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WATERSHED MANAGEMENT IN CAPE VERDE

INTERIM EVALUATION

WATERSHED MANAGEMENT PROJECT

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I. EXECUTIVE SUMMARY

The Watershed Management Project was designed as an employment project that would create a watershed management program. Through the construction of labor-intensive soil and water conservation works, the application of conservation techniques to farmers' land, and changes in cropping patterns, the project's goal was to create better environmental conditions and sounder farming practices that would, in turn, increase agricultural productivity and farmers' income. The project was approved in FY 1979, for 3 years. Total project funds were $6.275 million. Project implementation began in January 1980, but commodities did not arrive until mid-1980, and the project was effectively delayed a year. Through the first half of 1982, the project had spent only 37 percent of the funds anticipated in the project paper.

The focus of project implementation to date has been on: (1) the construction of dams, walls, and other works to decrease soil erosion and increase the amount of water available for agriculture, and (2) the development of an employment program which carries out the construction. The project is generally meeting its objectives in these areas. Over 424 of the 1500 check dams called for have been completed, and the rate of completion is increasing. About 82.5 kms. of contour walls have been built out of 133 kms. planned. There are signs that the supply of water is increasing, that run-off is being reduced and that these improvements are leading to better crop yields and new cropping practices in some places. The target of employing 3000 has nearly been met, and the vast majority of eligible families in the four watersheds have one family member employed by the project. Although the evaluation has specific suggestions to make in these two aspects of the program, overall progress is good.

However, the project was also to develop through an experimental extension program the capacity to take advantage of an improved resource base and to continue improving the environmental base through teaching of soil and water conservation methods. By the project's end, specific changes in crop yields and cropping patterns were to have led to considerable economic benefits. These benefits have generally not accrued. The initial core of an extension program is now in place, and it has had some impact on agriculture, but its development is far behind the development of physical structures and the employment program. Perhaps naturally the project implementation paid primary attention to construction, considering its employment goals and the logical sequence of first creating an acceptable environment, then worrying about how to use it. Also, since a national extension service was in the planning stages, the project hoped to rely on it for staffing and for reaching project objectives. The delays encountered in setting up a national program made that approach impossible and led to subsequent delays in realizing the benefits of the WSM project.

It has already made some important changes in this direction. In August 1982, the Ministry of Rural Development selected a Director for the Rural Assistance Program. Two part-time extension agents and an extension coordinatgor are on board. An extension plan was recently approved, and with the final decision to create a temporary extension service independent of a national effort, major bureaucratic obstacles may have been overcome.

Full project potential can only be realized, however, with fuller coordination and integration of the project components. There is, at present, no master plan except the project paper itself, yet a clear need exists to encourage, for example: applied research to develop a "package" of assistance and advice for farmers via the extension service; better integration of employment into overall watershed management needs (towards vegetative conservation techniques, perhaps towards access roads if marketing becomes an important future project component, and towards long-term maintenance). At present, there is, for example, not even a map showing work completed to date in the watersheds affected by the project. The importance of carrying out systematic measuring of soil and water changes would become clearer with a plan, as would the possible linkages between the project and the new Center for Agrarian Studies in Cape Verde. The need for planning becomes even more crucial for decision making about the future of the project.

The importance of this project lies in its commitment to creating the basic conditions necessary for a productive agricultural sector to exist. The level of soil erosion, the uncertain and scant water supply must be improved as the foundation of any long-term effort to improve agriculture in the country. While at this time, project administrators should commit themselves strongly to begin reaping some of the benefits of land and water improvements, through assistance to farmers in both irrigated and rainfed areas, the project's basic strength lies in its efforts to better permanently the country's resource base.

GENERAL RECOMMENDATIONS

1. The implementation of the project should shift to an emphasis on the farmers in the watershed area while maintaining the construction and employment project components.

   Justification:
   The economic analysis proves the importance of quickly increasing the project benefits. This can only be done by increasing agricultural productivity and profits of farmers.

   The economic and technical analyses show the importance of increasing reliance on biological rather than physical means of soil and water conservation. The success of this transition also depends on reaching and educating farmers.

   Finally, at this time enough work has been completed on the construction component that the logic of sequencing suggests the project is ready for this change in emphasis.

2. A general plan, including all project components should be developed.

   Justification:
   The complexity of the program has led to less than optimal sequencing of construction, extension planning, and research. A plan incorporating all elements would act as a basic referent to prevent this.

   The concept of watershed management is very broad. Even during this evaluation we make recommendations for new activities that should be part of a watershed management program in Cape Verde. A general plan allows the rational incorporation of new ideas and activities, allows systematic monitoring, and makes evaluation possible.

3. The decentralized and participatory aspects of the project, great strengths at present, should be further encouraged.

   Justification:
   The success of the employment subcomponent of the project stems in part from local decision-making and participation in the recruitment process. A close relationship with the people affected by the project has led to its perception as a fair, equitable project sensitive to local concerns.

   The extension program, through its recruitment and training, should follow the same path. Furthermore, more local participation in the processes of construction and recurrent maintenance would improve the long term prospects of private maintenance of the water and soil conservation structures.

4. The life of the project should be extended from March 1983 to March 1985.
   Justification:
   As this evaluation shows, the project is a good one, with important benefits for improving Cape Verde's natural resource base. The project is economically justifiable even in the short term, but its potential long-term conservation effects are equally important.

5. Appropriate technical assistance should be developed by hiring short term consultants, undertaking internal training, and using technical expertise from MDR and AID.

   Justification:
   The project requires more technical expertise in several areas: 1) a hydrologist specializing in water balance to help develop measuring techniques and appropriate watershed control methodologies; 2) an irrigation agronomist to help develop appropriate cropping practices; 3) perhaps a training specialist to assist the Rural Assistance Program. This would end bottlenecks in these three areas of project development. In addition, best use of skilled consultants can be made in conjunction with internal training programs (for extension agents and conservation agents) and the assistance of technical expertise in other sectors of MDR.

RECOMMENDATIONS FOR SOIL AND WATER CONSERVATION

6. Procedures to evaluate the effectiveness of various soil and water conservation methods should be established.

   Justification::
   The absence of data on the effects of conservation methods currently used makes it difficult to assess their usefulness in reducing erosion and increasing water infiltration. An adequate evaluation of their effects is not possible until systematic data collection methods are regularly employed. It is essential to quantify the real benefits of each method to allow informed decision-making on the proper mix of methods to be employed. Comparing different conservation treatments in similar sub-watershed units is a useful methodology which should be developed as part of the evaluation methodology.

