplot with one 50 kg bag rate of 16-20-0 amonium phosphate at sowing, equivalent to 23-0-0 one week before flood, for a total fertilizer input of 31-10-10 per hectare rate. Weed as seems most appropriate in timing. Compare yield of the two plots on a hectare basis using local volume measures if possible. Make two or three of these trials, complete with inputs and simple instructions, available to each Operation Riz-Mopti extension worker. Assemble kits at Operation Riz Mopti headquarters by ORM field staff with WARDA scientists as instructors. Summarized results for Operation Riz radio news release just prior to time certified seed of DM 16 becomes available for purchase by farmers.

3) Work out possible assistance to Operation Riz to assure uninterrupted multiplication of initial quantities of DM 16.

4) In the shallow water zone-in those portions that normally have the shallowest depth of flood-usually adjacent to upland, plant a row of pearl millet every three or four rows of rice seedlings (in effect ship a row of rice seedlings and plant millet). In those years in which the flood does not materialize a crop of millet can be expected, although the rice seedlings will be lost to drought. In normal flooding years a crop of rice can be expected while the millet will die. In such normal flood years this insurance intercropping, costs only the loss of millet seed and planting time.

The evaluation team suggests that several 5 X 10 meter farm trials of this intercropping with DM 16 rice and pearl millet be established by each Operation Riz-Mopti extension worker in the shallow-flood zones adjacent to uplands as observation trials. It is suggested that each 5 X 10 meter plot contain 5 rows of millet, each row 10 meters long with 3 rows of rice seedlings between each row of millet.

Note: Approximately 25 of the 150 Operation Riz Mopti extension staff have received training at the Fendall Monrovia Training Center. Most of those took the 6 weeks field assistant course, some the seed multiplication and several the 6-months rice specialist course (numbers of each not determined). ORM reported very favorably on the training courses.

Appendix D

# MANGROVE SWAMP RICE RESEARCH

# ROKUPR, SIERRA LEONE

By

D.K. Das Gupta, WARDA, Senior Agronomist

## 1. Variety Improvement

Satisfactory progress has been made in the following areas:

- germplasm collection and characterization
- hybridization, and
- field testing of promising rice cultivars.

It is envisaged, however, that promising rice cultivar will replace the present recommended varieties in Sierra Leone.

Field testing of promising rice cultivars has been extended to Guinea, Guinea Bissau, Gambia and Senegal.

## 2. Disease Pest and Weed Control

In Sierra Leone, the special project has carried out intensive studies of the following:

2.1 Disease: Disease survey, horizontal disease screening of rice cultivars and biology of important rice pathogens.

2.2 Pest: Pest surveys and collection, crop loss assessment of rice stemborer (Maliarpha separatella) and bugs (Asparia armigera stenocoris southwoodi)

-Ecological and population dynamics studies of rice stem borers, plant hoppers, parasites and some other rice pests,

-varietal resistance to insect pest and crab, and cultural and chemical control of these rice pests.

-Ecological studies of crabs.

2.3 Weed: Weed surveys and crop loss studies, cultural and chemical control of weeds.

In Guinea, Guinea Bissau, Gambia and Senegal surveys of diseases, pest and weeds were carried out to a limited extent.

3. Nitrogen application techniques

Over the years, a large number of trials both at the station and on farmer's fields in Sierra Leone has shown that efficient nitrogen utilization and significant grain yield increase are obtained by the use of injection method (placement of an aqueous solution of urea at the required depth).

The above technique is yet to be extended to the other countries.

4. Mechanical Cultivation

Trials, over the past four years, have shown that good ploughing and puddling with a single axle tractor (Honda) before transplanting can adequately suppress the predominant weed (Paspalum vaginatum) for the duration of the rice crop. The effect of mechanical cultivation on grain yield has been consistently superior to the farmers method (manual digging with hoe).

There is evidence that a multi-disciplinary team of scientists is pursuing an integrated rice research program at the Special Research Project in Sierra Leone.



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## 5. Field testing of rice production packages

Field testing of production packages such as improved variety, mechanical cultivation and nitrogen application by injection method was started in Sierra Leone in the 1982 cropping season, and repeated in 1983. This program (Adaptative Trials in farmers' fields) has been extended to Guinea and Gambia in 1983.

One year result of adaptative trials in Sierra Leone is encouraging. The farmers have acknowledged the benefits of improved rice varieties (CP4 and ROK5), mechanical cultivation and nitrogen application by injection method.

The North West Integrated Agricultural Development Project (NWIADP) at Kambia, Sierra Leone is utilizing the above rice production packages in 6200 ha of mangrove swamp rice. The field staff of NWIADP is getting training in the operation and maintenance of single axle power tiller and knap sack nitrogen injector at the mangrove swamp special research project. There is a close cooperation between the NWIADP and the WARDA project.

6. Trained African Scientists

| | | Qualification |
|---|---|---|
| 6.1 | One Entomologist (Team Leader, recruited internationally) | Ph.D |
| 6.2 | One Agric. Economist (recruited internationally) | Ph.D |
| 6.3 | One plant pathologist: Research Assistant (Pursuing research locally for Ph.D degree at the University of Sierra Leone) | M.Sc. |
| 6.4 | One Plant Breeder: Research Assistant (Submitted thesis for Ph.D degree) | M.Sc. |
| 6.5 | One soil scientist/agronomist: Research Assistant | M.Sc. |
| 6.6 | One weed scientist: Research Assistant (pursuing research locally for M.Sc. degree at the University of Sierra Leone) | B.Sc. |
| 6.7 | One Extension Agronomist: Research Assistant (needs further training) | M.Sc. |

7. Scope of Work

a) Evaluate the development and progress of the research programs in relation to the project purpose, the research priorities, the implementation schedule and anticipated outputs as described in the project paper.

The Mangrove Swamp Special Project, within a short period, has made a considerable progress in rice research on variety improvement, entomology, plant pathology, soil science, agronomy and weed science relevant to the eco-system in Sierra Leone.

It is worth noting that the project with limited manpower, has extended its research activities in Gambia, Guinea Bissau, Senegal and Guinea. However, the mangrove swamp rice ecology in Gambia, Guinea Bissau and Senegal has diverse conditions which differ markedly from those around Rokpur (Sierra Leone) particularly in the areas of low rainfall, short rainy season and highly salty nature of the soils. Thus, experimental results obtained at Rokupr need to be further tested thoroughly in these areas where mangrove swamp rice production is of high priority.

b) The research program in terms of appropriateness of its research priorities and its potential for effecting significant production increases.

It was noted during the visit to the farmers' fields and villages in Sierra Leone that the farmers are quite aware of the advantages and benefits of improved production packages such as improved variety, mechanical land preparation and nitrogen application by injection method. These production packages are being tested under farmers' conditions through adaptive trials. The North West Integrated Agricultural Project (NWIADP), at Kambia in Sierra Leone, is introducing the above improved production packages on 6200 ha of mangrove swamps. It is envisaged that these efforts will result in a significant production increase.

c) The process for formulation, review and approval of the research programs and priorities and the degree of station vs. headquarters involvement and input

The mangrove swamp ecology accounts for about 6.87% of the total rice area in West Africa (2,879,595 ha) and is concentrated in Sierra Leone, Guinea Bissau, Senegal, Gambia, Guinea and Nigeria. It comes second to irrigated rice in terms of grain yield. However, there exists diversity in the ecology itself and also in the manner of exploitation from country to country.

The project at Rokupr to date has made notable progress in variety improvement and various cultural practices suitable to the mangrove and associated swamp rice ecologies in Sierra Leone.

The research approach will continue to be multidisciplinary but an integrated program, however, greater emphasis will be placed on regional activities in Guinea, Guinea Bissau, the Gambia, Senegal and Nigeria. Thus collaborative work with national programs on mangrove swamps, training of young scientists/technicians in research methodologies and direct involvement with extension and rural development agencies will be stressed with a view to transfer appropriate improved techniques to farmers. In this endeavour, research priorities will focus on the following:

Variety improvement

- Evaluation of introduced and local varieties and hybridization.

- Development/identification of shorter duration (110-130 days) and salt tolerant varieties for non-tidal mangrove swamp areas in the north of the region with low rainfall and short growing season.

- Development/identification of high yielding intermediate duration (170 days) varieties which will avoid both early bird damage on grains and late salt damage when the rains end prematurely.

- Development/identification of high yielding long duration (190 days) varieties with intermediate plant height (120-130 cm) for tidal mangrove swamp areas with shallow tides.

- Development/identification of varieties tolerant to blast, iron toxicity and acid sulphate soil conditions.

Production practices

Improved and cost efficient production packages are needed for each of the diverse mangrove swamp ecologies. These includes

- efficient use of inorganic fertilizers and organic manures including the use of bio-fertilizers.

- Chemical, biological and cultural control of pests, diseases and weeds and development of an integrated pest management systems.

- Appropriate mechanization of rice on small farms in the mangrove and associated swamps.

The headquarter technical service research staff (TSS) are involved in the variety improvement, soil science/agronomy and weed science and plant pathology programs. The TSS also backstop other Special Research projects, sub-regional coordination and national rice program.

In addition to the above the formulation of research programs is done in the In-house Review of the Research Department. The second In-House Review was held in 1980 in Freetown, Sierra Leone. It critically discussed research activities of the WARDA professional staff. Areas covered were research work at Headquarters (the seed laboratory and seed nursery farm at Suakoko, Liberia), the Special Research Projects, and Research Coordination in the five sub-regional zones.

A similar review was held in Bamako, Mali, in 1981. The review dealt with the impact of the WARDA Research activities on regional rice research and development, detailed review of programs and methollogy, and a review of WARDA research structure, objectives and relationships with other WARDA activities.

d) <u>The adequacy of staff disciplines and training, research leadership, headquarters technical support, research equipment and station facilities in relation to the need of the research programs</u>

The basic infrastructure necessary for the project to function has been established at Rokupr, Sierra Leone.

Due to the diversity in the rice ecosystems of the mangrove swamp, there is a great need to develop different production packages suitable for the different swamp conditions. Thus, in order to implement the program of the project on the regional basis in Guinea, Guinea Bissau, Gambia, Senegal and Nigeria, the Mangrove Swamp Special Research Project needs further financial, trained manpower, technical and infrastructural support as follows:

I. Rokupr (Sierra Leone)

1. Scientific staff

-one plant breeder (vacant)
-one soil scientist (vacant)
-one agronomist (new)
-one mechanization specialist (new)
-an experienced laboratory technician to set up and carry out water, soil and plant analysis (new).

2. Office, laboratory and staff house

The project activities have increased considerably. The present office and laboratories are crowded. The soil science section is

still without proper analytical laboratory because the original laboratory has not yet been completed. At present facilities to analyse soil and plant samples are limited. Without soil analysis (such as nitrogen, pH, organic matter, exchangeable cations, CEC, phosphorus absorption coefficient, available phosphorus, potassium, active iron, aluminium, etc.) and plant analysis, soil fertility studies will be inadequate. Proper explanation could not be given for differences in yield response to applied fertilizers (N, P and K) without soil analysis. Thus farmers' field trials and adaptive trials may not produce desirable results.

On the spot and critical examinations of various field trials have shown that nitrogen is not the only limiting factor for mangrove swamp rice production. Symptoms of phosphorus and potassium deficiencies, iron toxicity and also of other nutritional disorders (possibly zinc deficiency and aluminium toxicity) were recorded. Due to complexity of the soil fertility problem and also when the WARDA Special Research Project is conducting field trials in other member countries, it is very important that soil and plant analysis facilities should be improved.

3. Chemistry laboratory: The project requires analytical facilities for:

-Routine plant and soil analysis of a range of nutrients

-Routine analysis of river water

-Simple soil physical measurements

-Completion of internal fittings

-Purchase of laboratory equipment and chemicals.

That laboratory building already exists but it requires the above facilities and equipment.

With the increase in the regional activities and scientific staff at Rokupr, additional office laboratory and staff houses will be needed.

4. Electricity and Water Supply

At present electricity supply is restricted between 7 pm and 7 am. Thus it is not possible to use electrically operated laboratory equipment during the working hours between 8 am and 5 pm. Similarly, there is an acute shortage of water supply both for laboratory and staff houses. Sometimes, during the dry season, water is not supplied to the station for weeks or months. Thus supply of electricity and water needs improvement.

II. Senegal, Gambia and Guinea Bissau Region

Scientific Staff

a) At Djibelor, Senegal

-One Agronomist

-One agric Economist/Extension

-One field technician

b) In Guinea Bissau

-Two Field technicians.

c) Gambia

-One Field technician.

The area has diverse mangrove swamp conditions which differ markedly from those in Sierra Leone particularly in the low rainfall and highly salty nature of the soils. Experimental results obtained at Rokupr therefore need to be tested thoroughly in this area where mangrove swamp rice production is of high priority.

The above team of scientific and field staff, in collaboration with scientists at Rokupr, will be responsible for basic data collection, and implementation of pre-extension activities for all disciplines, socio-economic studies and adaptive trials for the mangrove swamp rice program.

III. Guinea

1. Scientific staff

-Two field technicians at Sonfonia/Koba.

Research efforts in the country are limited. Since Guinea is near to Rokupr (Sierra Leone), the project scientists will be able to travel frequently to trial sites to conduct and supervise field experiments. The two field technicians posted in Guinea will assist the program activities.

IV. Nigeria

The country has shown interest in utilizing the potentials of 800,000 ha of the mangrove swamp ecology for rice production. However, only about 5000 ha of the swamps are currently under cultivation. Initial research program will include

- Reclammation of mangrove swamps
- Monitoring of salt level to determine salt free periods
- Screening of varieties
- Agronomy and cultural practices.

For the time being, the scientists of the Special Research project will limit themselves to liaison and collaboration with National Cereal Research Institute at Warri/Ibadan and River Basin Development Authorities with regular visits and possibilities of longer visits. However, it is envisaged that in future there might be a need to station one each of Agronomist and Field technician at Warri.

## Appendix E

### OBSERVATION ON METHODOLOGY OF RESEARCH

By
Dr. D. K. Das Gupta, WARDA Senior Agronomist

It is commendable that within a short period of time the Mangrove Swamp Special project has carried out lots field experiments at Rokupr, Sierra Leone. However the following general observation could be made for further improvement.

1. Plot layout: In some experiments the ratio of length and width of the whole plot seem to be high. The plot layout should be compact as far as possible instead of spreading the treatments along the length.

2. Nitrogen (Urea) application by injection method at 20 cm depth: In the field, rice roots grow and extend vertically and laterally. It has been reported by Yoshida (1981) from IRRI that a shallow-rooted, high-tillering irrigated variety (like IR20, IR442-2-58 and IR2035-117-3) has a very high root density around the plant base but the root's growth, both vertically and laterally is limited. Vertical root densities of the three varieties at 0,10, 10-20 and

20-30 cm depth are 14.4 to 22.7, 2.8 to 7.1, 0.9 to 1.2 and 0.1 to 0.4 respectively. Thus in low land swamp varieties vertical root density is highest between 0 to 10 cm depth. Thus due to low vertical root density at a depth of 20 cm the rice plant possibly cannot utilize nitrogen fully. Moreover, the rice roots have to reach 20 cm to tap nitrogen placed at that depth. Thus after transplantion the uptake of nitrogen will be low. Until the rice roots reaches at 20 cm depth.

