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SOIL AND WATER CONSERVATION PROGRAMS

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SOIL AND WATER CONSERVATION PROGRAMS

If salt water intrusion barriers are constructed to retard the movement of saline water into otherwise arable lands and if crops, particularly rice, can be grown on the land thus protected, the process is considered to be swamp reclamation and is the responsibility of the Irrigation and Swamp Rehabilitation Division (ISRD) of the Department of Water Resources in the Ministry of Water Resources and Environment. If salt water intrusion barriers and water retention structures are constructed to retain runoff waters from surrounding upland areas and if crops, particularly rice, can be grown on lands thus flooded, the process is considered to be water conservation and thus is within the purview of the Soil and Water Management Unit (SWMU) of the Department of Agriculture in the Ministry of Agriculture.

This rather minor semantic difference has led to the creation of two programs in two different Ministries doing basically the same job. While their approaches differ somewhat, both are extremely successful and both are needed. Questions as to whether or not the two should be merged are perhaps best left unanswered for the time being.

Statistics suggest that since 1978 as many as 22,800 ha per year have been used for swamp rice production and that from 1978 to 1984, swamp rice yields averaged 1540 kg/ha. Location and identification of this hectarage and provision of salt water intrusion barriers and/or water retention structures where appropriate should go a long way toward insuring consistent annual production of swamp rice.

The value of this approach is that it is technologically very simple. Construction is easily accomplished by the villagers themselves with a minimal amount of technical assistance and money required. Rice production in flooded areas can be done by traditional techniques; the function of the structures is to assure adequate water year in and year out, thus establishing a stabilized production base. This strategy has, in addition, important short-term benefits in that most lands can produce rice in the first rainy season following construction of the water retention structures.

Runoff rates from upland soils in The Gambia are estimated to range from 20% to 80% of rainfall received with higher runoff percentages occurring when soils are saturated or soil surfaces are sealed and infiltration is reduced. In the absence of water retention structures, this excess water moves through swamp areas primarily as sheet flow, until it reaches a discharge point. In years of average or above rainfall, sufficient water remains in swamp and low-lying areas for rice production probably with or without structural controls. One of the greatest values of the water retention structures is that in years of reduced rainfall or of poor rainfall distribution, water can--and will--be held in wet areas to depths sufficient for paddy production.

The runoff rates from upland soils in The Gambia are excessive. This is negative from the standpoint of soil erosion and water for upland crop production and clearly measures should be devised to reduce these losses. On the positive side, this runoff insures adequate water for rice production in low-lying areas if it can be retained there.

Recently completed studies by the ISRD on four irrigation perimeters (Sifoe, Pirang, Jabanack, and Bulock) conclude quite appropriately that attempts to develop or reclaim actual or potential acid sulfate soils should be abandoned (or not even started in the first place). In swamp reclamation projects, the up-stream boundary of the acid sulfate soils should represent the downstream limit of the reclamation effort. If a salt water intrusion barrier is part of the project design, it should be installed at that point in the landscape.

Both agencies (ISRD and SWMU) are adequately staffed to function at present levels of activity, although both are awaiting the return of personnel currently in training. Counterpart relationships are strong at the present time. When the tours of the present TAs are near completion, both programs (if they remain as separate entities) should be reviewed to determine future needs for technical assistance either on a short- or long-term basis. Future involvement for GARD in these reclamation efforts is not clear although the Task Force on Water Control Studies clearly should review them carefully. That scrutiny might identify some needed GARD inputs. Additional technical research (soils or engineering) is really not a question here as all the techniques being applied have been in use for years and have long since proven their worth.

No effort was made to examine the wisdom of the development of additional high tech rice perimeters in The Gambia as that is the responsibility of the Task Force on Water Control Studies in which GARD is involved. The track record to date (Jahally-Pacharr aside) is dismal. If, however, future investment in irrigation perimeters is deemed feasible, any, and all, sites

selected should be reviewed in detail by a qualified soil scientist before any final decisions are made on construction or development.

Soil erosion in The Gambia is a serious problem and programs to deal with it (primarily within the SWMU) are having trouble getting erosion control efforts organized. Part of this has to do with manpower shortages due to training although much more significant is the fact that many farmers simply are not aware of the fact that they do have soil erosion problems on their lands. Much of the agricultural land in The Gambia has very low slopes so water moves as a sheet across it. Sheet erosion is difficult to see and because of the absence of much active gullying (except around villages), farmers simply do not recognize the problem. Suffice it to say, however, that if 20% to 80% of the rainfall runs off, there is considerable soil erosion going on. In the URD where slopes are steeper, obvious efforts are being made to control erosion although active gullies are apparent there.

Many of the upland agricultural soils in The Gambia are composed of up to about 50 cm of medium to coarse textured materials which overlie 50 cm or more of very fine textured material. Infiltration (water movement into the soil) is limited both because the low organic matter content of the surface soil which reduces the aggregation of soil particles and because of the tendency of the soil surface to seal, particularly during high intensity rainfall events. Percolation (water movement through soils) is retarded by two factors. First, the upland soils have relatively high bulk densities throughout their profiles which means that soil materials are packed closely together and that the pore space available for air and water movement is reduced. Secondly, the fine textured subsoil materials contain, in addition to kaolinite, limited amounts

of clay minerals which expand when they are wetted. As a result of this, the subsoils, once wetted, become almost a carrier to the downward movement of water.

The upshot of all of this is that the bulk of soil water available for plant growth during the cropping period is held in those medium and coarse textured materials which overlie the fine textured subsoil. Soil erosion removes those upper materials which effectively reduces the ability of the soil to hold water for plant growth. If the rains stop for a period of time during the growing season, crops will become stressed for moisture as the available soil moisture is used up.