7. An appropriate balance between upstream and downstream works should be determined.

   Justification:
   Development of the lower valleys is necessary for increased agricultural production. Yet attention to upstream areas is also essential for erosion and flood control, and for increased filtration of water that will become available for downstream irrigation. Despite the logistical problems involved, greater emphasis on upstream works is warranted in the project area.

8. More emphasis should be given to biological methods of soil and water conservation to complement physical methods.

   Justification:
   The economic analysis shows that biological erosion control costs less and has more benefits. Rather than expensive physical structures, biological methods rely on convincing farmers to plant certain crops that impede soil erosion and water runoff. These methods have greater payoffs because the crops planted have multiple uses as food, as a market crop, as fuel, and as fodder.

   Recommended biological controls include congo beans, fruit trees and fuelwood species. Some, particularly congo beans, are already encouraged by the project.

9. With the assistance of the Division of Forestry Services and the FAO reforestation project, increase the number of trees planted next year to 60,000.

   Justification:
   Trees are a major form of biological soil conservation and provide additional benefits of fuel and fodder. The target number was based on an assessment of the capacity of the project to produce and distribute seedlings.

   This should be undertaken by establishing or enlarging nurseries in each watershed, providing training and technical assistance to nursery managers, and encouraging greater community participation via the extension service.

10. Where appropriate, greater use should be made of contour ditches for improving water retention and slowing erosion. Experiments with contour ditches and level terracing should be made and results systematically compared with present methodologies.

    Justification:
    Contour walls are expensive, given their probable payoff in preventing soil erosion and increasing agricultural productivity. The cost of ditches, including maintenance costs, is many times less expensive than contour walls. Results from the Tarrafal experimental watershed area show that, at least in drier areas, level contour ditches are effective in preventing runoff, even on steeper slopes of 25-30 percent.

RECOMMENDATIONS TO INCREASE AGRICULTURAL PRODUCTIVITY

11. The extension program must be developed (see next section).

12. Farmers should be urged to move to higher value crops, in conjunction with marketing studies.

    Justification:
    While farmers will continue to plant for their subsistence needs, the cost-benefit analysis suggests that the following crops are particularly profitable: bananas, carrots, tomatoes, cabbage, and onions. Sweet and Irish potatoes are of lesser value.

13. Concentrate on increasing the yields on improved land through the introduction of new techniques, better varieties of seeds, and through fertilizers.

    Justification:
    New techniques to improve traditional crop production include phytosanitary treatment of manioc and sweet potato cuttings; better planting densities and improved varieties. To carry out this recommendation, emphasis should be placed on (a) the dissemination of techniques, (b) further research on new techniques on both irrigated and rainfall land.

EMPLOYMENT COMPONENT RECOMMENDATIONS

14. Encourage the spread of fruit trees.

Justification:
The benefit-cost analysis showed that banana trees especially were potentially highly profitable and would be suitable for planting on the new land behind the dikes. Furthermore, fruit trees can be used for many purposes--as fodder, fuel, food, and thatching material. Other possible fruit trees include tamarinds, guava, citrus, and mango.

Furthermore, the inputs that were supposed to be provided by the project to increase yields have not been provided. Getting these inputs into the program should be a high priority for the project, because of their economic payoff in increasing project benefits.

15. The project should ensure that women receive training as masons and foremen with supervision over workfronts.

Justification:
Although women are now paid equal pay for equal work, and make up approximately 40 percent of the workforce, they are badly underrepresented among skilled laborers (mostly masons) in the project. No women are in supervisory positions.

16. New financial management procedures should be instituted to ensure that workers' salaries are paid on time.

Justification:
Workers' salaries have been paid as much as two months late, and at present the project is 15 days in arrears in salaries.

EXTENSION COMPONENT RECOMMENDATIONS:

17. The recruitment of full time field staff, preferably with prior training and experience in extension education, should become a project priority.

Justification:
This component of the project is presently behind schedule, and delaying the development of agricultural project benefits. Without trained full-time extension agents farmers will not receive the assistance they need to take full advantage of soil and water improvements.

18. The extension plan recently prepared should be expanded to include specific areas of integration with other GOCV agencies, specifically the newly established M.D.R. Center for Agrarian Studies in Sao Jorge and the national extension service.

Justification:

Over the life of the project, the institutional context has changed with the (1) creation of a new research institute and (2) a delay in creating a national extension service.

The Center for Agrarian Studies will be able to furnish technical assistance to the project, including measuring procedures and mapping, applied research, etc. It will also have a major role in training agents for the national extension program. Formal coordination is thus essential.

While the WSM extension service is now autonomous of plans to develop a national service, in the medium run the two services will be integrated into one. Planning so that personnel can easily be transferred from the WSM project to the national program, so that techniques and training will be useful both to the WS area and the country, and most important, careful monitoring that this pilot effort will develop lessons useful to the GOCV in its larger efforts should be undertaken.

19. In the short run, institutional development of the extension service should be a project priority.

Justification:

A strategy for organizational development that meets project needs but will also be compatible with gradual absorption into a national extension program needs to be worked out. This includes designing and implementing staff and farmer training programs, establishing a project information system, and developing experimental techniques useful to long term institutional development of an agricultural extension service.

III. EVALUATION PROCEDURES

THE EVALUATION TEAM

This evaluation was carried out in Cape Verde from November 23 to December 15, 1982, with preliminary research and post-country write-ups in the U.S.

The Ministry of Rural Development cooperated fully in this evaluation. The GOCV project manager, Horacio Soares, from MDR, assigned MDR administrators major responsibilities for assisting in the evaluation effort. This included primarily (a) attendance and participation in team planning and major discussion meetings. All meetings attended by GOCV administrators were conducted in Portuguese; (b) participation by the Center for Social Research led by Elizio Rodrigues in administering a questionnaire to farmers on the workfronts; (c) field trips and briefings by MDR and WSM administrators for the benefit of team members.

Similarly, the USAID staff involved in the project devoted much time to the evaluation, discussing with outside evaluators frankly the progress and obstacles to date in project implementation, undertaking field measurements necessary for the evaluator, arranging interviews, and field trips. In the judgment of the outside evaluators, it would be difficult to imagine a more cooperative and committed effort by project administrators to assist an evaluation.