As the hole created by injector is not sealed by soil after placement of aqueous solution of urea some nitrogen solution will be lost due to upward movement of water. However injecting nitrogen at a depth of 20 cm, some portion of the urea solution will be absorbed in the surrounding soil before it is lost in the tidal water.

In this respect IRRI has developed five (5) new types of urea applicator for deep placement under low land swamp conditions. The laboratory and field tests of the equipment have shown that nitrogen transmission in the flood water is as low as hand placement of urea super granules. These new applicators after placement of urea, seal the opening by soil cover. The findings of on-farm test of the new nitrogen applicators are encouraging. The special project could also contact IRRI for the above suitable nitrogen applicator.

3. Zinc deficiency (by De. Dutta, IRRI)

It has been reported (Patrick and Reddy, 1977) that the decreased zinc concentration in soil may be due to:

- precipitation of Zn(OH)2 as a result of increased pH after flooding.

- precipitation of $ZnCO_3$ due to $CO_2$ accumulation resulting from organic matter decomposition.

- precipitation of ZNS under very reduced soil conditions.

The reversible pH change, oxidation-reduction, and carbon dioxide partial pressures may play an important role in regulating zinc uptake by rice. The reversible pH change of the flooded soil, where the pH tends to increase in acid soil and decrease in alkaline soils, undoubtedly allows the zinc equilibrium concentration in the soil solution. Because the solubility of zinc minerals and zinc sorbed by soil colloidals is pH dependent, an increase in the pH of an acid soil when flooded will tend to decrease the zinc

concentration in the solution. Thus, the uptake of zinc by rice plant will decrease. The reversible pH change could partially explain why zinc uptake is higher in acid or higher in alkaline soil after flooding.

There is a possibility that the mangrove swamp around Rokupr is deficient in zince for rice.

Zinc concentration of 10 ppm in rice shoot at tillering and 1500 ppm in straw at maturity is considered deficient and toxic respectively.

Next to nitrogen and phorphorus deficiency, zinc deficiency now ranks first among the nutritional disorders that limit grain yield of rice. In zinc-deficient soils, complete fertilizers (NPK) alone will provide limited yield advantage unless zinc deficiency is corrected first.

One practical means of correcting some deficiency is to dip the seedling roots in a 2% ZNO suspension in water prior to transplanting. The most practical and least cost means of zinc deficiency for transplanted rice is by applying zinc sulfate (hyptahydrate) to the nursery bed and to the field before transplanting.



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The Mangrove swamp special project can conduct simple experiment using zinc zinc sulphate (hyptahydrate).

## 4. Entomology

4.1 It has been reported earlier that in northern Sierra Leone hibernation of Maliarpha larvae (stemborer) generally starts in October and and intensity of diapausing increases sharply in November and reaches peak in December. July transplanted crops escape the peak infestation of stemborer (Maliarpha and Chilo spp.), and thus have lower stemborer infestation and accordingly higher grain yield than later transplanted rice crops.

It has also been noted that crabs in the mangrove swamp cause considerable damage to newly transplanted rice plants (July transplanting). Crab attack on newly transplanted seedlings led to reduction in yield. Losses ranged from 19 kg/ha to 34 kg/ha for every one percent crab damage, and seedlings below 40 days old tended to suffer higher losses.

In other studies it was noted that seedlings from unfertilized nursery bed suffer twice as much as crab damage as seedlings from fertilized nursery bed. However, the unfertilized 60 days seedlings were significantly less damaged by crabs than the fertilized 30 days seedlings.

In other studies it was recorded that the visible crab damage along bunds and creeks are of greater economic importance than the randomised damage in the rice field. Various crab species are distributed transversely across and along rivers and creeks. It was also inferred that crab damage could be minimized if farmers reduce the seedlings member from ten to three seedlings per hill and increase the number of hills (from 15 to 30 hills) per square meter.

Traditionally farmers cope with the crab damage problem by transplanting large number of older and presumably tougher, seedlings in each hill. This tends to restrict farmers to the use of long duration varieties that can tolerate a long period in the nursery bed without serious loss of yiel

The above findings indicate that for higher grain yield early transplanting in July is important to escape stewborer damage could be reduced by late transplanting of older seedlings.

The following study could be undertaken with a view to finding out effect of seedling age, vigor and number of seedlings per hill on stand establishment, crab and insect pest damage, and grain yield.

4.1.1 Main plot (seedling number): 3, 6 and 9 seedlings/hill.

4.1.2 Sub-plot: (a) seedlings from fertilized nursery bed
(b) seedlings from unfertilized nursery bed.

4.1.3 Sub-sub plot (age of seedlings): 30, 40, 50 and 60 days. The seeds should be sown on nursery beds at various dates (10 days intervals) between May and June but the seedlings should be transplanted at the same date in July.

4.2 Methodology of screening rice cultivars against crab damage

It is necessary to develop a method of screening rice cultivars against crab damage.

The special project at Rokupr has concluded from the field survey that the visible crab damage along bunds and creeks are of greater economic importance than the randomized randomized damage in the rice field (1982 Annual Research Report p 31). It has also been reported that S. huzardi is the most voracious and common of the three crab species in the tidal Mangrove swamp along the Great Scarcies River. It is distributed transversely across and along rivers and creeks up to the tidal limits in the associated mangrove swamps.

For screening against crab damage, rice varieties (3 to 4 rows of 3m long) could be planted parallel to the bunds, or creeks or rivers where the natural habitat of crabs is distributed transversely. Thus the rice varieties are uniformally exposed to the crabs. A gradation of damage on rice varieties could be recorded. For example, in the same row there will be greater crab damage on the front hills than those planted away from the creeks or rivers. Similarly susceptable or attractive varieties will have greater crab damage than resistant or least attractive varieties.

In a bucket experiment it is difficult to create a natural habitat of crab as it needs a hiding place. Similarly how one can determine the correct number and same age of crabs in bucket experiment. Question arises what is the feeding habit of crabs and whether crabs feed only on rice seedlings in natural habitate.

5. Integrated pest management : An attempt should be made to conduct IPM trials at the station.

6. Adaptive Trials:

The adaptive trial consist of the following treatments.

Trial 1. Improved variety VS Traditional variety

Trial 2. Traditional variety VS Traditional variety
+ Fertilizer injected + No fertilizer

Trial 3. Improved variety VS Traditional variety
+ Fertilizer injected + No fertilizer

Trial 4. Improved variety VS Traditional variety
+ Fertilizer injected + No fertilizer
+ Mechanical ploughing + Manual ploughing

The above four treatments are scattered on pure mangrove and associated swamps. These exists variation in soil properties, crab population, depth of flooding by tidal water etc. from site to site and within pure and associated swamps. Symptoms of phosphorus deficiency and iron toxicity were recorded. At some sites, other than adaptive trials, crop response to phorphorus application was remarkable. Thus the present formula of nitrogen application only by injection method in absence of phorphorus and potassium application may not alleviate the nutritional imbalance problems and might not give desirable results. It seems that input of complete package (variety + mechanical ploughing + nitrogen) might be changed in future testing.

As the four treatments are not planted at the same site it is difficult to make any comparison and statistical analysis of data. It seems there is a need to modify the present protocal of adaptive trials, such as distribution and treatments.

The following modification of protocol is suggested.

Trial 1. Traditional practice (TP)

= Farmer's variety (FV) + Traditional manual land preparation (TML) + No fertilizer (FO).

Trial 2. Improved practice (IP):

= Improved variety (IP) + Mechanical ploughing (M) + nitrogen injected (FI).

Trial 3. IP-V = Farmer's variety + Mechanical ploughing + nitrogen injected (FV+M+F1)

Trial 4. IP-M = Improved variety + Manual land preparation + nitrogen injected (IP+TML+F1)

Trial 5. IP-F1 = Improved variety + Mechanical ploughing + No fertilizer (IP+M+FO).

The above five treatments could be planted at the same site and thus soil and other variation could be eliminated. Each site will represent one replication. Thus five sites near one village will give five replications and statistical analysis of data could be carried out.

In the proceedings of cropping system seminar Dr. R. A. Gomes of IRRI suggested a similar protocol for farmers' field trials.

Appendix F

# ASSESSMENT OF THE ROKUPR MANGROVE SWAMP RICE RESEARCH STATION, SIERRA LEONE, WEST AFRICA

By
REESHON FEUER

Professor of Soil Science and Extension Agronomist, Emeritus
Cornell University, Ithaca, New York

## BACKGROUND

The Rokpur Research Station work funded by WARDA II is devoted entirely to a unique system rice culture known as "mangrove swamp" management system, or as it is called in West Africa "ecology". Actually the soils used in the Mangrove Swamp Ecology (MSE) are tidal flats (mangrove and sedge marshes) that extent many miles inland, through which numerous rivers draining highly weathered uplifted coastal plain deposits and acid igneous and sedimentary uplands (residuum) soils (mainly ironstone flintic) Ultisol soils from a high rainfall (100 to 200 inches annually) rainforest zone.

The large volumes of fresh water discharged into the long tidal marshes (mangrove swamps) during the west season flushes much of the salt out to sea making it possible to grow varieties of rice during the "salt free" period that ranges from 3 to more than 6 months depending upon the configuration of the specific tidal swamp and its

fresh water steam volume. In general four zones of salt free duration are recognized: 1) more than 6 months (long duration); 2) 4 to 6 months (mid duration); 3) to 4 months (short duration); 4) no-salt free period (less than three months). Upper ends of tidal swamps are cleared of salt first, areas close to the sea become clear of salt last.

Long duration 150-180 days, usually day-length sensitive, rice varieties are grown in the more than 6 month salt-free zone; intermediate duration 130-140 varieties, fixed duration or slightly day-length sensitive, are grown in the 4 to 6 month salt-free zone, but only very short duration 110 day highly salt tolerant fixed duration varieties are adapted to the 3 to 4 month salt-free zone. (The Casamance Region of southern Senegal has the short 3 to 4 month salt-free period and low rainfall, in which only the highly salt tolerant 110 day fixed duration rices can be expected to be successfully grown.)

Classification of Mangrove Swamp Ecology (MSE)

The typical MSE consists of two parts; 1) the true tidal flat (originally with mangrove vegetation) that is inundated (flooded) by each tide (sometimes only by the two higher tides of each day) and 2) the associated swamp that borders the true tidal swamp portion, in varying width, and which adjoins the uplands. The associated

swamp does not receive tidal salt water inundation. It originally had a sedge and reed vegetation. Because nearly all the bordering uplands have highly weathered soils from acid material varying amounts of soluble iron enters into the associated swamp as seepage zones. This creates iron toxic conditions for rice produced in the associated swamp; most sever adjoining the uplands and in the seepage zones, becoming less severe towards the true tidal swamp zone.

Nutrient Status, Nutrient Needs and Variety Tolerance

Rice varieties for the associated swamp zone must be tolerant of iron toxicity, as well as of aluminium toxicity and saline conditions. Nitrogen and phosphorus are the major nutrient requirements for increasing rice yield. It is hypothized that because of the generally high organic matter content of the associate swamp zone, averaging 10 to 12 percent, and high soluble aluminium that zinc deficiency may be limiting rice yields because of organo-aluminium, iron complexing of zinc. Preliminary Rokupr research with zinc oxide is suggesting this, but a more soluable form of zinc, as widely used in other countries, low cost zinc sulfate (hyptahydrate) at the rate of 10 kg per hectare should be widely tested both in the station area and on farms. A 20 kg per hectare rate of zinc sulfate is suggested for trial in seed beds to ensure that seedlings have adequate zinc. Zinc sulfate probably is not available in West Africa but can be purchased from U.S., from

most Asian rice producing countries, where zinc sulfate (hyptahydrate) is widely used to increase rice yields. Rice varieties in the true tidal zone respond primarily to nitrogen but moderate amounts of phosphorous increases yield as well as increasing the efficiency of nitrogen response. Because the true tidal swamp averages approximately ten percent organic matter and has high soluble aluminium the true tidal areas likely also will show zinc response in rice yield. It is suggested that research to verify this is imperative, if lowest risk, lowest cost profitable combinations of rice production practices, so called "packages of appropriate technology" are to be developed for use by low income, mangrove swamp rice farmers. Preliminary research with zinc at the Rokupr was begun in 1983 on the true tidal and associated swamp zones.

Mangrove swamp rice farmers must use "drybed" nurseries to grow seedlings in the low fertility uplands. Seedlings are usually five to seven weeks old before transplanting. As we observed during farm and village visits and in discussions with research staff, these "old" seedlings are seriously nitrogen deficient. To provide stronger seedlings that are better able to resist transplanting shock, it is suggested that approximate research be rapidly accomplishment — the so-called quick and dirty method — as follows:

small amounts of single superphosphate and potassium incorporated in the seedbed to encourage the development of a stronger root system and nitrogen applied once or twice during the later stages of seedling growth.

since the highly weather upland soils of West Africa are low in available zinc, it is likely that seedlings grown in the drybeds are zinc deficient before transplanting. To correct this condition, it is suggested that trials be undertaken using a 20 kilogram per hectare rate of soluable zinc sulfate (hytrahydrate) in the dry seedbeds to verify whether increased vigor and yield result.

Research results reported from India in developing appropriate technology for low income small scale rice farmers on phosphorus deficient soils found a significant increase in rice yield from dipping rice seedlings in a slurry of super phosphate. The cost of this practice is very small. The technology concentrates a small amount of available phosphate around the rice roots where it is much more efficient in promoting increased plant growth and yield than broadcast phosphate. Since most experimental fields are likely to have residual phosphate available, it is suggested that this practice be investigated under farm conditions. Otherwise, the effect of dipping rice seedling roots in a super phosphate slurry is not likely to be as great as on phosphorus deficient farmers' fields where little or no phosphorus fertilizers have been used.

Although not observed, the results of discussions with the Rokupr and WARDA central scientists indicated that rice seedlings from "drybed" nurseries for transplanting to mangrove swamp culture are uprooted from the drybed without prior soaking of the bed. Rainwater could be used to soften the soil so that more of the fine feeder rootlets could be retained for prompt transplanting. Rokupr research results show that stemborer injury to rice seedlings (deadhearts) injury increases from mid June to late August transplanting. More stem borer injury occurs on the station plantings because of more varieties of rice seedlings and earlier growth stages than of rice on mangrove swamp farmers' fields. Because of no bunds on farmers fields, use of "older" seedlings with thicker tough stems, rather than the younger seedlings commonly transplanted on the Rokupr station fields crab damage to rice seedlings is a minor problem along river banks on farms in the true tidal areas.

These several "appropriate management technology" suggestions should contribute to developing low risk, least cost profitable MSE rice production technology on small scale farms.

## Hectarage of Mangrove Swamp Ecology Rice Area in West Africa

According to the excellent review of research and extension liaison progress presented to the evaluation team there are approximately one million hectares of mangrove swamp area suitable for rice production in West Africa. The majority of this is within the 15 country WARDA area. Only 214,000 hectares of this area is currently in rice. Very little additional area is being cleared of mangrove - a four year task but several thousand hectares previously cleared are currently fallow.

TABLE 1

Mangrove Swamp Areas in Selected
West Africa Countries
(From Rokupr Briefing 9/30/83)

| Country | Ha. under production (estimated) | percent of National rice area | percent of National rice production | Remarks |
|---|---|---|---|---|
| Gambia | 10,000 | 52 | 54 | |
| Senegal | 10,000 | 20 | 16 | |
| Nigeria | 5,000 | - | - | 80,000 ha. total |
| Guinea Bissau | 90,000 | 80 | 80 | |
| Sierra Leone | 35,000 | 6 | 12 | |
| Total | 214,000 hectares | | | |



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Mangrove swamp comprises seven percent of the currently used rice area in West Africa and 12 percent of current rice production. With the use of modern varieties, some currently available improved management practices and most inputs of fertilizer and zinc a 25 to 50 percent increase in production is a conservative near term estimate from these areas.