The technology for controlling soil erosion exists. Farming on the contour, particularly if ridging is employed, would go a long way toward controlling soil losses and retaining water for crop growth in most of The Gambia. In the long run, practices which incorporate organic matter into the soil such as the introduction of forage crops into rotations and the plowing in of crop residues rather than burning must be introduced into the farming systems.

The SWMU has had some limited success introducing upland cropping practices to reduce soil erosion, particularly when those practices have been tied to rice land reclamation projects. A valuable addition to the staff of that unit would be a long-term TA with experience as a soil conservation technician. These are people who work with farmers to lay out contour strips, to develop crop rotation systems and so forth. The urgency of this need depends on the priority attached in the farming systems approach to controlling soil erosion.

Again, adaptive research in soil erosion control is not required at the present time. Education and information efforts tied to the farming systems strategy are critical. Equally important is the maintenance of a strong technical back-up unit. Water conservation measures tied to the introduction of new cropping technologies will go a long way toward insuring the success of the demonstrations by minimizing the potential for moisture stress during the growing season. GARD must, of necessity, retain close ties with the SWMU.

SOIL SURVEY ACTIVITIES

Detailed soil surveys have been completed for about 50,000 ha in The Gambia; present plans call for accelerating the soil survey in order to finish mapping the remaining nearly one million hectares in the next 7 to 10 years. Soil survey information is the base line data required for any type of resource management and while the most pressing need currently is to support increased agricultural production, ultimately shifting land-use patterns and land-use conflicts will make soil survey information invaluable.

Four trained and experienced soil surveyors currently handle mapping responsibilities. Two are diploma holders and should be considered for training to the B.S. level. Degrees could be completed, probably, in two years which would include two full academic years and two summers of field soil mapping with the U.S. Soil Conservation Service. Replacements hired during the period of schooling should be retained on the soil survey staff to provide enough surveyors to complete the mapping effort within the established time frame. Given the relatively long field mapping period (approximately 7 months) and the proposed staff increase from four to six, the completion of the soil survey for all of The Gambia in less than 10 years is a realistic goal.

To repeat, the two diploma holders--Babou Camara and Ebrima Saidy--should be trained to the B.S. level, if possible. In addition, John Fye, who is the head of the soil survey program and, currently, is acting director of the SWMU, should be trained to the M.S. level. John should not be considered for advanced schooling at the present time but rather in year 3 of the project. The person who will probably become the SWMU director is scheduled to return to the Gambia late this year or early next and time is needed to move him into the directorship. Pulling John out now would be a grave error but in a couple of years, no problem. John Fye is an extremely capable soil scientist; additional training will only make him better!

Mapping is being done at a scale of 1:25000 and, in the case of the work done for OMVG, being transferred to maps with a scale of 1:10000. At the present levels of understanding of soils in The Gambia, this large scale exceeds the accuracy of the survey. For the purposes of the detailed soil survey, orthophotographs at 1:25000 prepared for OMVG by Mark Hurd Associates should be used. This photography can be obtained either from the Department of Surveys or from Mark Hurd directly. The SWMU has need for these photos for planning, for watershed work, and for soil survey; these needs could be met for less than $7000. Final soil survey maps can be printed directly from the orthophoto sheets.

The MFP has a set of color infrared aerial photographs of The Gambia at 1:25000 which should be made available to the soil survey staff when that project terminates. This imagery, in addition to the corrected black and white photography (which also includes 5m contour intervals), are exactly what's needed for the soil mapping program. In addition, the orthophotography

is tied both to latitude/longitude and to UTM so that if the soils information is ever to be automated, it will be in the proper format for digitization.

To support the soil survey program, short-term trainers/advisors (four to six weeks) should be provided at 12 to 15 month intervals. Soil scientists familiar with soil classification and mapping either from a university or from the U.S. Soil Conservation Service would work with the Gambian soil surveyors to review mapping progress, to sample and describe typifying pedons of major series and/or map units and to help establish appropriate priorities for future mapping. Samples collected should be characterized at labs in the States until the Soils Lab at Yundum is in a position to run routine characterization analyses.

Characterization data for the major soil series in The Gambia are needed not only to provide a better basis for soil interpretation but also to improve soil fertility recommendations. To date, a fair amount of information has already been developed but it needs to be reviewed, organized and evaluated. An effort will be made to begin that review at the University of Wisconsin-Madison in the months ahead. Data must be developed soon--if it is not already available--for soil series on the experiment stations at Yundum and Sapu, and at Mixed Farming Centers and other locations where active soil fertility programs are ongoing.

All this leads to a general prioritization of soil survey activities: active research and extension/demonstration sites; watersheds where soil and water conservation programs are being designed and installed; arable land that is being cultivated; arable land that is not being cultivated; and so on. Both mapping progress and future priorities should be reviewed periodically by the soil survey staff and the STTA.

A great deal of information has been collected which relates to soil/crop/water studies including Technical Bulletin 3 from the Land Resources Development Center on soil-water studies in The Gambia. This material will be reviewed by appropriate researchers at the University of Wisconsin-Madison and suggestions for further work, if necessary, will be developed. Efforts should be made to contact a Gambian currently being trained at Montana State University (M.S. in soil physics) to determine, if possible, his future research interests. It would be appropriate to have this student spend some time in Madison to discuss soil/crop/water problems with U.W. researchers.

The problem of acid sulfate soils remains unresolved. The current decision to abandon reclamation efforts on these soils is sound and there are vast areas of potentially productive soils which clearly do not have any of the problems associated with acid sulfate soils. Implementation of the barrage scheme at Ballinghar would create an estimated 9000 ha of acid sulfate soils and the need for research would then become most pressing. It should be noted that a great deal of very sound research has already been done on these soils and the general conclusion is that they (the acid sulfate soils) are best left alone.