The evaluation team included:

Dr. Margaret Sarles, political scientist, on leave from the American University to Development Studies Program, AID; team leader.
Dr. Gene Ellis, University of Denver, economist.
Pat Byrne, Specialist in Agriculture
Dr. Ronald Schwartz, Consultant for Food Crop Research in Dakar, AID; Anthropologist.
George Thompson, Environmental Office, Africa Bureau, AID, engineer and environmentalist

SITE SELECTION FOR THE EVALUATION

The evaluation included the four watersheds of the WSM Project, Santa Cruz, Saltos, Flamengo, and São Miguel. When data were available for the entire project area, they were used; however, the evaluation team concentrated its own primary research on one watershed, São Miguel, for the following reasons:

1. Selecting one geographic area for multi-disciplinary field research allowed the team to consider the interdependence of the project components. Within the context of a month-long study, all aspects of the project in all watersheds could not be studied first hand.

2. The team was particularly interested in comparing upstream and downstream effects and progress of the project; the upper parts of the São Miguel watershed were more accessible at the time of the evaluation than upstream areas in other areas. São Miguel was also of interest because the watershed land is privately owned, so that the effects of extension work,of the creation of new lands on land tenure, etc., could be studied in the context of private enterprise development.

3. This methodology has the important limitation, of course, of not covering in depth some consequences of the project in the other three watersheds. In particular, the attitudinal data of workers and farmers, the impact on private and public land ownership, and other findings may vary to some degree in other watersheds. Although we believe this problem is compensated for to some degree by the richness of the data in Sao Miguel, it nonetheless remains a limiting characteristic of the evaluation.

TECHNIQUES OF DATA COLLECTION AND ANALYSIS

Collection of Soil and Water Data. Lack of measurement by the project made data collection difficult and unreliable. Much of the analysis was based on estimates and samples made by the AID soil conservation specialist, Dr. Richard Pellek. Data were also obtained from the MDR and extrapolated from findings made elsewhere in similar projects. Reports on the Agrhymat project, a project on hydrological and meterological data collection for agricultural puposes in the Sahel countries, was particularly useful.

Measuring Changes in Agriculture. A method to measure differences in production between land behind dikes and land unaffected by dikes had been developed by the USAID/PASA soil conservation advisor. Two samples of ten corn plants each were harvested from a 10 m. x 20 m. plot behind the dike and in a similar area near the dike but beyond its influence. This sampling was repeated in four locations. Green field weights and oven-dry weights were measured for ear (cobs and grain) and total plant biomass. Population densities of each area were estimated and production per hectare calculated. The same technique was applied to areas between contour walls and control areas in an attempt to determine the impact on grain yields and total plant biomass of the relatively greater moisture level observed near the walls. See Appendix A, Tables 1-3.

Impact and Employment Analysis. Micro-social and economic data on the impact of the employment conservation and extension components of the project were collected through a questionnaire given to a 10 percent sample of the farm families represented on nine of the ten workfronts in the valley of São Miguel (See Appendix B). Fifty-six farmers were interviewed as well as São Miguel foremen. A team of five researchers did the interviewing. Supplemental information was gathered through open-ended interviews with farm families in Ribeira Seca. Although not part of the Watershed Management Project, this adjacent valley was the site of a similar but older employment project (i.e., the same employment practices, the same structures) where the longer term project effects could be more readily discerned.

Economic Analysis. The quantifiable benefits and costs, and their timing within the project horizon, were estimated using benefit-cost analysis. Some factors were "shadow-priced." Both the project and major subcomponents were tested for economic feasibility. The costs and benefits of particular technologies and cropping patterns were investigated to give project administrators information on the relative economic return of the technological and agricultural choices open to them. Finally a "backwards analysis" was undertaken to assist in evaluating non-readily quantifiable benefits, by calculating how much benefits would have to be worth for the project to have a positive return on its investment.

Sensitivity Analysis. Because many of the components of the project were subject to probabilistic variation, and because only a limited number of observations (e.g., on rainfall, expected yield, expected yield increases due to structures) were available, extensive use of sensitivity analysis was made. Major assumptions were tested to see how changes in the assumptions would affect the economic viability of the project.

Computer Analysis. This was the first AID field evaluation to use a microcomputer for analysis. Analysis of original project assumptions plus economic and agricultural analyses of project progress was carried out with the aid of an APPLE II computer and software (SUPERCALC and the BENEFIT-COST ANALYSIS PACKAGE) as part of an experiment conducted by AID. Using the SUPERCALC spreadsheet, the original project assumptions and findings were recreated, and a model established which allowed testing of a variety of assumptions within a short span of time.

IV. ANALYSIS OF THE ORIGINAL PROJECT PAPER

The design of the Watershed Management Project was ambitious and complex, going well beyond the employment, soil and water conservation goals of its precursor, a Rural Works Project in effect from 1975 to 1979. During its three years, the WSM project was required to develop an overall watershed management plan, construct appropriate soil and water conservation structures, develop vegetative soil and water conservation techniques, implement a pilot extension program and change the pattern of crop production in areas affected by the project. In practice, however, as in the Rural Works Project, the WSM project has focused primarily on building conservation structures and creating employment, with the important difference of beginning the rudiments of an extension program. Difficulties in implementing--and evaluating--the project as a holistic integrated watershed management project are in part the result of several general weaknesses in the original project design.

First, watershed management planning was not given a high priority. While the project paper mentions the importance of integrated planning, the development of a plan was seen as an output of the project rather than as a precursor to action. The project paper itself recognized this problem but argued that the normal "order of precedence: plan first, construction following--must of necessity be reversed during the initial implementation of this project" to provide quick and massive employment for the island's unemployed farmers (p. III-3). This reversal, however, has led to distortions in the implementation of the project that threaten to diminish its ultimate value. Insistance on proper planning should have led to (a) a stronger commitment to measuring the soil and water data necessary to assess progress towards fulfilling project goals; (b) a general perspective for analyzing under which conditions particular conservation techniques are most appropriate (particularly in deciding between vegetative techniques and construction of dikes and dams); and (c) better integration of project components, such as the importance of extension program to better agricultural productivity and the relationship of agricultural research to developing worthwhile extension efforts.

Second, the design and place of the extension service in the project was not sufficiently spelled out.

In the original project design, developing an extension and training program was seen as a crucial project element. It is given both as an output and as a purpose. Different indicators mark its success, however. As an output, the extension service was supposed to train eight agricultural extension agents, one technician, and four watershed management planners. At the purpose level, it was viewed as one component of establishing a "viable program in WSM" and the relevant indicators seemed to be developing detailed watershed management plans (including photography) and having 1500 farmers benefitting from pilot agricultural extension services. The relationships among the indicators was not discussed.

However important in the log frame, in the actual design little attention was paid to the extension service. Mention is made that training and extension could accelerate "building a scientific base for permanent and stable agriculture in Cape Verde" (p.III-7) and that increasing the "rate of training" of technicians and establishing an extension service are important project goals, but the details of how to accomplish this are not spelled out. The project paper underestimated the difficulties in recruitment of trained administrators.