Varieties Recommended from WARDA Research

Some 2,000 rice selections have been tested, mostly from the International Rice Trials from the International Rice Research Institute. Three hundred and forty of these were put into the regional coordinated trials. Of the 88 crosses made at Rokupr 34 varieties were found to be salt tolerant at the Rokupr station and two with excellent tolerance to iron toxicity. As of 1982 WARDA recommended rice varieties totalled 128. Of these 14 were recommended for mangrove tidal swamp, 11 for iron toxic "associated" swamp as well as for inland fresh water swamps, which are usually iron toxic.

Currently the locally selected 135 day ROK 5 variety (medium duration) is recommended for all "associated" swamp because of its salinity, iron toxic tolerance and high yield without (or with) fertilizer. The early maturity of ROK 5 makes it better suited to a 5 month salt free period. If grown in a 6 month area ROK 5 matures ahead of currently grown local varieties and requires extra "bird

scaring" management. The 175 day CP 4 (SR 26/Wellington cross) and 177 day ROK 10 are recommended for "true tidal" mangrove areas in the longer duration salt free areas of 6 or more months. Unlike the ROK 5 variety CP 4 gives low yields without fertilizer, is not tolerant of iron toxicity and tends to shatter its grains upon maturity. The Kuifiak Kunder and ROK 5 varieties are recommended for medium (4 to 6 month) salt-free areas.

Although rice varieties presently grown by farmers in the mangrove swamp ecology ware referred to as "traditional" the majority of these were developed by Rokupr research during the period from 1936 to 1947 during which period 2,500 tons (800,000 bushels) 60 lbs. (27 kg) of pure rice seed was distributed to farmers.

Currently farmer yields of paddy (rough or unhulled rice) in the mangrove swamps ecology is reported to average two tons (approximately 74 bushels per hectare, 30 bushels per acre). Farmers use neither fertilizer nor insecticides. Under similar conditions the best new variety is ROK 5 with an average yield of 2.5 tons/hectare. With approximately 20 kg of nitrogen per hectare in the ture tidal mangrove zone, TAT farmer trials during the period 1978 to 1983 have shown an average increase of 300 kg (11 bushels) of paddy (unhulled rice) per hectare (also see table following paragraph).



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The research and extension liaison group at Rokupr report carrying out 100 to 200 farm trials of several types each year on farms in the MSE (mangrove swamp ecology) zone. Over a period of five years from 150 nitrogen trials on farmers fields (variety unspecified - presumably that of the farmer, in the true tidal mangrove zone) showed the following yields (kg paddy/ha).

Cost of nitrogen in Sierra Leones[1]

| | M. tons/ha | Off. rate | Open Market | Incr. yield 70 lb bu | Value of |
|---|---|---|---|---|---|
| Check | 1.9 (70 bu) | zero | zero | - | Le 250 |
| 20 kg N[3] | 2.4 (88 bu) | Le 77 | Le 14 | 18 | Le 250 |
| 40 kg N | 2.6 (96 bu) | Le 14 | Le 24 | 26 | Le 360 |
| 60 kg N | 2.8 (100 bu) | Le 21 | Le 36 | 30 | Le 840 |

1/ 50 kg bag of 46-0-0 urea contains 23 kg N
Official Le rate cost/bag = Le 14
Open market Le rate cost/bag = Le 250 to 30

2/Official price per 60 lt bushel of dry clean paddy is Le 20. Commonly paid per bushel to farmers, "farm gats" is reported as Le 10

3/Presumably the nitrogen was applied by the injection method. The cost of an injector unit at open market Le rate is Le 600. 20 kg N injection applied is equivalent to 40 kg N split broadcasted in yield increase.

5 gal knapsack unit costs Le 400
Injector unit costs Le 200 - open market
Injector requires 5 man days per hectare to apply.
Estimated 2 man days for broadcast split application.

Rokupr Station Research

To his evaluator, who reviewed the 1980, 1981 and 1982 annual reports of the WARDA Research Department and the 1982 Annual Research Report, Rice Research Station, Rokupr, Sierra Leone (WARDA/83/APR-15, 114 pp) before a two-day visit to the station, the large number (approximately 35) of well-laid, scientifically designed and excellently labeled experimental trials, was a gratifying sight of a well executed research program.

Every trial was excellently applied by the research scientist involved. We were each given field mannual that had keyed plot diagrams with same key numbers on the large plot sign at the field experiments. Access bunds are large and well constructed providing easy access to all portions of the experimental areas, yet allowing free movement of seepage to "associated" swamp areas and free access of tide to the "true tidal" zone experiments.

During the afternoon we viewed several on-farm trials and Technology Assessment and Transfer (TAT) farm trials by boat. We also visited two villages, having a short discussion session with the villagers at one village (through interpretor). We came away with feeling that the villagers wanted the improvements, especially the use of the power tiller, that they had experienced through the TAT program, but did not have the operating capital for improved practices, particularly as the



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costs of operating loans were extremely high — a common problem in most developing economies. The friendliness of the villagers towards the Rokupr and TAT staff, and to us as visitors was a highlight of our village visit.

In the morning of the second day the Rokupr staff led by the project team leader made an impressive presentation of the work of the station, research accomplishments to date, relationships and work with other member countries have mangrove swamp rice ecological areas as well as some of the operating constraints and a look ahead.

During the afternoon we briefly visited a comprehensive set of upland rice field research experiments some eight miles away from the Rokupr station, that were excellent. Individual experiments covered each of the many critical problems of producing upland rice in the high rainfall zone (upland rice zone II) of West Africa. This evaluator was impressed. It certainly appeared to this evaluator, who has done some upland rice extension work in the Philippines that these trials would provide all the necessary fuel for promoting an effective upland rice extension program in West Africa, with one exception, the research area is on a level area of iron stone (Plintic) Ultisol soil rather than on a sloping area. Some of the experiments are in the fourth year. The Sierra Leone national research scientists, who are leading this research were most enthusiastic in explaining their work and results to date.

Later in the afternoon we visited with the team leader and his staff of the Northwest Integrated Extension Project, an European Economic Community and Sierra Leone joint effort of agricultural extension. Here is the opportunity for the WARDA TAT program to interface with a national e[illegible]sion effort. These relationships are discussed in greater detail in the TAT evaluation section prepared by this member of the evaluation team.

It is the considered opinion of this evaluator that the Rokupr station research results to date on mangrove swamp rice production is sufficient from which to lead effective extension programs with member countries having mangrove swamp ecology. Only a few refinements (fine tuning) are needed. These can be accomplished within a short time span, particularly applied research with the probable need for the minor element zinc in both seedbeds (nurseries of rice seedlings) and on the true tidal and associated swamp producing fields. Final selection of a long-duration rice variety with adequate tolorance to iron toxicity of the associated swamp areas adjacent to long duration true tidal areas may take a long time. Having varieties of equal duration for both adjacent zones would greatly reduce the need for separate "bird scaring" efforts.

The mid duration variety ROK 5 can be grown both in the true tidal, mid duration salt free zone and the adjacent associated swamp, because ROK 5 is tolorant of iron toxicity. ROK 10, a variety of long duration, is not tolorant of iron toxicity, therefore, is adapted only

to the long-duration true tidal areas. Promising long duration selections with iron toxicity tolerance are being evaluated by the Rokupr station scientists.

In the TAT section a more detailed discussion of the "extension liaison" aspect is presented, as well as recommendations.

Recommendations

1. Continue with experiments concerning mangrove rice production where firm conclusions are not yet accomplished. Examples of these:

   a. Need for the minor element zinc.

   b. Determine residual effects of several years of phosphate application on station fields.

   c. Establish a few simple supplementary applied research trials on nearby farmer fields to determine, if first, second and third year applications of small amounts of phosphate ($P_2O_5$) expecially 20 kg $P_2O_5$ per hectare rate (with and without 10 kg per hectare rate of zinc sulfate) show any different yield response from that of station fields. Use both ROK 5 and ROK 10, and if possible a probable long duration potential variety for the associated zone. Use seedlings with and without zinc treatment in the seedbed.

   d. Determine how much less crab damage occurs on farmer fields adjacent to tidal river banks than under station conditions and, how far into a field from typical crab infested banks does crab damage occur.

2. Consider reducing or eliminating those experiments where firm conclusions already have been determined.

3. Establish aupplied research trials on selected farms to determine the extent of stemborer injury to ROK 5, ROK 10 and one or two promising selections at several key dates of transplanting and ages of seedlings with a low level of nitrogen and phosphate input. For example, 20+20+0 per hectare rate and also at a 40+20+0 rate.

4. Similarily to Dr. Jackson's suggestion of mutagen breeding of a selected glabberima variety to select for possible non-shattering, perhaps the CP 4 variety should be tested to select for two needed factors: 1) non-shattering and 2) tolorance to iron toxicity.

Appendix G

# TECHNOLOGY ASSESSMENT AND TRANSFER PROGRAM

By
Anoop S. Sandhu, WARDA Extension Specialist

An important factor in the improvement of rice production is the development of improved technology and its effective use by the rice farmers. Research scientists have come to believe that the impact of new technology is measured not by its excellent in experimental plots but by the extent it is adopted by farmers on their farms.

Empirical evidence exists that when agricultural research is undertaken on crops without high levels of environmental control, substantial yield difference can be expected between the experiment station and the farmers' fields.

Hence, there is growing awareness about the need to extend the research process to include assessment of new technology under farmers' socio-economic, cultural and production constraints. Feedback from farmers enables a direct farm level input into technology design and helps improve understanding of the technology generating process. Technology assessment is especially important in African countries where communications links between farm and research are weak, and farmers often do not have the information and management experience and risk orientation to conduct and modify various components of a new package to suit their needs and resources.

Since the extension education system in most African States is generally weak and inadequate, and lacks facilities for experimentation and research to evolve an extension strategy to be used in transferring improved technology to farmers spread throughout the countryside, it is necessary that the technology assessment phase should also include designing and testing of an extension approach, that could be successfully used by the national extension services, for the transfer of improved technology to farmers.

Thus, the concept of technology assessment and transfer has the twin objectives of evaluating the improved technology generated by research, for its suitability to farmers' socio-economic and production constraints, and of devising and testing an extension education strategy for use by the extension organization of a country in transferring the improved technology to farmers.

WARDA's technology assessment and transfer model contains four phases. Major activities under these phases involve conducting a socio-economic survey, identification of a technology package and its assessment through adaptative farmer-field trials, and designing and testing extension education strategies to be adopted by the national extension services for communication to farmers.

The Extension Liaison Function became functional in 1982, a year later than stipulated in the project document. A set of guidelines for the methodology to be used for the selection of the improved production packages and for their testing, were approved during the annual rice review meeting in May, 1982. A committee consisting of three members from research and three from the development department was set up at the headquarter to coordinate the program. Similarly, a committee consisting of the Station Director, Extension Economist and Extension Agronomist was set up at the Special Research Projects in Sierra Leone, and Mali, to coordinate activities at the zonal level. A 3-point assessment criteria for use for the evaluation of the performance of the technology package consisting of yield comparison, economic benefits, and socio-personal considerations including labor use compatibility, risk potential and general acceptance by the farmers, was developed.

For the mangrove swamp areas of Rokupr, Sierra Leone, four technology packages were identified in May, 1982. The packages included (a) improved variety only, (b) improved variety + fertilizer injection, (c) improved variety + mechanical land preparation and puddling, and (d) improved variety + fertilizer injection + mechanical land preparation and puddling. These packages were tested in 40 Adaptive farmer-field trials that were transplanted in July-August, 1982 spread to 15 villages. These trials were conducted both in the pure mangrove swamps (22) and associated swamps (18), and in both the short and long duration



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areas. The results of these trials were presented in the annual rice review held in May, 1983. In addition a thorough review of the methodologies for the conduct of these trials was done, which was also presented in the Workshop on Farmer Participation in the Development and Evaluation of Agricultural technology held in Upper Volta in September, 1983.

Since the technology package included the use of a single axle power tiller for land preparation and puddling, and a fertilizer injector, besides improved variety, and since these are high cost technology items, it was necessary to design and test an extension education strategy that could be used by the national extension service for their adoption. As a result three farmers' cooperative have been organized in 1983. Each group has been supplied with one power tiller and ten fertilizer injectors on credit. A membership fee of Le 50 each paid about 35 percent of the cost. A small amount is charged from each member who uses them. As a result it is expected that the entire credit and other repair and maintenance costs will be recovered within three years. Progress of these cooperatives is being monitored, although all activities are being managed by the members themselves. If the results show that the strategy can work, it will be recommended to the national extension services.

Technology packages have also been identified for the mangrove swamp areas of Gambia and Guinea and in 1983, 40 adaptive trials are being conducted in Sierra Leone, 48 in Guinea and 46 in Gambia as the socio-economic surveys have been completed in these areas. Socio-economic survey is in progress in Guinea Bissau this year and adaptive trials are planned to be conducted there in 1984.

For the deep water and floating rice areas of Mopti, Mali, an improved technology package was identified in May, 1982. However, the research team at Mopti, after a further review suggested to test it one more year in research before passing it for adaptive trials. As a result no adaptive trials could be conducted in 1982. Instead, eight pre-extension varietal trials were conducted in two villages in the non-controlled areas. Three improved varieties, namely D1 16, BKN 6986-105-P and BKN 6986-381 were tested. The objective was to evaluate the performance of the improved varieties against traditional ones as no research work had been done by WARDA in the non-controlled zone. Due to the serious drought in Mali during 1982, most of these trials did not mature, and those few that did mature did not provide reliable data to draw any valid conclusions. However, a technology package was identified later and 40 adaptive trials have been laid in five villages of both controlled and non-controlled zones of Mopti, Mali, in 1983.

In summary, socio-economic surveys have been completed in Sierra Leone, Mali, Gambia, Guinea and is in progress in Guinea Bissau. As many as 40 adaptive trials in Rokupr, Sierra Leone, and three pre-extension trials were conducted in Mopti, Mali, in 1982. In 1983, 40 adaptive trials are being conducted in Sierra Leone, 48 in Guinea, 46 in Gambia and 30 in Mopti, Mali. Besides three farmers cooperative are working in three villages of mangrove swamp areas of Rokupr to test the extension education strategy for the spread of power tiller and fertilizer injectors to farmers.

The economic, social and cultural acceptability of the production technology packages tested in 1982 were worked out and results presented in the annual rice review in May, 1982. As a result improved variety CP 4 had to be dropped for the long duration areas of Rokupr and has been replaced by another improved variety ROK 10 for the adaptive trials being conducted in 1983.

The methodology for conducting of adaptive trials developed in 1982 has been thoroughly reviewed on the basis of experiences gained in the 1982 adaptive trials. As a result the trial size has been reduced from 4,000 m2 to 2,000 m2 for Rokupr, and Gambia and to 1,000 m2 for Guinea. It is well recognized that trials in farmers' fields may have fewer management controls than those in research stations. Hence, higher experimental error and probably a greater

proportion of failure can be expected. Further, adaptive trials must represent model rice farm size in the area, and should be large enough to generate labor and economic data to draw any conclusions. They should also be able to serve the purpose of a demonstration. Hence the trial size is all right.