It did not discuss the integration of the extension program into other project components or other agencies of the GOCV. This led to some misunderstanding between us and GOCV administrators over the relationship of the WSM extension program to the GOCV's efforts to create a national extension service, and to delays in implementing the extension component. It did not consider the research and institutional development necessary preparatory to putting extension agents in the field to assist farmers. There is a natural sequencing of institutional development, research, development of extension "packages" of information and assistance, farmer training, and improved agricultural productivity and farm-level soil conservation methods that was not developed in the project paper, which seemed to assume simultaneous development on all fronts.

The third major weakness in the original project design was in the assessment of project costs and benefits. Problems included the following:

(1) In the overall calculation of the benefit-cost ratio, the original analysis incorrectly used a 7 percent discount rate rather than 15 percent as stated in project paper to determine that the project had a favorable benefit-cost ratio of 1.11. In fact, had a 15 percent discount rate been used, the benefit-cost ratio would have been .79; economically, the project would not have been justified with the original assumptions. It is unfortunate that this analysis survived review and three years of implementation.

(2) Given the drought and massive unemployment in rural Cape Verde, and the fact that food aid would have been given to farmers without this project, rural labor should have been 'shadow-priced' in the original analysis. The cost of labor was, in other words, estimated as too high. An assumption of the project design was that the cost of rural labor should be calculated at its wage rate. With an unemployment rate estimated at 75 percent, however, the opportunity cost for most workers was very low. Furthermore, the GOCV was receiving PL-480 money on humanitarian grounds, and there is little doubt that the government would have provided direct relief to farmers if no employment project had been possible, so some costs of payments to farmers would have existed with no project. In short, rural labor should not have been costed at its wage, but rather shadow-priced at its real opportunity cost (i.e., its productivity in the best alternative). We do not know the correct shadow price, but can establish some parameters through sensitivity analysis. If rural labor were viewed as a "free good" and priced at zero, the benefit-cost ratio would jump to 1.54 with an internal rate of return of .34. Based on the original assumptions, any shadow price between 57.5% and 0% would have given the project a favorable rate of return.

(3) Other cost estimates were high as well. Wages for unskilled labor were overbudgeted at 70 rather than the 40 escudos a day actually paid. Since wages represented the greatest project costs, the project expenditures were much lower than predicted. In addition, the land on which the project was carried out was considered a government cost. This decision prudently increased the financial participation of the host country but it was not a true economic cost.

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(4) In assessing the economic value of the project, the project paper relied exclusively on estimates of increased profits from agriculture. This is understandable to a degree, because profits are readily quantifiable and serve easily to "justify" a project. Given the lack of information about current agricultural production, however, such profits were at best "guesstimates," often not realistic. If this evaluation had concentrated solely on the agricultural benefits and how close the project was to achieving them, the project would have looked very poor indeed. So far there have been only small gains in agricultural productivity.

The proposed benefit levels in agriculture were in part a 'convenient fiction' used to gain obligations for a project which was thought to produce large levels of unquantifiable benefits. There is danger that in evaluation, a sense of misplaced concreteness will lead to a seriously misleading evaluation. The long-term economic benefits of improving the country's resource base should be considered as well, even if they do not substantially improve this short-term project's benefit-cost ratio.

Fourth, the project paper exaggerated the number and type of technical assistance and personnel who could be assigned to the project. The project manager has other heavy responsibilities in the Ministry of Rural Development. Two hydrologists were called for in the original project paper to be assigned to the project; currently there is one, who is just beginning to work on this project, and he also has important responsibilities elsewhere. Measuring and monitoring have been delayed for lack of trained personnel; it was simply assumed in the project paper that such people were available, or that training for them was easily available. The same problem of lack of technical expertise exists in extension and planning. This is not a problem easily overcome. Short term consultants can help to some extent, and are recommended at several places in the evaluation, but as originally planned, the project stretched the human resources available for project work beyond feasible limits.

V. TECHNICAL ANALYSIS

MEASURING DATA

The evaluation team was hampered in its efforts to assess progress made on this project by the lack of technical data. While the number of structures (dikes, walls, ditches, etc.) built were known, as well as overall construction costs, the following information was either very imprecise or not available:

-- a map showing the location of project construction.

-- costs broken down by structure or structure type; by location; by benefits/unit; by construction vs. maintenance costs.

-- rainfall measurements: intensity, amount, runoff, evaporation and transpiration rates.

-- groundwater levels and amount and quality of water extracted.

-- estimates on changes in soil erosion, moisture content and soil type.

-- reliable estimates on the amount of new partially irrigated land created by the project.

-- reliable estimates on the amount of land improved by the project.

There have been some efforts to obtain some of these data.

1) Mapping.

The project called for aerial mapping of the project area. Geological maps made by the Portuguese at a scale of 1:25,000 were available, however, and adequate to the project's needs, so this effort was dropped. Dr. Richard Pellek, the AID soil conservation expert, has taken the primary role in having the maps enlarged to 1:10,000 in the United States. This enlargement is crucial for inventorying and deciding where and which soil conservation methods should be applied. Maps of three watersheds are now in process; officials have not yet located the appropriate map for Santa Cruz watershed.

2) Water and Soil Measures.

Data on rainfall and runoff are presently being collected by Rui Silva, who is the head of the AGRHYMET project in Cape Verde, as well as head of the agro-meteorological and hydrological department of the Center for Agrarian Studies in Sao Jorge. Beginning in Ribeira Seca (site of a previous AID construction/employment project) he has begun installing rain gauges and flowmeters, developing a system adequate for making water balance calculations. He plans to begin a similar measurement program in the Sao Miguel watershed, and possibly in the other watershed valleys of the project, depending on whether he get the necessary support from the project. He also has plans to begin erosion measurement. What is presently missing from this program is groundwater measurements. If these can

be added to his program, in coordination with the national Ground Water Service, the data base of the project will be vastly improved.

Dr. Pellek began a systematic study of soil moisture in areas affected by project works, but due to the pressure of other project work, was forced to stop. He has also taken some soil samples for testing to the Center for Agrarian Studies at Sao Jorge, but has had great difficulty in getting them properly tested.

3) Measuring the quantity and quality of new and improved land.

Dr. Pellek has made some very preliminary estimates of the land created behind the dikes. The Ministry of Rural Development, MDR, using approximately the same method, but examining different structures, has come to significantly different findings.

Measuring the changes in land and water on land which used to be rainfed but is now irrigated for part of the year has not yet been undertaken.

The project simply does not know what the impact is of the construction works that have been built. The implications for the project in not having undertaken sufficient data measurements are serious:

-- There is no data base for deciding what technologies are most appropriate since the impact of the structures cannot accurately be estimated.

-- There is no way of quantifying the benefits of the structures without data on runoff, etc. The economic analysis of this evaluation would be strengthened by including these very important project benefits from decreased soil erosion and increased water retention in the benefit/cost ratio. Quite beyond this evaluation, in making allocation decisions for limited GOCV and AID funds, a quantitative assessment of potential benefits would clearly be a useful input.

-- The decisions as to what crops should be grown and how they should be cultivated is dependent on knowing how much and what kind of land exists, how far from a structure one can expect an adequate water supply, and so forth. Hence, the agricultural benefits, as well as the soil erosion and water conservation benefits, become exceedingly difficult to predict. The Rural Assistance Program's task is made more difficult as well, as the cropping practices extension agents should be teaching farmers will clearly vary depending on the land available, and the soil and water conditions of the land.

-- Finally, planning itself is difficult. There is not the data base for deciding what succeeds and should be replicated, and what fails; what costs more or less, considering benefits; what inputs (seeds, fertilizers, etc.) will be most beneficial; what training farmers need, and so forth.

To improve the data base for this project, the following steps should be undertaken:

1) A hydrologist should be hired on a consultant basis to assist with the planning of water data collection. At present, there is simply not the expertise available to the project to carry this out. The WSM should fully support the Center for Agrarian Studies and Rui Silva with equipment, supplies, and support.

2) Measure groundwater levels and the amount and quality of water extracted; improve, expand, and coordinate rain and runoff data measurements. These measures can best be undertaken using paired samples of treated and untreated mini-watersheds, so that differences in cropping patterns, protection methods, energy systems, etc., as well as erosion and water can be compared.

3) Improve the use of the soil conservation technical assistance. Develop counterparts, so that Cape Verdians are trained in practical measurements. For this, the lines of authority and responsibility between the U.S. soil conservation expert and other parts of the program must be made clear. There should be greater emphasis on training at Sao Jorge in the field of measurement collection and analysis.

Dr. Pellek's responsibilities should focus on planning and training. He should have the responsibility for training up to twelve Cape Verdians in simple measuring and mapping techniques. Carrying out routine measuring should not require more than a primary education. Coordination between his efforts at data collection and analysis and the Center for Agrarian Studies should be a high priority, since this has been a source of conflict, particularly over the priority of soil analysis in the project area. His mapping efforts should be supported by the MDR and integrated into the planning of the project.

PROGRESS

The project paper set out several "verifiable indicators" of project success in terms of soil and water conservation and the construction of project works. It called for a 300 percent increase in water resources and sufficient dams, walls and ditches to support 2000 hectares of rainfed farmland; the problems in evaluating progress towards these goals has been outlined above. Some of the goals were unrealistic; many of the results cannot at this time be measured. To the extent possible, this section analyzes project progress in developing the physical and vegetative soil and water conservation measures and their impact on soil, water conservation, and agricultural productivity.

Table 1 summarizes progress against project paper targets. In general, good progress has been made in the construction of structures to impede water runoff and soil erosion. A greater number of catchment dams and systems have been built than targeted in the original design. Check dams are being constructed, as are contour walls. The project has already surpassed the targeted planting of perennial vegetation.

TABLE 1

Progress towards Soil and Water Conservation Targets

Method:	Target	Quantity Built as of 9/1982
Check dams	1500	424
Catchment dams and systems (reservoirs, canals, etc.)	8	14
Groins.....	15	0
Wells (Improved and built)	0	10
Contour walls	133K	82.5 K
Perennial vegetation.....	1000 hectares of congo beans	400-800 hectares of congo beans and 68,000 trees.

The actual effectiveness of the soil and water conservation measures are difficult to compute for this evaluation. The benefits have been discussed in qualitative terms; to a limited degree they can also be analyzed quantitatively.

Many of the gains from soil conservation measures accrue slowly over time, and many of those gains are difficult to quantify. One of the basic objectives of the project was to slow down the runoff of rainfall so as to increase recharge of the groundwater table and to decrease flooding which has been very destructive of valley bottom irrigated lands in the past.

In a watershed adjacent to the project area (Ribeira Seca), the presence of newly installed flowmeters and already completed conservation works makes it possible to make some preliminary estimates of the effectiveness of dikes and contour walls. With total rainfall through September 2, 1982 of 133 mm. (about one third of normal), a total of 3.6 mm. ran off, according to Rui Silva, a MDR hydrologist with AGRHYMET in Cape Verde. For the 28.2 sq. km. watershed, this equals a volume of

$$3.65 * 10^{6} \ m^{3}.$$

Using high and low estimates of runoff from Fernandopulle and BURGEAP studies* and comparing that with the actual runoff in the watershed, he estimates that from 1.14 to 1.77 million cubic meters evaporated, transpirated or infiltrated.

*Fernandopulle has estimated 20 to 80% runoff, depending on catchment soils and rain intensity, and BURGEAP assumed an average 50% runoff. See Peter Freeman, Victor Green, et. al., CAPE VERDE: Assessment of the Agricultural Sector, AID/RA/PSA Report, August, 1978, pp. 67, 69.

Only a fraction of this amount would in fact be recoverable, but it is noteworthy that at a rate of 1 million cu. meters per 50 has. and a recovery rate of 50%, recoverable water would be sufficient to take 40 additional hectares under irrigation. In sum, these data substantiate that the structures have reduced runoff and added to the groundwater table. The effect is to increase the long-run viability of irrigated agriculture in the watersheds, although the amount of recoverable water and its precise economic value has yet to be determined.

Research is not available on the economic costs of the degradation of the environment which would occur in the absence of the project, although the 7 to 8 meters of coarse deposits one research team found to have inundated a valley floor over the space of 20 years are mute testimony to the possibilities.*

The project paper correctly emphasized the importance of working upstream and on the side slopes, and, when possible, of using vegetative methods of erosion control. Well-planned soil and water conservation requires that upstream side-slopes be treated first for several reasons. One, the greatest erosion damage occurs on the unprotected valley side slopes, which are steepest and laid bare by seasonal cropping and/or fuel and forage harvesting. (Especially harmful are methods which harvest "roots and all", thereby loosening soil which easily erodes.) Second, treatment of upstream sideslopes reduces the size of the works necessary downstream. Third, and most important, the soil on the valley side-slopes is potentially productive if it can be saved.

However, at present the great majority of costs of works, (over 90% in Sao Miguel) have gone to torrent control dikes and water conservation in lower valleys. Check dams downstream filling with sediment from erosion at a very fast rate demonstrates this lack of emphasis.