The criteria developed for the selection of improved production packages as well as the one developed to evaluate the performance of the packages in view of their social, economic and cultural factors, have been critically reviewed and is fairly satisfactory.

Discussions with the Permanent Secretary, Chief Agriculturist and others in the Ministry of Agriculture and Forestry, Sierra Leone, with the farmers in the mangrove swamp rice areas in Rokupr, and with the staff of the North East IADP, Kambia, revealed that all of them accept WARDA as the sole institution responsible for doing research on mangrove swamp rice. All of them were aware of the improved varieties, use of power tiller and fertilizer injections method; the three components included for adaptive trials. The newly started NWIADP project has already selected these components of the technology developed by WARDA, and are in the process of training their staff in order to extend them to 6200 acres of mangrove swamp rice areas. Discussion also revealed that senior officials of the Ministry of Agricultural and Forestry that are concerned with mangrove swamp rice are involved in the planning of

the research program, as well as when the results are discussed both at the station and in the annual rice view meeting held in Liberia. Thus, there appears to be a strong linkage between extension liaison units, the special research projects and the national extension services. However, there is need to develop a formal arrangement between the special research projects and various extension services in the region, whereby the results of the performance of improved production packages in adaptive trials are discussed and approved and extension strategy planned for their communications to farmers. Although no single arrangement could be suggested for all the countries, but it may be useful to set up an Agricultural Technology Approval Committee, consisting of the Director of the Special Project and the Extension Economist and the Extension Agronomist and the sub-regional coordinator to represent WARDA, while four senior professional officials nominated by the Ministry of Agriculture, to represent the national extension service of the country.

One of the criterion laid by WARDA for the selection of improved production packages for testing in their adaptive trials is that there should be good prospects that necessary inputs in sufficient quantities will be available to farmers, at the time they will be needed. Our discussions revealed that inadequate attention has been paid to this. Adoption of improve package is possible only if adequate and on-time arrangements are made with the Ministry of Agriculture, of each concerned country for the production of seed, procurement of farm machinery and inputs.

The Special Research Projects have a regional role, and are charged with the responsibility of evolving improved technology suitable for each country covered by the concerned ecology. Accordingly improved production packages for mangrove swamp rice have been identified for Sierra Leone, Gambia, and Guinea. As the AID project stipulates, around 40 adaptive are being conducted in each country.

Thus, the number of trials and their distribution within each country is quite fair and adequate to cover the various sub-zone.

Whereas general information regarding soil fertility level do exists, but soil analysis of each selected site could better help explain the variation of yield in the adaptive trials.

Progress reports about the various activities being carried out for the technology assessment and transfer program are sent by each special research project to the Director of Development at the headquarter. The Extension Specialist who coordinates the extension liaison unit at the headquarter, and the Director of Development pay frequent visits in order to monitor the progress as well as to provide guidance that may be necessary Final results are presented in the annual rice review meeting which is held in May every year. A six monthly progress report is sent to AID office in January and July. Thus the method of reporting progress is adequate and satisfactory.

The cultivation of deep water and floating rice in Mopti, Mali, depends upon adequate and timely rainfall in July for the germination and establishment of the crop, and on flood waters in September. However, drought in 1982 followed by inadequate floods in September and their early receeding in October caused complete crop failure. In 1983, there were enough rains in July-August, and as a result the germination and crop stand of all the 40 Adaptive trials have been good, but flood water had not reached adequately up to the time of visit in October, and as a result most of the Adaptive trials are not likely to mature. Same is the situation of farmers rice crop. Even at the experiment station, efforts are being made to save the research experiments by pumping water into the plots. However, experience of working with deep water and floating rice ecology indicates that such failures are not unusual and scientists should accept a bigger challenge of evolving more adaptive, drought resistant varieties of different durations.

Discussions with the officials of the Operation Rice, Mopti, revealed that an elaborate extension system has been set up to popularize deep water and floating rice technology amongst the farmers in Mopti and Segou regions. The extension agency is keenly looking forward to WARDA for improved technology. Hence, there exists a close and effective link between WARDA's Special Rice Research Project at Mopti, its extension liaison function and the national extension service concerned with deep water rice ecology.

Appendix H

# A CRITIQUE OF THE TECHNOLOGY ASSESSMENT AND TRANSFER PROGRAM (TAT)

By
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## BACKGROUND

Achieving "self-sufficiency" in rice production is the generally acknowledged long-term goal of the 15 WARDA member countries of West Africa. The WARDA organization was developed to speed up attainment of this goal through scientific research in all phases of modern rice production technology adapted to the specific rice growing conditions of West Africa. In addition, the strengthening of national programs of rice research and more recently, interfacing with national extension agencies and programs, are developing goals of WARDA.

The "payoff" of the results of rice research comes from increased production officiency by the millions of small scale rice farmers of West Africa. Adoption by West African farmers of "appropriate" combinations of improved rice production practices can be expected to result in increased yields, if favorable and stable economic policies are instituted by member countries. If the small scale rice farmer perceives that he and his family profit from growing more rice, the transfer of appropriate results of rice research can

be expected to increase rapidly. The more effective that the extension units of a country are, the more rapidly with rice farmers become aware of available new production technology and adopt appropriate aspects to their farms.

It is unrealistic to believe that the limited numbers of rice research scientists can accomplish the extension of appropriate combinations of rice production technology to the millions of small scale rice farmers of West Africa. Only a qualified, well paid, and dedicated extension organization in each country with hundreds of field professional staff can be expected to accomplish the task.

It is the responsibility of extension to combine appropriate research results suitable for local conditions on farms working closely with farm families to motivate and assist those families in achieving increased rice production and increased incomes.

It is the responsibility of research scientists to develop, test and evaluate new varieties combining high yield, stable yield, as much disease and insect resistance as feasible, appropriate production characteristics for each production ecology as upland, irrigated, riverain, mangrove swamp (tidal and associated), inland swamps, boli-lands and deepwater. Appropriate quantities of foundation class seed should be made available as rapidly as possible to country seed production units and to extension for use in farm trails. Basic fertilizer and minor element requirements, timing and

placement should be thoroughly explored in relation to existing soil and climatic conditions, as well as longer term residual effects. Basic understanding of insects, diseases and rodents attacking rice should be studied in depth, distribution and timing in different areas determined, practical and lowest cost methods of control developed. Improved, low cost improved cultural management practices should be developed along with in depth studies of weeds and their practical control under key farm conditions. Basic economic implications of representative rice production systems, at current market prices, should be developed for guidance of national policy makers and extension leadership.

In addition to regular scientific reports and professional journal papers of research findings, rice research scientists should be enouraged to prepare semi-technical, easy to comprehend versions of key areas of rice production, ideally in collaboration with key rice extension subject matter specialists of each country that extension leaders can then use in upgrading the working knowledge of and motivating the field extension staff who work directly with farmers.

Currently the WARDA organization is doing a creditable job of training extension and applied research workers of member countries through the Fendall Training Center. It is presumed that the current results of WARDA rice research results is being made available to current trainees in digestable forms, but firm indications of this process were not evident.

A more pertinent question is to what extent are current findings of significant research results in semi-technical format going out from time to time to the 900 plus graduates of Fendall training.

The several issues of "Technical Notes" prepared by the Research Department are an excellent example, in this evaluator's view, of appropriate semi-technical format. How widely are these distributed by WARDA to appropriate audiences, especially to graduates of Fendall training, national and county extension subject specialists? Do these go to country policy makers with a covering letter from the appropriate sub-regional coordinator?

## THE TAT PROGRAM

The WARDA developed Technology Assessment and Transfer model, a four phase concept[1/] is a theorectical approach expected to bridge the gap between research, the typically weak West African agricultural extension systems and small scale farmers. Conceptually TAT proposes to: (1) make socio-economic surveys of rice farmers in a

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[1]J.C. Levasser, D. Sanni and D.S.C. Spencer,"Orientation of the Technology Assessment and, Transfer Program" (WARDA/ARPM1/81/13).

specific rice production ecology; (2) from the results researchers select packages of technology; (3) test the packages through adaptive farm trials and; (4) design and test an extension education strategy "to be adopted by national extension services---".

The first TAT concept that of a socio-economic survey of representative farm families is an excellent first phase extension method-that of assessing the current situation. The TAT carried out such surveys in the Mangrove swamp area near the Rokupr station in Sierra Leone, in the Gambia and in Guinea. A similar survey was carried out in the deep water (floating rice) area near Mopti Station in Mali.

For the first attempt of TAT second phase, a WARDA headquarters development team selected a 4 part technology package in May 1982 consisting of: (1) two Mangrove swamp ecology improved rice varieties (long duration CP 4 and mid-duration ROK 5); (2) variety plus 40Kg of a nitrogen solution injected 20 to 30 cm below the soil surface at early tillering; (3) variety plus power tiller land preparation[2], and; (4) variety plus nitrogen fertilizer plus power tiller.[3]

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[2]Mangrove swamp soils typically are plowed by hand with a long handled African hoe and puddled partially by foot. Draft animals are not used because of Tsetse fly.

[3]See WARDA response at end of this report.

Each technology package was put on 10 farms, 40 farms in all. Because each kind of technology package was on a different farm it was not possible to compare packages on any one farm. A 4,000 sq. meter (0.4 hectare or one acre) trial was requested of each farmer; a small scale farmers who only had 2.0 hectares of rice in all. The request was made two months after the average farmer had already begun "hand plowing" his land in March. As a result of this delayed, large area, high risk request most farmers gave their poorest land for the trial; some sites were close to tidal channel banks, where the ensuing crop suffered crab damage. Some of the areas offered were in the most iron toxic portions of the farm. Some were heavily infested with the difficult to control grass weed (pappalum vaginatum, locally called "kire-kire"), some sites were on sandy areas. In order to sample the two main mangrove swamp ecology zones, half of the trials were on true tidal areas and half were on the associated swamp zone, which is not inundated with tidal water. Because the associated swamp zone receives seepage from the plintic Ultisol soil (highly weathered soil with a clayey subsoil and iron stone pebbles) uplands the associated zone always is variably iron toxic for rice. The ROK 5 variety is tolerant of iron toxicity but the CP 4 variety is not. The TAT people paid no attention to this varietal difference although rice research scientists had long since proven this, and even warned the TAT workers concerning this.

Furthermore, it is well documented that on the true tidal zone rice responds primarily to nitrogen fertilizer but there is a modest response to both phosphorus and potassium. Most true tidal swamp farmers do not use fertilizer for rice production. Long established research results from the WARDA Rokupr Station, and in a published research paper from Nalja University, Sierra Leone in 1971, show that on the iron toxic associated swamp zone phosphorus is the first limiting element. Rice responds to both phosphorus and nitrogen in the associated swamp zone. There also is a moderate yield response to potassium, especially in the more iron toxic portions of the associated swamp. The TAT staff, however paid no attention to these research findings, using only nitrogen fertilizer in trials on both the true tidal and on the associated zones of the mangrove swamp ecology.

A further confounding factor is that the ROK 5 variety does will both with or without fertilizer. The CP 4 variety only gives high yield with fertilizer.

Results were to be expected; overall yields were low, in several cases the CP 4 variety yielded less than the so-called "traditional" variety of the farmer. Reasons given in the TAT report (page 7 of 1983 Annual Rice Review Meeting "TAT Programme 1982" (WARDA/83/ARR8B) were toxicity experienced by the CP 4 variety.

In the opinion of this evaluator the initial TAT approach to adaptive farm trials is not an example of developing an effective extension methodology. It is difficult to understand why known research results were not used in "selecting" technology packages to test.

The 1983 CGIAR research review team raised the question of why were the TAT farm trial yields so low, when numerous on-farm applied research trials showed high yields for the same two rice varieties.

A four plot supplementing trial (each 5x5 meters) with (1) no fertilizer, (2) nitrogen only (3) nitrogen plus phosphorus and (4) nitrogen plus phosphorus plus potassium implemented in the 1983 TAT associated swamp zone to show the TAT field staff that the research findings are real and are worth considering in developing transfer technology.

Because of farmer resistance to large trial plots, the 1983 size was reduced to 1,000 square meters, still at least 10 times too large in the opinion of this evaluator based on long experience with small scale rice farmers. A 5 by 10 meter plot size is sufficient to introduce a minimum risk, lowest cost improved technology to a low income small scale farmer. A pair of such 5x10 meter plots makes for excellent comparison of two practices. For example, an adapted new variety in one plot and the same variety with a minimum fertilizer input in the second plot.

The yield of 5x10 meter plot can be expected to be sufficient to plant approximately a quarter of a hectare during the following season if the farmer likes the results and saves the yield for replanting. Through this procedure, if large numbers of farmers receive the initial trials seed, dispersal of an improved rice variety to many farmers can be rapidly accomplished at low cost. Because rice is self-fertile no crossing takes place from one generation to the next. The only precaution is to use "foundation" class seed for the initial trials.

By using may 5x10 meter farm trial plots in a local area---say a village---even to the point of one plot for every farmer in the village---no favorities to cause jealousy or envy among farmers---a "critical mass" of acceptance of a new variety (or its rejection) can be readily achieved and at low cost, especially important at low perceived risk.

The 1981, 1982, 1983 diffusion trials of the ROK 5 variety of rice to 20 farmers by J.W. Stenhouse, of the Rokupr station showed that those receiving the new variety were most reluctant to share any of the yield with neighbors unless the person was a close relative.[4]

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[4]J.W. Stenhouse, J.M. Adam, and M.W. Brown, "The Acceptance and Diffusion of ROK 5 in Moribala, WARDA Special Research Project, Rokupr, Sierra Leone, August 1983, 699, typed paper.

A fundamental decision that extension workers with the TAT must face, to assure the greatest degree of acceptance of new technology by small scale farmers with extremely limited financial resources, is the level of "appropriate technology" to promote.

Of course, a thoroughly tested, broadly adapted, stable yielding variety with a wide range of soil, soil fertility, disease and insect tolerance and acceptance eating quality is a logical first. The ROK 5 variety for all medium duration salt-free areas of true tidal and associated mangrove swamp ecology is an ideal example of such a variety. (In fact ROK 5 is a proven variety for inland fresh water swamps that commonly become iron toxic during the rainy season from seepage from the highly acid Ultisol soil uplands.)

In contrast the long duration CP 4 variety is not a suitable variety for release because of its tendency to shatter grains, low tolerance to iron toxicity, and non-adaption to low nitrogen status although yields are high with nitrogen fertilization. ROK 10 is likely a better choice, for the long duration true tidal zone of the mangrove swamp ecology. ROK 10, from a mid 1960 cross of Nyasien 57/Gantang is higher yielding than mid duration ROK 5. ROK 10 was recommended by the Rokupr Station for Sierra Leone in 1978. ROK 10 does not have resistance to iron toxicity. Therefore, ROK 10 should only be grown in the long duration salt free areas of the true tidal swamp.

How much nitrogen fertilizer for initial extension farm trials in the true tidal zone and how much nitrogen and phosphate in the associated swamp zone of the mangrove swamp ecology small scale rice farms should be used? Mimimum cost for a readily visible increase in yield should be the guiding principle. From a preliminary review of the WARDA research results to date, visits to the area, discussions with the research scientists, and this evaluator's long experience with submerged soil rice production in many countries of Asia the following levels are suggested:

a) 20 kg/hectare rate nitrogen fertilizer for the true tidal zone.

b) 20 kg/hectare rate of nitrogen and 20 kg of phosphate ($P_2O_5$) fertilizer for the associated swamp area

The ideal minimum risk, minimum cost, extension farm trial to accomplish these two initial introductions of "appropriate technology" is to use a pair of 5x10 meter strips; one with ROK 5 or ROK 10 and a second strip of both, the same variety, and 20kg/hectare nitrogen and 20kg/halrate of phosphate (available $P_2O_5$) on associated swamp farms. These should be distributed by extension with the assistance of a organized TAT interface program to a large numbers of farmers, even to all mangrove swamp rice farmers of selected villages.

It is not necessary, and psycologically defeating to ever challenge what the farmer is doing by having a so-called "farmers" variety or "practice" plot. The farmer knows what he is doing and the yield he gets and so does the extension worker because the farmer's field is all around the extension trial. If the extension farm trial results do not produce a significant improvement in yield then we have nothing to offer to the farmer.

Precautionary

Although the Rokupr results of mangrove swamp ecology research is excellent and adequate to supply a full scale national extension effort, this evaluator, from his knowledge of submerged soils management for rice, suggests that these continuously wet soils high in organic matter (10 to 12 percent) are likely to show a large yield response of rice to the addition of a low-cost soluble form of zinc (zinc sulfate hyptahydrate) at 10kg/ha rate in the field and 20 kg/ha rate in the seed bed (nursery). The yield response to soluble zinc may be at least equal to more than that of fertilizer at only a fraction of the cost of fertilizer. Preliminary research on the need for zinc, but with insoluble zinc oxide, was begun at Rokupr in 1983.

## Power Tiller Trial

The power tiller technology package introduced as one of the mangrove swamp 1982 TAT adaptive farm trials was a well conceived and executed farm test of mechanization in a "hand" agriculture area. Obviously it required considerable time and funds to develop a viable program. In a sense the trial is more closely an applied research trial in cooperative mechanization. The research group had been carrying out power tiller cultivation trials on farms for three years prior to the TAT program.

## The Northwest Intergrated Agriculture Development Project (NWIADP)

It is satisfying to learn that the newly organized Northwest Integrated Agriculture Development Project (European Economic Community Fund) of the Sierra Leone National Extension Service is adopting the cooperatively owned power tiller concept to use on some 2,500 hectares of mangrove samp ecology farms during the next two years, utilizing training and guidance of the Rokupr Research Station.

In addition the NWIADP is one of several extension projects with which the government of Sierra Leone hopes to achieve effective agricultural extension in the nation. Some 40 extention workers, with seven production credit offices are being organized. Emphasis

will be with mangrove swamp rice farm families but also with upland farm families. The project hopes to reach 4,000 farm families within the first phase of the project. In the northwest project near the Rokupr station there are 30,000 farm families on 155,000 hectares. Within this area there are 40,000 hectare of mangrove swamp.

The evaluation team was much impressed with our short interview of the Northwest Intergrated Development Project leadership.

In the opinion of this member of the evaluation team the existence of the NWIADP is the "golden" opportunity for the WARDA/TAT effort to show that it can actually interface successfully with extension. But as stated by the NWIADP Director — "WARDA should do adaptive research and they can be of great help to us in training, supplying research results, providing information on rice culture (especially in mangrove swamp) and the use of power tillers, as well as monitoring, but we will develop and do the extension." Can and will WARDA's TAT concept successfully meet this "real life" challenge of interfacing with extension?

Recommendations

1. Eliminate the independent farm trials that are "retesting" already proven research results of the Rokupr Station and of the 100 to 200 on farm applied research scientists each year.

2. Concentrate all efforts on interfacing with the Northwest Integrated Agriculture Development Project.

3. In close collaboration with the WARDA research scientists learn in great depth the characteristics, fertility and minor element status of the soils; the weed, insect, disease and predator status as well as salt free timing of each zone of the mangrove swamp ecology throughout the NWIADP area. Train extension workers in the key items.

4. Become authorities on the characteristics, adaptation, tolerance, response of the few very best rice varieties, and their management, for the mangrove swamp zones and "salt free" periods, learn how these new rice varieties will fit in relation to those rice varieties currently grown by NWIADP farmers.

5. Arrange for adequate seed production and availability, in a timely manner for (1) extension farm trials and (2) farmer commercial use.

   (a) Multiply 135 day ROK 5 for the medium duration salt free areas, both true tidal and associated swamp zones.

   (b) Multiply 175 day ROK 10 for the long duration salt-free areas, for the true tidal but not for the associated swamp area because ROK 10 is not tolerant of iron toxicity.

   (c) Begin multiplication of an adapted 110 day variety, highly salt tolerant for the 3 to 4 month true tidal zone.

6. With NWIADP extension leaders, extension field workers and key farmers develop an extension plan of work, for observation on-farm trials on large numbers of farms meeting these criteria: low cost; minimum risk; great assurance of initial success; small size, using the basic 5 x 10 metric strip plot (1/200 hectare) in singles or pairs. Extension workers should agree on the packages of technology, prepackage the supplies and distribute them with simple instructions that also can become effective teaching aids for extension workers and farmers. Plan to achieve "critical-mass" interest and participation. Start "small and simple."

7. In collaboration with research scientists and Sierra Leone extension subject matter, prepare simple "FACT SHEETS" for extension field workers on all key factors of deep water rice production.

8. Similarly develop recommendation #1 through 7 for upland rice--- a far more important crop than mangrove swamp rice ecology. The upland varieties LAC 23, ROK 3 and the new ROK 16 are the most promising upland varieties for the higher rainfall uplands (rainfall area II). Complete minor element supplement and erosion control on sloping lands are very important. There is also a large hectarage of level, highly plintic ultisol (gravelly) loans for upland rice in the area.

WARDA Response to "Critique of TAT Program", by Reeshon Feuer

In this chapter as well as in that on the Mopti TAT program, Dr. Feuer has raised two basic issues: first, that the technology package for the 1982 TAT trials was selected by the WARDA Headquarters Development team and hence was faulty; and secondly, the trial plot size is too large and should be reduced to 10 X 5 meters. The first is a factual error, while the second seems to reflect a lack of understanding of our philosophy of both extension education, and the TAT trials.

The technology packages for Rokupr were proposed by the team leader, WARDA Special Research Project for Mangrove Swamp Rice, Rokupr, Sierra Leone, on the behalf of his research team. They were presented by him at a joint Research and Development Department meeting held in Monrovia in May, 1982, where it was discussed thoroughly before it was approved. Hence, the research team did not warn against the selected variety, since they selected it with the full knowledge of its potential limitations. Consequently, all the

other observations made on the TAT staff are invalid. The technology package was proposed by the research team and included those components that had maximum chances of success under farmers' socio-economic management and production constraints. Furthermore, an understanding of the process of package selection as described in Dr. Sandhu's chapter would have shown that it is impossible for the TAT team on its own to select a package! It is rather the results of the 1982 TAT trials that proved that CP 4, which has given outstanding performance in research trials on small plots has little chances of success under farmers' conditions.

As for the size of the adaptive trials, it is well recognized that the trials in farmers' fields have fewer management controls than those in research stations. Hence, higher experimental error and probably a greater proportion of failure can be expected. Consequently, larger fields are needed. It is a well recognized principle in extension education that the size of the extension oriented adaptive trials should conform to the modal field size in the area so as to inspire confidence in the farmers that the improved technology is performing better in their own fields rather than in tiny plots. In addition, the size has to be large enough to generate data regarding labor use and economic benefits to draw valid conclusions. Hence, the trial size of 10 X 5 meters suggested by Dr. Feuer reflects a research orientation and is not suitable for TAT trials.

We should stress that the TAT trials are not on-farm variety trials, neither are they variety popularization or distribution programs. The decision to reduce the plot size from 4,000 to 2,000 square meters in the Rokupr area was not due to farmer pressure! Rather the experience of working with farmers in Sierra Leone, Guinea, Gambia, and Mali during the 1982 and 1983 TAT trials show that both the farmers and the related national extension service people have confidence in the program and are keenly awaiting the results of these trials. This was confirmed by the report of the CGIAR Quinquennial Review team which conducted a detailed review of the program!

The recommendations given by Dr. Feuer, if implemented, would reduce the Rokupr TAT program to an extension and input delivery program for the northern mangrove swamps of Sierra Leone. WARDA's mandate does not include, and should not include replacement of national extension activities by WARDA. TAT program is a regional program, the objectives of which are clearly stated in the chapter by Dr. Sandhu. It is not necessary or desirable for WARDA to "arrange for adequate seed production and availability in a timely manner for (i) extension farm trials, and (ii) farmer commercial use." The Sierra Leone Government already has a seed multiplication project which is receiving technical assistance from WARDA, and which already has ROK 5, 10 and other varieties under multiplication.

While Rokupr Project staff (Research and TAT) as well as other WARDA staff have given, and will continue to give maximum assistance to Northwest Project, WARDA cannot take over the extension functions of the project, as implied by the recommendations of Dr. Feuer.

Appendix I

# PROJECT ADMINISTRATION AND MANAGEMENT

By
William A. Carlson, Consultant
Agricultural Development Planning, Management and Evaluation

"As an on-going entity, WARDA has the administrative capability for the implementation of the project and all of its components."[1]

The Team's review of WARDA II Project operations in Monrovia, Fendall, Rokupr and Mopti indicated that administrative and management problems were seriously constraining full and effective project implementation. The following material reflects only some of the most critical findings and recommendations. In the absence of a full understanding of the extremely difficult conditions under which WARDA functions, and the unrealistic expectations embedded in the WARDA II Project design, the team's findings could be viewed as a devastating criticism of WARDA's overall institutional capability. In fact, the team feels that overall (with the exception of the management of WARDA's cash flow problem) WARDA's professional staff have done a good job considering the inherent difficulty of their task. To help the reader better appreciate this point of view, the underlying nature of WARDA's development problematique should be understood.

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[1] WARDA II Project Paper p.46

## I. The WARDA Problematique

To assess the performance of a development organization, one must consider three dimensions:

- the nature of the development task
- the environment in which the organization must function
- the organic nature of the organization

WARDA's development task can be simply stated - to increase the quantity and quality of rice produced in West Africa and help achieve regional self-sufficiency (at least for that part of West Africa represented by WARDA's Member States). In one sense, it is to WARDA's advantage to have a single-purpose mission. The evaluations conducted of successes and failures in development program implementation indicate clearly that single-purpose development programs have a much better chance of successful implementation than multipurpose development programs, all other things being equal. But all other things are not equal. The same studies reveal that the most difficult type of development programs are those which depend upon achieving widespread behavioral change in traditional societies involving adoption of new and risky technology. And the greater the number of social and political institutions involved, the more difficult the task. It is clear

from development experience, for instance, that it is much easier to successfully carry out an infrastructure project (highways, electric generator facilities, railways, etc.) than to implement a project requiring widespread adoption of new technology to transform traditional agriculture in a subsistence rural economy - the task faced by WARDA. WARDA must not only develop the new technology (tested and proven rice varieties to fit a complex variety of ecological conditions, together with appropriate and economical agronomic practices), but must also find methods for stimulating 15 independent nation-states (divided by cultural, geo-political, linguistic, religious, and ideological differences) to transfer those technological packages to traditional, as well as more modern, farmers in a region that may have as many as one thousand distinct linguistic/cultural sub-societies existing in dozens of agro-climatic ecological rice-growing zones. And this must be accomplished with little more than persuasion and example as leverage. Surely, this is one of the most difficult development tasks ever faced by any organization.

As if the nature of the development task was not enough of a management challenge, this task must be implemented in <u>the environment</u> of West Africa - a region notable for the difficulty of conducting business with dispatch and efficiency. National and international development assistance agencies, as well as private

sector business enterprises, recognize that West Africa is a region where it takes longer and costs more to achieve results than most other regions in the developing world. Lack of adequate telephone and postal services, sketchy road and railway networks, undeveloped public and commercial services of all kinds, insufficient numbers of properly trained and motivated workers, and government administrative structures based on nineteenth century Western models, are only some of the more obvious barriers to effective performance. While there are a few notable exceptions in West Africa, a few metropolitan areas offering support facilities comparable to those found in industrialized countries, most of the region (and especially the rural areas) presents a formidable challenge to carrying out the most simple tasks in a prompt and economical manner.

Given one of the most difficult development tasks to perform in a very difficult environment, what sort of organic structure did WARDA's designers produce? WARDA was designed as a supranational regional organization dependent for its financial support and policy guidance on some 15 newly independent nation-states carved out of a multiplicity of colonial experiences, without a common language, religion, political ideology, or ethnic base. The disappointing experience with supranational regional organizations in parts of the world where the nations share a

common cultural tradition, language and religion (such as Latin America) suggest the degree of optimism that must have prompted WARDA's designers. To complicate the matter further, the economic condition of most of Member States is such that financial dependence upon non-regional donors is essential. At one time or another some dozen or more foreign donors are using WARDA as an instrument of achieving the donors' development objectives - objectives that are not necessarily mutually compatible nor even consistent with WARDA's basic mission. USAID's desire to emphasize assistance to the poorest of the poor, for instance, is not altogether compatible with WARDA's charge to emphasize increased production of rice. The international donors have not attempted to coordinate their policies or assistance projects with each other, nor with the 15 Member States on WARDA's Governing Council. Indeed, no mechanism exists for such purpose. As a regional organization, WARDA must necessarily be sensitive to the politics of its situation. Care must be taken in administrative and management matters to "balance" the national interests, the Anglophone-Francophone interests, the ideological interests, as well as the personal interests of the members of the Governing Council. While doing all this, WARDA must adapt its administrative practices to meet the diverse bureaucratic requirements of its various donors - with different fiscal years, legal constraints, reporting requirements, and administrative styles. WARDA, for instance, operates at least three distinct

budget systems - one for its Governing Council, one for CGIAR, and one for USAID! To minimize as much as possible its administrative diversity, and perhaps to emphasize its self-image as an international organization, WARDA has adopted basic administrative practices (accounting systems, etc.) used by the FAO. One might imagine that if the world's five most outstanding development management experts were formed into a committee and charged with the task of designing the most difficult and challenging organization to manage effectively, they might well invent something that resembles WARDA.

Given the nature of WARDA's development task, the environment in which it functions, and its organic structure, it should not surprise anyone that after 10 years it still has not achieved its objective. It is, in fact, somewhat astonishing that it has managed to survive at all!

## II. Management Focus of the Evaluation

WARDA is an institution experiencing severe environmental stress. Member States, the principal source of financial support for WARDA headquarter operations, have expressed strong objections to

many management policies and practices. Many of them feel that top management officials of WARDA have been unresponsive to their concerns. Anglophone and Francophone rivalries, superimposed upon national interests, have generated internal strife within the WARDA Governing Council which has been reflected (and in some cases magnified) in internal dissentions and counter-productive management practices. Many Member States, most notably the largest contributor Nigeria, have failed to fulfill their financial commitments. Foreign exchange shortages resulting from deteriorating international economic conditions is usually cited as the "official" reason for the shortfall, but it is generally acknowledged that the deep policy disagreements are at the root of the problem.