Increasing groundwater, another project target, should also begin at the higher reaches of the watershed where vegetative cover can slow the heaviest rains. In this project, vegetative cover has not been given enough consideration. An example of proper emphasis can be found in Ribeira Seca where upstream vegetation has been promoted for many years; amazingly low runoff rates were seen in the first year after measurements began. Making very rough assumptions, perhaps between 40 and 63,000 cubic meters per square kilometer of drainage area had been saved from runoff to the sea.

THE IMPACT OF PROJECT TECHNOLOGIES ON THE ENVIRONMENT

1. Perennial vegetation. In this project, congo beans and trees are used in soil conservation. Perennials help stop erosion, through their root system and through reduction of impact which water drops have on soil, and slowing water flow due to grasses and humus on ground. The humus also helps to "build" more fertile soil; many perennials are nitrogen fixing which improves soil. Improved infiltration can also occur but may not be so in the case of the very permeable Cape Verdean soils. Most perennials do use more water annually than most seasonal; in total water balance equations this must be considered.

*See Freeman, p. 66.

Perennial vegetation is the only feasible method of soil and water conservation possible on many of the steepest sloping lands. On lands which are too dry to support other crops perennials in association with other land shaping methods are often the most feasible. Most importantly perennial vegetation is the basis of almost all soil and water conservation methods. It is the most preferred solution considered, because it is the least disruptive, usually the least expensive, requires the least maintenance, and most of the time not only protects, but also produces (e.g. beans, wood, fruits, lumber, forage...etc.).

At the present time, too small a percentage of funds are expended toward the promotion and planting of perennials. This is true partly because of the project's design as a construction-oriented employment project. A proper balance between vegetative and physical construction needs to be done within the framework of developing a general project plan.

2. Contour ditches. These ditches dug along contour lines on hillside shorten the unrestricted flow of water overland thereby slowing runoff, reducing erosion and gullying, and increasing infiltration and ground moisture in the vicinity of the ditch. They perform well on mild slopes for forestry type planting and may be much more useful in closer spacings and small sizes, and in conjunction with plants and/or contour walls.

The project has hardly used contour ditches at all because of the problems associated with them. Heavy maintenance is required because of damage occurring from animal and human trampling and during heavy rains when their uncompacted embankment are over-topped. But due to their low cost and potential benefit and due to the minimal amount research done on them to date they still ualify as a viable experimental element in a watershed management plan.

Dr. Sam Kunkle, formerly head of the Forestry Support Program, Science and Technology, at A.I.D., argues that ditches, dug at proper intervals, hold as much water as do terraces, are no more likely to break and that furthermore, maintenance may be an equally important consideration for contour walls. The "downside risk" of walls collaspsing, creating gullys of flood water may in fact be more potentially damaging to the environment than the breakdown of contour ditches, which are smaller, especially if the ditches are used in conjunction with erosion-controlling vegetation.

In the original project paper it was assumed that ditches would be constructed by farmers, at no cost to the project. This was clearly not realistic.

3. Contour walls. The next higher level of structural means of side-slope control is contour-walls. They function as do contour ditches, but may have fewer maintenance problems due to their rock masonry. They are expensive from a farm investment point of view, and it seems unlikely that farmers can afford to build them themselves (which is not the case with ditches). Still, they are the proven method of side-slope stabilization in this project. If an upstream-downstream approach had been used one would therefore expect to see a large amount of effort go into their construction. For a stabilized

watershed one would expect a significant amount of the total budget for the stabilization of the watershed would be spent for planted or physically stabilized sideslopes. For the Sao Miguel Watershed less than 5% of the labor budget has been spent thusly. The 2000 ha target was not based upon any analysis of required hectares but rather on what was believed achieveable. But this number of hectares is not an unreasonable number to target. At this point in time fewer check dams and more hectares of contour walls plantings would have been expected.

Project and Ministry of Rural Development officials were virtually unanimous in preferring contour rock walls over contour ditches. The rock walls were seen as more permanent, requiring much less maintenance than ditches. Because soils are not compacted, there is fear that ditching simply will not stand up under the torrential rains. Although contour ditches cannot be used in all circumstances, in many cases they present an alternative to rock walls.

To get a sense of the costs of the technologies, the contour walls (arretos) were analyzed, to see under what conditions they might be economical, and then contour ditching was analyzed as a possible (under some conditions) alternative.

First, the walls affect agricultural productivity. Based on data collected by Dr. Richard Pellek and the evaluation team, corn yields were higher on either side of the walls, which had served to spread and slow down water. The increases were on the order of 5%. An earlier study had found increases of 49%. (The effects are highly dependent on yearly rainfall, it is thought.) The direct effects on agricultural productivity are thought to be concentrated on an area of from 1 to 2.5 meters on each side of a wall. If this is so, each kilometer of wall affects at most 5 hectares. If planted in the traditional corn and beans (which was the case in the samples), and if the maximum yield increase of 49% were experienced yearly for 20 years, the benefit-cost ratio would still be a very low .12 (if labor is costed at its wage). The implication of the analysis is that shadow-priced labor and other benefits besides agricultural productivity must be considered to justify the structures, economically.

The walls do indeed bring other benefits. They slow down water runoff, reduce soil erosion, and spread water. An attempt was made to construct a small computer model to determine the types of assumotions which would have to be made to make the structures pay, using fully-priced labor. The analysis indicated that if each wall were to affect an area of 500 meters down from it (i.e., 50 hectares per kilometer) and if soil losses of about 3.5% per year over a 20 year project were prevented, then the walls would be a breakeven proposition. These are exceedingly generous assumptions. If labor were shadow-priced at 50% of its wage, then even a 1% prevented soil loss each year would make contour walls pay.

An attempt was made to compare the costs and benefits of contour walls and contour ditches. Basically, the question is whether labor is more productively spent in wall or ditch construction. Data were obtained on the costs of contoured walls from the project paper; data on ditches from work done by Utah State CID at the Tarrafal project site. Because the ditching costs seemed

greatly understated, and because they did not include administration costs, they were multiplied by a factor of ten. It was assumed that walls required no maintenance, but that ditches required 25% repair per year. The capital-intensity rates of the two should be similar, so the issue is one of conserving labor: a change in the assumed wage would make little if any difference. It was assumed that ditches would have to be placed 1 meter apart to be effective (otherwise water velocity would increase and lead to washout); walls were assumed to be placed 10 meters apart.

Surprisingly the analysis indicated that the discounted costs of walls are, in a 20 year project at a 15% rate of discount, approximately twice those of contour ditches. (See Appendix C, Tables 1-5.)