Whatever the causes, and they are many, 1983 became a crisis year for WARDA. As discussed more fully in the following sections, unless Member States significantly increase their contributions before December 1983, WARDA will not be able to continue salary payments to its current staff. It is already too late to reduce costs to meet currently available funds. WARDA management, by failing to take prompt and effective action, has seriously overextended WARDA's financial commitments. "Payless paydays" are in store for WARDA's employees if contributions from Nigeria and other Member States are not forthcoming soon. The survival of WARDA, as presently constituted, is in question if the underlying

policy conflicts are not resolved. Under the circumstances, the team had to face the issue of whether to evaluate WARDA's management and administration in terms of its long-run survival as a supranational regional international institution, or whether to hew closely to the terms of reference for the mid-term evaluation and assess the impact on the specific projects funded by USAID under the WARDA II Project. It soon became clear that the long-run survival of WARDA could not be ignored, even though it may be possible to deflect the most serious short-run impacts on USAID-funded activities during the remaining life of the WARDA II Project.

Accordingly, the main body of this report will focus on the narrow issue of the WARDA II Project through 1985, and the longer-term implications will be discussed in an Addendum to the report. The time available for field review did not permit a comprehensive assessment of all aspects of WARDA management and administration as they bear on WARDA II, nor was such a review necessary under the terms of reference. Rather, the focus was on administration and management as a (possible) constraint on project output and effectiveness. If all project outputs were judged to be forthcoming on schedule and within budget, then no serious management constraint to project success would exist. Problems of overall management efficiency and responsiveness could be viewed as the proper concern of the WARDA Governing Council (GC), not as matter of direct concern to USAID.

## III. The Cash Flow Problem

A. Nature and Significance. Over 70 percent of the costs of WARDA's Executive Direction and Administrative Support Services (all units except the Research, Development and Training Departments) are financed by Member States under cost-sharing formulas developed and approved by the Governing Council. Two funds have been established by the Governing Council to receive Member States contributions:

General Fund. The basic fund intended to finance the recurrent costs of the core headquarters administrative staff.

Special Fund. A separate fund (officially titled the WARDA Fund) established by the Governing Council in 1975 (initial contributions made in 1977), to finance special projects, certain types of non-recurring costs, and "meeting other financial obligations which the Association deems necessary" to meet WARDA objectives. The formula for the Special Fund contributions of the Member States was based on the "ability to pay" principle, as measured by each states's GDP, with a minimum of $10 thousand and a maximum of $500 thousand initially. Nigeria was the only Member State assessed the maximum.

The initial Special Fund formula generated substantial cash surpluses through 1981, despite continuing shortfalls in the contributions of some Member States. Because of the absence of clear and rigorous criteria governing the use of the Special Fund, and the absence of close monitoring by the Governing Council and donor agencies, WARDA headquarters managers were not subjected to serious overall budgetary discipline. Staff expansion and increased operating costs resulted in the Administrative Budget increasing from 18 percent of the WARDA budget in 1977 to 25 percent of the WARDA budget in 1982.

By 1982 WARDA's Executive Direction and Administrative Support units comprised 24 percent of WARDA's total budget and 29 percent of WARDA's professional staff, as shown below:

| | 1983 Budget | |
|---|---|---|
| | Percent of total Budget | No. of Professional Staff |
| Executive Direction and Administrative Support | | |
| Secretariat | 5.6 | 6 |
| Department of Finance and Administration | 9.7 | 7 |
| Communications Division | 5.9 | 9 |
| Documentation Division | 2.8 | 5 |
| | 24.0 | 27 |

Program Departments

| | | |
|---|---|---|
| Department of Research | 45.9 | 38 |
| Department of Development | 17.0 | 19 |
| Department of Training | 13.1 | 9 |
| | 76.0 | 66 |
| Total, WARDA | 100.0 | 93 |

The budgeting, accounting and fiscal procedures and practices that evolved during this period of "easy money" were not designed to provide management with reliable and timely cost/commitment information related to responsibility centers and project performance. Nor were they well-suited to ensure the integrity of the donor project-specific funds.

In time, Member States became dissatisfied with the lack of budgetary and financial discipline in WARDA Headquarters, and with the lack of responsiveness of headquarters managers to the concern expressed by the Member States. In 1980 a special investigation committee of the Governing Council was appointed to investigate headquarters operations. Reports presented to the Governing Council recommended reorganization of the headquarters operations, to be accompanied by a shift of professional staff from headquarters in Monrovia to field stations, and an overall reduction in the headquarters' budget.

A change was also made in the formula for Member States' contributions to the Special Fund which reduced the maximum for any Member State from $500 thousand to $250 thousand. This revised formula by itself would have reduced the amount of funds flowing to the Special Fund, and thus reduce the flexibility of headquarters managers on financial matters. However, in addition, Member States' shortfalls in contributions also increased (apparently in response to the failure of headquarters managers to fully implement the austerity measures recommended in the Governing Council Special Committee's Report). In the face of an increasingly adverse ratio between actual income and budgetary commitments, and the strongly expressed views of the Member States that headquarters staff and operations should be reduced, prudent management could have been expected to introduce economy measure (including headquarters staff reductions through attrition and/or RIF's) in a timely manner. This did not happen. By mid-1983 the budgetary situation was becoming serious, and cash-flow problems were becoming critical. Budget projections indicated that, unless steps were taken to reduce staffing levels by September 1983, the costs of terminating employment contracts would exceed the savings that could be realized by the end of the WARDA fiscal year (Dec. 31, 1983).

Instead of developing and implementing plans for retrenchments, reflecting program/project priorities, WARDA management chose to act on the optimistic assumption that the Member States (especially Nigeria) would have a last minute change of heart and contribute sufficient funds to keep the existing headquarters organization intact at existing levels of staffing. Temporary expedients were adopted to meet immediate cash-flow problems, including a partial freeze on filling vacancies, reduction in travel, and deferment of purchase of supplies, materials and equipment. No analysis was made of the program/project impact of this strategy. The orientation was exclusively towards managing cash-flow, not managing programs or projects in light of considered priorities. To the extent that priorities were reflected in cash-flow management decisions, it appears that first priority was given to preserving intact WARDA headquarters staff and prerequisites even at the expense of depriving field operations of funds to pay salaries and wages and to maintain essential life-support and project-support systems - a policy that can only be regarded as bordering on the irresponsible.

At the time of the team's review, Member States' contributions were in cummulative arrears of over $6.6 million, a shortfall of 38 percent. For 1983, the WARDA headquarters administrative budget was reduced from $2.5 million to $1.5 million, of which less than $500 thousand had been contributed by Member States. The Director of

Finance and Administration was continuing to express optimism that Nigeria and other Member States would contribute sufficient funds before the annual meeting of the Governing Council in December to avoid the need for a dismissal of Staff or payless paydays. Hardly anyone else interviewed by the team shared the Director's optimism.

TABLE 1 - Member States Assessments and Areas as of September 30, 1983

| General Fund | Total Assessment | Total Arrears | Percent Arrears |
|---|---|---|---|
| Nigeria | $3,331,883 | $1,744,861 | 52.4 |
| Ghana | 746,250 | (289,698) | (38.8) |
| Ivory Coast | 695,967 | 210,574 | 30.3 |
| All other (12 countries) | 5,342,163 | 2,780,400 | 52.0 |
| Total GF | $10,116,263 | $4,446,137 | 43.9 |
| Special Fund | | | |
| Nigeria | 3,000,000 | 1,054,731 | 35.2 |
| Ghana | 1,393,045 | — | — |
| Ivory Coast | 973,429 | 393,209 | 40.4 |
| All other (12 countries) | 1,647,148 | 693,190 | 42.1 |
| Total SF | $7,013,622 | $2,141,130 | 30.5 |
| Grand Total | $17,129,885 | $6,587,267 | 38.5 |

B. Impact on USAID Projects

The WARDA cash flow problem should not, in principle, impact on the USAID-funded projects. The cash-shortage exists only in funds provided by the Member States to finance WARDA Headquarters core

operations. Funds are currently available through USAID/Liberia to pay all necessary and reasonable expenses for WARDA II activities through 1983 and beyond. Nevertheless, the policies and procedures adopted by WARDA management to deal with the cash flow problem have, in fact, impacted adversely on WARDA II activities.

During the years of "easy money", WARDA headquarters adopted the policy of depositing all funds received, regardless of source or purpose, in a single consolidated checking account. Disbursements are processed as vouchers and bills are presented for payment, and no attempt is made to assure the integrity of fund source or purpose. Temporary deficiencies in advances or reimbursements from donors or Member States did not result in delays or deferrals in project or activity spending, since payments could be made from the consolidated checking account when due. Indeed, USAID-funded projects benefited from this arrangement since USAID did not follow the practice of providing an advance of funds to WARDA but, instead, operated on a reimbursement basis. Until 1982, when a cash advance/reimbursement system was initiated, USAID activities were in fact being financed by interest-free loans from other donors and Member States through the consolidated checking account.

As Member States' contributions fell further and further behind, the effect was to place an increasingly greater strain on the WARDA

Special Fund. Instead of tailoring headquarters operations to the actual level of the General Fund, management used Special Fund resources to finance the overextended headquarters operations. When Member States then reduced their Special Fund contributions in an attempt to force WARDA management to economize, WARDA management pressured USAID/Liberia to provide working capital for financing WARDA II projects. A $600 thousand advance to WARDA was made by USAID/Liberia during the Spring of 1982, with the understanding that it would be used to pay WARDA II Project bills. Upon submission of appropriate supporting vouchers each quarter, USAID/Liberia replenishes the working capital advance. Since the advance and replenishment are deposited in WARDA's consolidated checking account, they of course are "available" for paying bills for any and all WARDA activities, including core operations. WARDA headquarters management was not able to resist the inevitable temptation to divert USAID funds to other purposes, assuming that the delinquent Member States would soon come forth with contributions owed in amounts sufficient to cover all expenses. When that did not occur, WARDA headquarters was faced with a difficult policy choice - whether to respect the integrity of USAID (and other donor) funds, and reduce headquarters expenses to a level supportable by actual Member State contributions, or whether to use donor funds from approved projects to maintain the headquarters staff, salaries and privileges. The team saw abundant evidence that the decision was to use USAID and other donor funds for that purpose.

As discussed in more detail below, WARDA II activities under approved 1983 budgets were gradually starved for the cash needed to pay expenses already incurred - causing serious disruption in Special Project activities and forcing field managers and staff to adopt all sorts of expedients to maintain operations at survival levels. Debts were incurred up to the limits tolerated by banks and suppliers. Staff members paid official expenses out of personal funds just to keep operations going, hoping for early reimbursement. Fuel supplies were depleted to the point where field trials and extension activities were curtailed, and even to the point where essential life-support activities (e.g., water supply, electricity, etc.) were reduced below safe levels. Reductions in the number of temporary laborers threaten the integrity of field experiments and trials. Desperate pleas to headquarters for prompt cash reimbursements to pay expenses incurred under approved operating budgets were treated unsympathetically. At no point did headquarters officials assume responsibility for advising or directing field station managers on adjustments that should be made in operating plans or budgets. They continued to let field project managers operate on the vain hope that the "temporary" cash shortage would soon be corrected without need to restrict program operations.

In the meantime, all headquarters staff in Monrovia continued on the payroll, with their salaries paid on time, comfortable in their

air-conditioned offices, and with limosines and chauffeurs at the disposal of the top officials. Instead of making a serious effort to help Special Project managers deal with the mounting problems stemming from cash shortages, the Director of Finance and Administration and his staff blamed the field-level cash shortages on West Africa's notoriously unreliable communications/transportation infrastructure, and on the field staff's "inefficiency" in properly preparing and promptly submitting adequately-documented requests for cash replenishment. Factors, curiously enough, which had not caused such serious problems during the years of "easy money."

Not all of the problems identified by the team in the activities of WARDA II are due directly to WARDA's cash flow problem. But they have been made more troublesome and more difficult to resolve, as project managers have been forced to spend excessive amounts of time (including personal trips to Monrovia to plead for cash to pay the bills and debtors) in coping with the problems of maintaining minimum levels of operations without sufficient funds.

C. USAID Responses

In the face of mounting evidence that WARDA's cash-flow problem was hampering operations, and in recognition of the fact that USAID/Liberia had been contributing to the problem by funding WARDA II on a pure reimbursement basis, USAID agreed to provide a $600 thousand working capital advance to WARDA in June 1982. This must have slightly eased WARDA's financial bind, but it could not solve WARDA's basic cash flow problem.

As evidence began to accumulate that WARDA management was now diverting USAID's cash advance to help finance Headquarters core operations, USAID/Liberia, under pressure from USAID/Washington, requested WARDA to establish a separate checking account for WARDA II funds. WARDA management refused to comply on the grounds that it would unduly complicate procedures and would increase workload. Discussions with WARDA finance officials, and with the USAID/Liberia Comptroller, revealed that there may have been some misunderstanding of the procedural nature of the request and the work required for compliance. At the team's request, joint meetings between the USAID Comptroller and WARDA finance officials were held to clarify the requirements and resolve the issues.

A separate checking account for USAID-funded activities, if rigorously adhered to, could go a long way toward providing a

"safety net" for WARDA II activities. At the same time, it would exacerbate WARDA's overall problem by reducing even further WARDA's flexibility in managing its cash flow. If USAID's proposal were also followed by other donors (particularly CGIAR), it could substantially hasten the day of ultimate crisis for WARDA, the day the till is completely empty to pay salaries for Headquarters staff. In the absence of a rescue operation by the Member States, this might well trigger the collapse of WARDA as it is presently constituted. (AID contingency plans for such an eventuality are discussed in an Addendum to this report).

In any event, at some point, USAID may have to consider whether it is more important to protect the integrity of its funding processes, or whether it is more important to save WARDA as an institution.

It should also be noted that merely establishing a separate checking account for USAID funds would not guarantee that Special Projects would receive sufficient funds to maintain operations. If WARDA headquarters charged non-WARDA II bills to that account and USAID/Liberia refused to reimburse for those charges, USAID's only recourse would be to withhold funds. WARDA headquarters then would simply not reimburse the Special Project operations, and they could collapse.

Thus USAID would have engaged in the unappealing practice of cutting-off its (Special Projects) nose to spite its (WARDA/HQ) face.

Recommendation

USAID/Liberia should take immediate steps to provide sufficient replenishment to the WARDA II cash advance to permit emergency checks to be delivered directly and immediately to the Station Directors at Rokupr and Mopti in amounts sufficient to restore their credit worthiness with local suppliers and to meet essential program needs during the next few weeks. Such action should be made contingent upon adequate assurances from the newly-installed Executive Secretary that appropriate steps will be taken to assure direct and immediate delivery of emergency funds to the Stations, by special courier if necessary.