In the Tarrafal project, three years of study revealed no ditch breakdown, even on slopes of 25-30%. (It is important to note that Tarrafel has less rainfall than the project area, and that the results are not directly transferable.) One would nevertheless be forced to conclude that contour ditches have overwhelming cost advantages, that trials should be conducted in their use, and that the project ought to consider the conditions of slope, soil compaction, convexity/concavity of land, etc., under which ditching might be a feasible alternative.

4. Check dams. Check dams are one of the best methods of attaining gully and/or channel stabilization and torrent control. They also increase infiltration and soil-moisture content, reduce run-off and may recharge aquifers. They can be very small, essentially a modification of a contour wall into a check dam, for stabilization of a gully which is forming on a side-slope. They can be very large -- veritable engineering feats on large streams -- as in Rebeira Seca. They collect sediment behind them as does any dam and once filled are still useful as they have reduced the effective slope of the stream bed therefore reducing water velocity and soil erosion. The sediment which is trapped can become useful cropland or it can be very poor for crops. Though vertification through demonstration is required, the engineering evaluator believes that the quality of sediment increases as its quantity decreases with the upstream treatments in a soil conservation program. That is, the upstream/downstream approach, especially using vegetation, also has a beneficial effect upon the quality of soil retained behind check dams or catchment dams. In fact sediment in general is enriched.

The number of dams constructed seems small but the volume of cubic meters constructed is already 78.6% of the total after less than half the project funds are used. Also in Sao Miguel over 70% of total funds for construction were used on dikes.

5. Catchment dams. Catchment dams are simply impermeable dams with walls extending down to bedrock and a system for tapping the groundwater trapped behind them. The groundwater recharge produced by the entire system upstream is tapped through the use of these catchment dams.

Because of the obvious and quick benefits they provide, these dams have been constructed more quickly than originally planned and more have been constructed than planned. This is logical and will undoubtedly continue as more viable areas for such structures are created due to the system upstream.

6. Groins. Groins have not been constructed as called for in the project paper, nor have long low dikes at the lower end of the watersheds for lack of the heavy equipment.

This is good, because these are the last elements to be constructed in an upstream/downstream approach. New equipment options should be explored; improvised draglines and bulldozer excavation are possibilities. In the meantime, the watersheds are being treated upstream and therefore the sediments that will eventually be trapped may be of higher quality soil.

7. Wells. Wells have been improved and constructed under the project, although not called for in the project paper. This activity is a consequence of trapping water for agricultural purposes: farmers and their families strongly support well construction as part of the overall construction. (See the discussion of social impact of the project.) Given the demand for domestic water sources, the project should consider incorporating wells more fully into its construction plans.

8. Flat terraces. The terrace concept of erosion control is based upon reducing the effective slope of hillsides. This slows runoff and increases infiltration, which, in turn increases soil moisture, reduces erosion and possibly recharges aquifers. The terraces can take many forms from the most commonly recognized flat terraces to contour plowing. Flat terraces have only been constructed by this project in a few relatively large and less steep areas where full-scale vegetation was possible. However, farmers seem to stair-step even very steep rainfed slopes with flat terraces. The risk of landslides due to flat terraces increases with slope, as does the cost. Nonetheless, such stair-stepping should be considered for the experimental paired watersheds to determine their effectiveness in increasing soil moisture. To date, the project has spent little effort experimenting with or costing out flat terracing as a technology. It has concentrated on two other types of terracing, contour ditches and contour walls.

THE IMPACT OF STRUCTURES ON AGRICULTURE

1. Dikes. Direct effects of dikes on agricultural production vary from site to site depending on geology and topography of an area, age of the dike, and proximity of other conservation structures. In Ribeira Seca a considerable area of arable land has been reclaimed behind dikes and is being exploited in a variety of mixed cropping systems: corn/bean association during the rainy season; recession agriculture involving sweet potatoes, squash, and other vegetables on residual moisture from November to March: temporary and permanent irrigated areas. Much of this land has a high percentage of clay (at least for the present) and therefore good fertility and moisture-holding capacity. In Sao Miguel, however, due to the steep and narrow nature of areas where dikes have been constructed, an estimated total of only 3.5 ha of arable land has been reclaimed behind 92 dikes. Moreover, soils trapped behind these dikes tend to be sandy and silty, have a reduced moisture-holding capacity in relation to heavier soils, and thus are generally not as favorable for recession agriculture [illegible] Ribeira Seca. Therefore, only a small total increase in production is e[illegible]d behind the Sao Miguel dikes based on the rainfed crops which have been pla[illegible]d there.

A methodology to measure differences in production between land behind dikes and land unaffected by dikes has been developed by the USAID/PASA soil conservation advisor. Two samples of ten corn plants each were harvested from a 10 m. x 20 m. plot behind the dike and in a similar area near the dike but beyond its influence. Green field weights and oven-dry weights are measured for ears (cobs and grain) and total plant biomass. Population densities of each area are estimated and production per hectare calculated. Data from four sites (Appendix A) show that corn production behind dikes is significantly higher than in adjoining control areas. However, it is difficult to say how much of the increase is due to the diking action and how much to topographic differences between dike and control areas. It does seem apparent, though, that increased soil moisture and microclimatic conditions (protection from winds, higher humidity) in these water drainages behind dikes result in favorable sites for tree planting. Deep roots and the permanent nature of trees put them in a much better position than annual crops to take advantage of increased soil moisture. Fruit trees and/or multipurpose trees such as tamarind should be given high priority in the utilization of these new areas. If the trees are planted along the edges of this land they will be protected from periodic torrents and will leave space for continued cultivation of other crops.

2. Catchment Dams/Wells/Irrigation Systems. Structures in this category have had the largest direct impact on agriculture, and are the source of most of the economic benefits of the project. Increased water availability has allowed increased production on already existing temporary irrigated areas, and resulted in 35 ha. of new land being brought into irrigated cropping. The long-term benefits of these developments will depend on a number of factors, including (a) Efficient management of the water resource. This requires regular monitoring of groundwat[illegible] levels and the quantity and quality of water delivered, established policies for water distribution, and introduction of efficient methods for conserving water from its source to end use on the crop. (b) maintenance and protection of the systems. This includes establishment of regular inspection and maintenance procedures, as well as such preventive measures as stabilization of slopes along which irrigation pipes are laid (a landslide has already knocked out a section of pipe in the Flamengos system) and protective walls as necessary along the borders of irrigated perimeters. (c) rate of adoption of improved farming techniques and higher value crops. (This is discussed in more detail in Section II.C.)