## IV Scenarios for the Future

In some ways, the timing of the Evaluation Team's visit to West Africa was fortuitous. Although conditioned by the seasonal nature of deep-water/floating rice production, the team's visit occured at a critical moment in WARDA's history, and a critical time for the WARDA II Project. However, the schedule was such that the team had to depart West Africa before some of the imminent events cruicial to WARDA's survival had occurred. Consequently, in October 1983, it was somewhat uncertain what the immediate future might hold for WARDA as a regional organization and therefore what fate might have in store for the USAID-funded activities under WARDA II. Recommendations to USAID regarding possible mid-course corrections in the WARDA II Project would necessarily be highly sensitive to alternative assumptions about WARDA's prospects for the next six months. Three general scenarios seemed possible:

A. The Optimistic Scenario. The optimistic assumptions of the Director of Finance and Administration seemed to most observers (in and outside of WARDA) to be quite unlikely. Because of the underlying political and policy nature of Nigeria's complaints with WARDA management, and because Nigeria's share of the deliquent contributions was so great, it did not seem at all probable that a last minute change of heart by Nigeria would result in its delinquent contributions being fully paid before the Governing Council meets in December. On the other hand, it might appear to Nigeria that some tactical advantage would accrue if it contributed just enough to avoid shouldering the blame for WARDA's collapse prior to the crucial Governing Council meeting. If so, WARDA Headquarters operations might be kept intact by a combination of slightly more austere economy measures (including laying-off some temporary employees - a move heretofore resisted), and a few "payless paydays" for the regular staff. Since WARDA employment, at salary and benefit scales far out of proportion to the alternatives for most employees, is so attractive and the alternatives are so few, most (perhaps all) WARDA Headquarters staff could be expected to tolerate a few "payless paydays" - especially since they could expect to borrow from the employees' Provident Fund to tide them over for awhile. On this basis, WARDA might survive as presently constituted until the Governing Council could resolve its policy issues with WARDA management in December. It could be expected that WARDA management would find it expedient to make sufficient changes in response to the General Council demands (assuming that the General Council could achieve a consensus of views) to earn continued financial support. However, the level of that support could not be expected to return to the earlier "easy money" days.

B. The Collapse Scenario. The deep and long-standing nature of Nigeria's grievances with WARDA's management, and indeed with the basic nature of WARDA's organic structure, combined with the national rivalries and the Anglophone/Francophone jealousies of the 15 Member States, might well prevent the Governing Council from reaching an effective consensus on needed structural and policy changes in WARDA. If Nigeria simply refused to contribute any more funds under those circumstances, and other Member States or donors declined to make up the deficit (which seems likely) then WARDA, as a regional international organization, could not continue to exist. Individual activities and projects

WARDA might be salvaged, by donors or individual West African countries, or some combination thereof, but the supranational regional aspects of the institution would disappear. This could happen before the end of the WARDA II Project period.

C. The Reconstruction Scenario. Both the Optimistic and Collapse Scenarios, while possible, seem less than probable. In spite of WARDA's problems, and in view of its perceived potential, there seems to be enough vested interest in WARDA's survival by international donors and at least some Member States to support an alternative scenario. If the two principal donors (CGIAR and USAID), and a majority of the Member States on the Governing Council, have sufficient interest in salvaging some vestige of an international regional institution for rice development, and can submerge their individual preferences sufficiently to achieve a common goal, then a method could be developed to salvage WARDA; not as presently constituted under the existing constitution, and not necessarily with all of the individual Member States participating, but on a reconstructed basis that would eliminate some of the organic flaws in WARDA and transform it into an organization more closely resembling the other International Agricultural Research Centers (IARC's).

The management evaluation and recommendations in the following sections are addressed to the "Optimistic Scenario", although many of the recommendations would also be relevant under the other two Scenarios. This is followed by an Addendum containing a brief discussion of prospective strategic options for USAID under the "Collapse Scenario" and the "Reconstruction Scenario".

## V. WARDA Headquarters

Except for the activities under the TAT, USAID does not finance any of WARDA's headquarters budget. The principal sources of

headquarters funds are the contributions of the Member States and CGIAR. (It would not be inappropriate for USAID to be expected to make a contribution to headquarters operations expenses in view of the fact that USAID-funded projects do create additional administrative workload.)

USAID's direct interest in headquarters operations extends only to these aspects that impact directly on USAID-funded projects. In light of that fact, and aware that the CGIAR review group was making a comprehensive review of WARDA's organization and management systems, the team did not undertake to make an extensive evaluation of all aspects of WARDA's administrative and management systems. Primary attention was focused on the financial and budgeting operations as they related to cash flow management problems, and on program planning processes.

Annual Program Planning

The WARDA headquarters process for annual review of research and TAT activities, and development of long-term and annual program plans, is elaborate and expensive. It also suffers from many deficiences, including:

- lack of effective integration between annual program planning and annual budget development;

- insufficient participation by field station specialists in the planning and budgeting process;

- overly centralized decision-making by top headquarters officials who do not spend enough time at station sites to develop a good understanding of local conditions, constraints, opportunities and problems;

- absence of flexible and responsive reprogramming procedures, to permit timely and realistic mid-year revisions of program plans and budgets;

Annual Budgeting

WARDA does not have a budgeting process, it has several budgeting processes. At least three major budget processes are required to service the demands of the three principal sources of funds -- CGIAR, USAID and Member States. Each of the three processes involves a separate budget calender (different fiscal years and schedules), different forms and data requirements, and different approval routes.

The Budget Officer (appointed only three years ago and paid by CGIAR) has attempted to regularize procedures and upgrade budgetary documents, in an effort to respond more effectively to donor-imposed requirements. The budget office even prepared, for the first time, a "consolidated budget" statement for WARDA. However, there has been no effort by WARDA management to attempt to utilize this information for evaluating WARDA's overall resource allocation and priority-setting processes. WARDA's policy-makers continue to deal with budget and financial matters in a fragmentary, uncoordinated way.

Field station participation in budget development is especially weak. Formal calls for estimates are mailed to the stations each year (using the notoriously unreliable West African mail services) but deal primarily with costing assumptions, and specifying dates and forms for supplying data. Budget calls are accompanied by fiscal guidelines and assumptions (price assumptions, inflation factors, cost-estimating ratios, etc.), but not with program or policy guidance. There is no systematic attempt to integrate program planning with budget development, giving consideration to alternative programs or project design and related cost-effectiveness considerations. The budget development and review process is thus very fragmented, and does not represent a useful tool for managing WARDA as an integrated organization.

The budget execution process is even less useful as a management tool. Primary attention is paid to the purchased inputs, little attention given to results. During the past year or so, the entire attention of WARDA's top management has been focused on the short-term cash management problem. No serious effort has been made by the previous Executive Secretary and the Director of Administration and Finance to assess the program or project impacts of the cash management decisions. Station managers have not been brought into the confidence of the headquarters cash managers, and given guidance on the types of program or project adjustments that should be made to meet cash shortage problems. They have been cast adrift to survive as best they can, led to believe that the cash shortage was temporary and would soon be corrected. As a consequence, station managers have not been able to systematically plan for appropriate adjustments in annual operating plans in light of reasonable assumptions about overall financial constraints.

Recommendation

The annual program planning and budgeting processes should be integrated throughout the organization. Headquarters managers and professional staff should make a special effort to become personally acquainted with operating and financial problems and opportunities at the field locations. An annual on-site station review, attended by senior officers and by professionals from WARDA headquarters, should take place during the first quarter each year. This review should cover both the program and financial operations for the current fiscal year, and a preliminary review of the program and financial plans for the next fiscal year.

Recommendation

Station managers should be given an annual budget allocation (representing full authority to obligate and disburse funds for all goods and services not reserved for Headquarters purchase). Adjustments in spending levels during the year, where needed, should be made through adjustments in operating plans, not by unpredictable adjustments in cash advances or reimbursements. Quarterly (or trimester) reviews of current operating plans and budgets with Station Managers should be instituted.

Recommendation

Program adjustments should be made to bring current commitments within a conservative estimate of available funds. Cash should be made available to stations to liquidate aging debts, including bank loans, and sufficient cash advanced at the start of each fiscal year to cover 3-months needs (an official policy that has not been followed).

Recommendation

WARDA, perhaps with financial and/or technical assistance from CGIAR, should engange the services of a program budget expert to assist in designing and installing a modern program and performance budgeting system that is fully integrated with WARDA's annual program planning process.

## VI. WARDA Training Center

Unlike the Special Projects in Rokupr and Mopti, WARDA's cash flow problems have not severely damaged the Training Center's operations. Its close proximity to WARDA headquarters, and the mutual support arrangements it enjoys with the Liberian College of Agriculture, have provided the Training Center with the opportunity for dealing with the worst effects of cash shortages.

The principal effect of the cash-flow problem has been to delay the filling of one position, an interpreter/translator (to bring the total to three). This position is included in the USAID-approved budget for 1983, and announcement of the vacant position was published in the spring of 1983. The Director of the Department of Training at WARDA headquarters alleges that the extended delay is "normal" because of the difficulty of finding qualified people. It seems more likely that the normal procedure has not been aggressively pursued in light of the cash shortage.

Translation Services

The delay in hiring an interpreter/translator is somewhat constraining on the effectiveness of the Center. Because of the Anglophone/Francophone balance which WARDA tries to maintain, the Director has established a policy of excluding from the on-site library any publications that are not available in both languages (thus some IRRI documents are absent due to a lack of French translations!), and not reproducing lecture notes for distribution to trainees until bilingual versions are available. The two existing interpreter/translators are busy performing simultaneous translations during course sessions for much of the year, and are reported to be reluctant to perform tedious written translation work between course sessions.

The perceived political sensitivities involved in enforcing strict administrative discipline on unresponsive employees, and the relative scarcity of quality translators, seems to inhibit the Center's Director from obtaining greater productivity out of the present interpreter/translators.

In view of WARDA Headquarters position that cash flow is not the reason for the delay in recruiting an interpreter/translator, and the importance for training purposes of reducing the backlog of translation of training materials, the Training Center should be authorized to engage the temporary services of contract translators.

Recommendation

USAID should authorize WARDA to fully utilize the savings resulting from the delay in filling the authorized positions to employ contract translators to reduce the backlog of training materials translations, and should closely monitor WARDA headquarters' response to assure that cash is promptly made available to pay for such services.

Recommendation

USAID should explore the possibility of utilizing excess P.L. 480 foreign currencies to obtain translation services (in countries where the currencies and translation capability exists) to assist the Training Center in reducing the translation backlog.

Recommendation

WARDA should propose to the Governing Council in December that Member States who are in arrears in their contributions to WARDA be permitted to substitute translation services performed in-country for part of their foreign exchange obligations to WARDA.

Recommendation

The team understands that IRRI has a capability for translating publications into other languages (including French) upon request and on a fee-basis. CGIAR has a joint interest in both organizations, and should be able to finance the costs of such translations at IRRI. These translations would have a special value to WARDA, but would obviously also have a world-wide value in Francophone areas.

## Evaluation of Training Program Impact

The limited studies conducted of the experience of course participants following training, and anecdotal reports from knowledgeable observers, strongly suggest that Member States are employing Training Center graduates in rice-development related work in their home countries. However, there is little direct systematic evidence of the extent to which WARDA's "training of trainers" objective is being met. While some graduates are known to have conducted subsequent short-term training courses or seminars upon return home, no quantitative follow-up studies have been made of the extent to which this occurs. Because in-country training by country nationals can be one of the most cost/effective ways to increase skill levels of research and extension workers, efforts should be made to evaluate this impact and the results used to improve the training program.

Recommendation

USAID should offer to finance a special evaluation study of the extent to which Training Center graduates are engaged in training rice research and extension workers upon return to their home countries, the quality of the training, the numbers trained, and the employment of trainers in relevant rice-related development work. Such a study might be done under direct contract with USAID, or by employees of the WARDA Department of Training, with the participation of the Training Center staff.

Long-term Training Requirements

USAID is currently financing a substantial expansion and up-grading of the physical facilities at the Training Center. The Center's capacity for housing participants will be doubled, from 32 to 64, when construction is completed. It is not clear at this time that a doubling of capacity is really justifiable. There has been no analysis of the long-term requirements for trained manpower in the WARDA Member States, the cost/effectiveness of alternative modes of training (such as in-country training by WARDA-trained trainers), or the long-term commitments of USAID or Member States to finance Training Center operations after the end of the WARDA II Project period.

The Training Center has already graduated over 900 course participants, including more than 200 in the basic six-month Rice Production Specialist Course. Clearly, at some point in the not too distant future the absorptive capacity of the Member States for trained manpower will have been reached. At that point, only replacement needs and refresher courses are essential — and these may not place great demands on WARDA if in-country training by WARDA trained participants is successful. It is equally clear that USAID cannot commit the U.S. Government to paying the full costs of maintaining a WARDA Training Center in perpetuity.

In light of the above, and particularly in view of the possibility of a major reorganization of WARDA occuring soon, a serious effort should be made to assess the long-term needs and funding requirements of the Training Center, including the prospects for eventually making the Center self-financing through tuition charges and/or greater reliance on Member States contributions.

Recommendation

USAID, in cooperation with WARDA, should commission a special study of the long-term training needs of the Member States, their willingness and ability to finance the Training Center on a continuing basis when USAID financing is no longer available, and the role of in-country training in meeting long-term requirements. A provisional plan should be prepared for phasing-out USAID funding over time and phasing-in Member States financing, by establishing a revolving-fund arrangement that will permit the Center to be self-financing after the WARDA II Project is completed.

## VII. The Special Projects (Rokupr and Mopti)

The greater the distance from Monrovia, the more serious the impact of WARDA's cash flow problem. The TA. operations at WARDA headquarters and the Training Center at Fendall have been inconvenienced by headquarters cash management practices, but have managed to minimize short-run adverse impacts. The research and TAT activities at Rokupr, and to an even greater extent at Mopti, have not been so fortunate.

## The Situation

Because of the distances involved, the remoteness of the sites, the absence of reliable communications and transportation facilities, and the lack of appreciation of key Headquarters officials about local conditions and program effects, the field program activities have been seriously constrained. It was reported to the team that the previous Executive Secretary and Director of Finance and Administration had rarely visited either site, except for brief ceremonial appearances. Except for the Director of the Development Department, none of the top headquarters officials have visited either station during the 1983 fiscal year — the period when the cash flow problem became acute. Consequently, the officials most directly responsible for managing the cash flow were unaware of, and appeared indifferent to, the effects of their policies on field program activities.

At both stations, the station managers and professional staff had exerted every effort to maintain operations in the absence of funds and policy guidance from headquarters. Both stations were deeply in debt to input suppliers for essential supplies, materials and services. Staff at both stations were financing official expenses out of personal funds. The Rokupr station had reached the limit of its ability to borrow from the Central Bank of Sierra Leone (the Malian counterpart refused to advance credit at all to the Mopti

station). Field research and trials, and extension trips to surrounding areas, were drastically cut back. Inventories of supplies and materials were reduced to day-to-day subsistence levels. Essential equipment purchases had been deferred. Even vital life-support functions (water supplies, electricity, etc.) had been reduced to levels threatening health and safety of staff and families.

Station managers and other staff had made personal trips to Monrovia to plead for cash reimbursements sufficient to maintain station credit-worthiness with suppliers, after paying their own travel expenses. They received little cash and less sympathy from Administration and Finance staff. Indeed, they were blamed for the local cash shortages on the grounds that they had not submitted regular monthly replenishment requests — often batching two or three months vouchers to await the occurance of a trip by someone to Monrovia, since mail service is unreliable.

The Special Problems at Mopti

Conditions at Mopti were in greater disarray than at Rokupr. In addition to the cash flow problems, Mopti had been without a permanent Director until September 1983. The Acting Director, a competent scientist but inexperienced administrator, had not been able to cope effectively with his combined scientific and managerial



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responsibilities. Personal relationships among station staff had deteriorated, and a history of rivalry and conflict between research and TAT personnel had clouded the atmosphere. Indeed, unlike the cooperative research-TAT relationships at Rokupr, the Mopti situation had deteriorated to the point where the Acting Director was maintaining separate cash accounts for research and TAT activities and had borrowed funds from the TAT account to pay for research expenses! The newly recruited Director had arrived on the scene, but had not yet assumed command at the time of the team's visit. It was clear to the team that the Acting Director resented the appearance of his "replacement" and was not in a mood to cooperate fully in expediting the transition. For example, he had not informed the new Director that he was in possession of a plane ticket (issued by headquarters the previous May) and was soon to depart on extended home leave, and he had rebuffed several efforts on the part of the new Director to schedule personal briefing sessions on station financial management and administrative practices. It was only by attending interview sessions conducted by team members with the Acting Director that the new Director discovered the full seriousness of the cash problem! In fact, the relationships are so bad that the team believes it essential for USARDA Headquarters to take immediate action.

Recommendation

The previous Acting Director should be transferred as soon as possible to a scientific (not managerial) post at another WARDA station and that a senior staff member be designated by the Deputy Director to serve as Acting Director in the Director's absence.

## Immediate Cash Needs

Both stations require immediate infusions of cash to forestall interuption of essential services. The amounts owed to the stations by headquarters are so large that quibbling over details of individual transactions (in part as an excuse to defer cash payments) is ludicrous. The expenses have been incurred and the bills must be paid. The stations are not demanding immediate payment of all outstanding replenishments due -- but are willing to settle for sufficient cash to pay creditors and restore vital life-support services to reasonable levels. It is time for WARDA to get its priorities straight. The field stations do not exist primarily to provide a justification for the existence of the WARDA headquarters. WARDA headquarters exists only to support and facilitate the work in the field. If headquarters cannot manage to do this, it does not deserve to continue in existence.

If necessary to raise cash, WARDA headquarters might even consider selling the Mercedes limousines and laying off some of the 15 drivers currently serving headquarter officials in Monrovia.

Temporary employees could be separated, and permanent staff placed on half-pay for the duration of the emergency. USAID/Liberia could be petitioned to increase its cash advance on a temporary basis, with appropriate assurances that the increased cash will go directly and entirely to the field stations.

Recommendation

The new Executive Secretary and Director of Finance and Administration should give highest priority to the immediate cash needs of the field stations at Rokupr and Mopti and, in consultation and cooperation with USAID/Liberia, take immediate action to transfer sufficient funds to maintain basic station operations for the next three months. If necessary, the money should be delivered to the station managers by special courier from WARDA headquarters, rather than depending upon unreliable means of conventional delivery or waiting for field station personnel to come to Liberia.

Recommendation

USAID/Liberia should provide a temporary increase in its cash advance to WARDA, sufficient to cover the amounts due the stations for unpaid expenses already incurred on behalf of WARDA II activities — provided adequate assurance is given that the full amount of the increase will be delivered entirely and directly to the stations. If such assurances are not forthcoming from WARDA headquarters, USAID/Liberia should immediately institute revisions in funding procedures to use the USAID Missions in Sierra Leone and Mali as agents for the direct transfer of funds to Rokupr and Mopti, eliminating transmission through WARDA headquarters entirely.

Recommendation

To overcome the endemic problem of delays in communications in the West Africa region, WARDA headquarters should institute a regular courier service on a once-a-month schedule around the circuit of capitals in which WARDA field activities ocur. Field stations, confident of the regular arrival of a courier to the capital, can thus establish regular courier links to the capitals to facilitate delivery of documents, reports and bank drafts. In Sierra Leone and Mali, the USAID Mission should offer its services as a courier depository to facilitate services to Rokupr and Mopti.

Recommendation

A study should be made, working closely with the appropriate ministries in the Member States, to assess the feasibility and cost-effectiveness of establishing a regional radio communications network serving WARDA headquarters and all WARDA field stations and offices.

## Electricity and Water at Rokupr

The Government of Sierra Leone has undertaken a commitment to supply the Station with water and electricity for station operations and for household use. The generator (owned and operated by the GOSL) for delivering electricity to the station and for pumping water is the same generator that also services the municipality. The GOSL and the municipality are also experiencing cash flow problems, and cannot purchase sufficient fuel to operate the generator around-the-clock. Although not required to do so under the agreement with the GOSL, and without having funds included specifically in its budget for the purpose, the station has been supplementing the resources of the GOSL by paying for diesel fuel to operate the generator. The station's own cash shortages (and over extension of local credit) has drastically limited this option. Short-run emergency steps must be taken to provide cash to the Rokupr Station to meet essential station-support and life-support systems (see recommendation on page 21), but a long-term solution is also needed.

Recommendation

The Rokupr Station should be authorized to acquire a stand-by generator, and a sufficient reserve supply of diesel fuel, to be available for supplying electricity during periods when the COSL generator is down.

## Salaries of Station Directors

Rokupr and Mopti are USAID-funded Special Projects, devoted entirely to implementing WARDA II project objectives. USAID funds pay the salaries of all professional staff except the two Station Directors. CGIAR currently pays for the Rokupr Director's salary, an arrangement that originally was instituted as an accommodation to some temporary fiscal procedure problems during the transition between WARDA I and WARDA II, and is committed to paying the Mopti Director's salary in 1984. There is no programmatic or managerial logic to this arrangement. While not causing serious problems at the moment, this arrangement contains the seeds of mischief over time, subjecting the stations to potential additional stress from fragemented and discontinuous funding procedures as well as ambiguous lines of responsibility and divided loyalties.

Recommendation

USAID should agree to assume full responsibility for funding, under WARDA II, the salary and related costs of the Directors of the Rokupr and Mopti projects.

## ADDENDUM

### A.I. AN AID Strategy for the Collapse Scenario

Although the "Collapse Scenario" is to be regarded as a low-probability outcome, the possibility clearly exists. If the WARDA Governing Council fails to reach agreement in December on the policy issues in dispute, and Nigeria simply refuses to provide any further contributions, WARDA headquarters will soon be bankrupt.

Under the prevailing uncertainties, USAID should begin now to develop contingency plans for rescuing as much of the WARDA II project as seems desirable and feasible. A contingency planning team should be established, with a representative from the USAID Africa Bureau, and from the USAID Missions in Liberia, Sierra Leone and Mali. The contingency plan might include the following strategic elements:

A. Training Center

There seems to be general agreement that the Training Center at Fendall is the most successful element in the USAID-funded support for WARDA. There seems to be no reason why the Training Center could not continue to operate as a free-standing organization in the absence of WARDA as a parent organization. The "orphan" could readily be supported throughout the remaining WARDA II project period, under the surveillance of USAID/Liberia. Plans should be made for eventually phasing-out full USAID funding in favor of a gradual evolution to a self-supporting regional training center financed by tuition fees paid by donors and participating States (see discussion under Section VI in the report).

B. The Rokupr Special Project

The Team believes that the activities at Rokupr hold promise of making a significant contribution to the rice economy of the mangrove rice producing areas of West Africa. Continued USAID support for the WARDA II project period is warranted. However, the event of the demise of WARDA as a parent organization, there is no justification for continuing the Rokupr project under USAID/Liberia's jurisdiction. It should be transferred to USAID/Sierra Leone's portfolio. Discussions should then be held with the government of Sierra Leone looking toward the transfer of the activity to the Sierra Leone University of Agriculture Research

Station at Rokupr. Any continued particpation in post-WARDA II project financing is part of USAID/Sierra Leone's portfolio would be a question to be addressed during the end-of-project evaluation.

Transforming the activity into a national research operation would not necessarily deprive it of regional significance. As the primary mangrove swamp rice research station in West Africa, its results (if useful) would be transferrable to other mangrove rice areas, and would be in demand.

The TAT component at Rokupr should continue as a station oriented effort, with activities available to and carried out in neighboring countries upon request and with appropriate financial participation.

C. The Mooti Special Project

In retrospect it appears to the team that USAID's commitment of large resources to develop a deep-water/floating rice project was a mistake. The prospects for a dramatic breakthrough in genetics to produce a high-yielding variety that poor farmers will be able to afford to produce seems remote. Improvements can be made in yields, using relatively low-technology inexpensive inputs, but large scale deep-water/floating rice production will not likely be

profitable except under conditions of perpetual subsidy. There is no reason to believe that the Government of Mali will be willing to pay these subsidies - nor should it. There are less costly ways for Mali to increase domestic rice production if it wants to do that. Nor is there any reason to expect international donors to undertake the commitment for expensive input subsidies in perpetuity.

If USAID believes, however, that Mopti deserves to have a fighting chance to prove its worth under its new management in the event of a collapse of WARDA, then responsibility for the Mopti activity should be transferred from USAID/Liberia to USAID/Mali for the remainder of the WARDA II Project period. As with the Rokupr Station, the TAT component should remain with the project to test extension methodology in cooperation with the existing Malian organizations such as Operation Riz. Extension of support beyond the WARDA II project period is an issue that should be addressed in the end-of-project evaluation.

However, the Team believes that another alternative that should be considered under the "Collapse Scenario", is that the Mopti location be closed out and the remaining non-fixed resources at Mopti be redirected to Rokupr where some deep-water rice research capabilities exist. It is unlikely that the Mopti station can develop satisfactory technology for the deep-water flash-flood



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high-rainfall areas of Guinea, Sierra Leone, Togo and other countries along the West Coast. According to WARDA estimates, about 165 thousand of the 450 thousand hectares of deep-water rice are located in the high rainfall areas, with the largest amount in Guinea.

Consideration should eventually be given to transferring the station to the jurisdiction of the Government of Mali.

D. Technology Assessment and Transfer

Except for the components of TAT at Rokupr and Mopti, it is difficult to visualize a legitimate role for a region-wide TAT program in the "Collapse Scenario". Contingency plans should be prepared by AID for closing down the AID contribution to the TAT operation. Assistance should be offered to TAT staff for post-WARDA employment (some could be useful in the Rokupr, Mopti and Fendall operations). Plans for disposing of AID supplied TAT equipment and supplies will be needed. An evaluation of the experience-to-termination should be conducted, and a record made of the lessons learned for possible future use in West Africa or other regions of the world.

## A.II. A USAID Strategy for the Reconstruction Scenario

While the "Optimistic Scenario" contemplates the survival of WARDA as presently constituted (though on a somewhat reduced scale), the basic structural/organic weaknesses would persist. The long-run viability and effectiveness of WARDA would still be in doubt. For those donor agencies and Member States who still have faith in the desirability of sustaining a supranational regional organization in West Africa, some fundamental changes in WARDA's organic structure should be considered. If the "Optimistic Scenario" does not prevail, then fundamental changes would be essential to prevent a total collapse.

One of the structural weakness of WARDA is that it depends for its sustenance basically on three separate entities -- Member States, CGIAR, and USAID -- in about roughly equal proportions. The defection if any one of the three would destroy WARDA as presently constituted (unless the other two filled the financial gap, which seems unlikely). Each of the three place different policy and administrative demands on WARDA, sometimes conflicting demands, and WARDA cannot afford to ignore or alienate any one of the three by an unambiguous resolution of any conflicts that might exist. The three supporting entities themselves have failed to establish a mechanism for resolving their conflicts or coordinating their policy and

administrative requirements. The current financial crisis faced by WARDA, and the fortuitous coincidence in timing of the CGIAR Quinquennial Review and USAID's Mid-term Evaluation, may well create the conditions for the three "sponsors" of WARDA to face up to these conflicts and structural problems and take concerted action to rescue WARDA and reconstruct it on a sounder basis.

A "Reconstruction Scenario" implies, of course, that a high value is placed on the institution-building aspects of the WARDA assistance program. The team has noted that the WARDA II Project Paper does not incorporate "institution-building" as an objective, nor does it explicitly place a value on the political or psychological value of WARDA as an instrument for promoting a sense of community and cohesion among West African States. Taking this at face value, there would not seem to be much incentive for USAID to incur substantial bureaucratic or financial costs to participate in a coordinated salvage operation with CGIAR and the Member States.

Under the present, somewhat ambiguous, circumstances USAID may not find it expedient to exert leadership in the effort to reconstruct WARDA. But it could make it clear that it is prepared to participate with other donors and Member States in a rescue operation -- if CGIAR and a majority of the Member States strongly indicate a desire to engage in such an operation.

A. The Shift to CGIAR Alternative

One available strategy would be for USAID/Washington to cut its losses so to speak, and shift its support of WARDA to CGIAR. USAID, being a member of CGIAR, could take the position that whatever general interests it has in supporting WARDA as an institution could be discharged through CGIAR. Even though the bureaucratic pretence is cultivated that no USAID money currently funnels through CGIAR to WARDA, the fact remains that USAID funds help finance CGIAR's overall support for all IARC's including WARDA.

B. The Concerted Effort Alternative

A more forthright strategy would be for USAID to participate directly, and overtly, with CGIAR and the Member States in a concerted effort to reconstruct WARDA.

In the event of an imminent collapse some type of "Receivership" arrangement might have to be established to manage the short-term transition to a leaner organization. Perhaps a Transition Committee could be established comprised of a representative from CGIAR, a representative from USAID, and one representative from the Governing

Council. This Committee could undertake to obtain minimum financial commitments from all parties for supporting WARDA through the reconstruction period and beyond, and should be empowered to make the decisions necessary to:

- -- contract for a comprehensive management and financial audit of WARDA's operations, with an internationally recognized management consulting firm;
- — engage the services of an organizational design team to develop and evaluate alternative organizational structures for a reconstituted WARDA;
- — assess the capabilities of, and need for, the existing headquarters staff;
- — schedule selected Headquarters staff terminations, as needed, to bring expenses within expected available funds;
- — allocate remaining staff to the minimum essential positions in headquarters, or to field operations where possible, pending final resolution of the structural question; and
- — develop a recommend organizational structure and a new organic framework (a revised constitution or equivalent implementing document) and present it to a plenary session of donors and interested Member States for approval, modifications or other disposition.

Among the suggested improvements in a reconstructed WARDA gathered during the team's review, a few key ideas seemed to recur with some frequency, including:

- — appointment of the Chief Executive Officer (now titled Executive Secretary, preferably re-named Director-General) by a donor-Member State selection committee from a world-wide roster of internationally-renowned development agency managers (not necessarily either a research scientist nor an extension specialist). This would be in lieu of the current method of electing an Executive Secretary from candidates nominated by Member States with all of the political hazard that process entails.

- appointment of a representative from the major donor agencies (primarily CGIAR and USAID), together with representatives from Member States, to a newly constituted Governing Board (to replace the present Governing Council), empowered to make policy for WARDA on the basis of a majority (or perhaps 2/3) vote. This would be in lieu of the current practice wherein only West African States are eligible for membership or the Governing Council, and any single state can veto changes in WARDA's constitutional structure or policies.

- elimination of the current position of Director of Finance and Administration, and establishment of a Comptroller position separate from the Administrative functions. The first occupant of that position should be appointed by the selection committee from a world-wide roster of professional comptrollers;

- elimination of the function of the FAO representative as "Acting" Executive Secretary during the absence of the Executive Secretary and Deputy Executive Secretary, a role not sanctioned by the present WARDA constitution. Considerations could be given to eliminating the FAO "liaison" role altogether, and according FAO the opportunity for membership on the Governing Board if it were willing to provide continuing financial support for WARDA;

- either eliminating the post of Deputy Executive Secretary, or converting it to a full-pledged Deputy CEO, with "Chief-of-staff" responsibilities and functions;

- establishment of a modern internal audit operation (including management audit as well as financial audit) staffed with qualified professional auditors, and supplemented by a more professional external annual audit conducted by an internationally recognized commercial firm;

- provision for automatic suspension of Governing Board membership and voting rights for any member state or donor failing to contribute its annual assessment for three years. Under the present arrangement, Member States can vote to terminate membership of any state in arrears, but have never done so though some Member States haven't made a full contribution in the last six to ten years.



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