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3. Contour Walls. Contour walls appear to have a positive impact on agricultural production. By their action in slowing runoff, increasing infiltration, and decreasing evaporation, more soil moisture becomes available for crop use in the vicinity of the walls. If complemented by other methods, especially some degree of permanent vegetative cover, they can play an important anti-erosion role and thus help maintain the productive capacity of the soil. According to interviews with MDR technicians and with farmers, the latter's attitudes toward construction of contour walls on their land have changed considerably since the works program began in 1976. Whereas there was initially skepticism and resistance to the idea, after seeing the results for themselves, farmers now request that their land be selected for improvement with contour walls.

What is still uncertain is the quantitative value of the influence of the walls. The amount of rainfall received in a particular year plays a crucial role in determining whether walls result in significant production increases or not. For example, in the relatively favorable rainy season of 1980, MDR comparisons of corn yields in adjacent areas with and without contour walls showed an average increase of 49 per cent on the treated land (Goncalves, 1981). In 1982, however, after a very poor rainy season, the effect ranged from nil to small. Preliminary observations indicate that increased soil moisture this year is limited to a narrow band on either side of the wall. The area of this band represents perhaps 25% of the total treated zone. The height of corn plants in this band was about 20 per cent greater than in control areas, whereas plant height midway between walls was equal to that of the controls. Thus, production increases over the total area are estimated at 20% increase x 25% of the area = 5% increase with contour walls, a very modest effect. (This estimate is based on the assumption that plant height is roughly correlated to yield of grain and biomass.) Results of sample harvests in the same areas corroborate the conclusion that contour walls are of little value in increasing production in low rainfall years.

Given the high cost of contour walls, the question that arises is, can their effectiveness in terms of agricultural production be increased? One way of doing this is to select as construction sites only those areas where agricultural potential (considering slope, soil type, microclimatic conditions, etc.) is high enough to take full advantage of the improvements. A low-cost proposal which has been expounded by MDR personnel is to sow strips of Congo beans alongside the walls as well as at contour levels between them. This is a worthy proposal which should be adopted at once. In areas where wall construction is already completed, field extension agents will play a major part in persuading farmers to undertake such a plan. In considering new areas for walls, MDR could set the condition for farmers that following construction, a certain minimum amount of permanent vegetative cover be established. Not only would this serve the technical objectives of erosion control and increased food production (in most years), but it would also involve farmer participation and help instill the idea that farming practices are intimately involved in the overall soil and water conservation program. Note that this proposal does not aim to replace the traditional corn/bean cropping pattern (which would certainly meet with considerable resistance), but rather to complement it in border strips. Congo bean is seen as the primary species for this "permanent" vegetation in conjunction with walls, but low-growing firewood species could also be considered in certain situations.

VI. AGRICULTURAL ANALYSIS

PROGRESS

The ultimate goal of this project is to assist small-scale farmers increase the agricultural productivity of their lands, so that they can make a living from their farming efforts. The project uses three distinct approaches which, integrated, should promote this goal. First, it attempts to increase the supply of water and improve water use. Second, it attempts to increase and improve the land itself. Third, it attempts to improve farmers' skills, knowledge, and capabilities to take full advantage of an improved resource base. The success of the agricultural component of this project hence depends on the success of each component of attack plus the institutional integration of all three components.

The project paper spelled out very specific changes in cropping patterns which were to occur by the end of the project. Below is a summary of progress as measured by these original indicators:

Table 2

Planting of New Crops

Target	Performance
1. On newly irrigated land below the catchment dams: 30 new hectares of bananas, 15 new hectares of cabbage, 15 new hectares of carrots, 30 new hectares of tomatoes.	1, 2. Neither on newly irrigated land nor on improved land has significant progress been made towards these indicators. Some cassava, sugar cane, banana and sweet potato planting is evident.
2. On improved land above the check dams (land irrigated part of the year): 100 new hectares of Irish potatoes, 60 new hectares of onions, 65 new hectares of sweet potatoes.	
3. Utilization of lettuce, peppers, melons, squash, turnips, papayas, and cauliflower in the new cropping patterns.	3. No extension other than Congo beans, Irish potatoes and tree seedlings has been attempted.
4. The use of plants such as acacia, prosopis, atriplex, eucalipas and Parkensonia for firewood, cover, borse, and windbreaks.	4. Approximately 68,000 trees have been planted as ground cover (estimating 400 per hectare, 162.4 hectares covered.
5. It was assumed that on rainfed lands with newly protected slopes (from contour walls or ditches) that traditional planting of corn and beans would continue.	5. Planting of traditional crops has indeed continued.
6. On 100 hectares of 60% slope, a permanent cover of Angola beans.	6. An estimated 186.5 hectares have been planted, mostly on the worst slopes.

In brief, there has been little shift into more profitable crops in newly irrigated areas. In improved rainfed areas, on the other hand, more progress has been made than expected. More Angola beans have been planted as ground-cover, and in addition, 68,000 seedlings planted as a further measure to impede erosion.

The project paper called for the following improvements in crop yields:

Table 3

Projected Increases in Crop Yields

On irrigated lands	FROM: metric tons/hectare	TO: metric tons/hectare
Bananas	28	40
Cabbage	12	23
Carrots	12	21
Onions	6	15
Potatoes, Irish	10	14
Potatoes, Sweet	8	16
Tomatoes	8	20
On rainfed lands		
Angola Beans	0.3	0.5
Beans (undersown)	0.2	0.3
Corn	0.4	0.9

On irrigated land no measured change in cropping patterns has occurred, nor any measured increase in agricultural productivity. None of the inputs called for in the project paper--and specifically, the uses of fertilizers--have been used. (Field trials using fertilizer are now underway.)

The project paper assumed that improved seeds and fertilizers would be imported and applied to newly irrigated lands. This has not occurred. First, there is still very little new, permanently irrigated, land. In addition, until recently there was no extension service or institution capable of educating farmers as to the proper use of fertilizers and seed.

At present, the Rural Assistance Program has undertaken fertility trials using fertilizer on sweet potatoes and cassava to determine the optimum level of fertilizer for crops. In the next irrigated season, these trials should continue, and the results put to the test on some farms. A Swiss vegetable specialist has been working in Cape Verde for four years and makes recommendations to the GOCV on what seeds to import, so there is already in place good basic information on varieties and cultural practices of improved seed. Vegetable seed distribution should continue as the extension service develops the capacity to train farmers appropriately in their use.

On rainfed land improved by contour walls, there has been an increase in productivity of traditional crops. Data is preliminary, but the increase in corn yields has apparently ranged from 5 to 49 percent.

As mentioned in the critique of the original project proposal, many of these shifts in cropping patterns could not realistically be expected to occur until after the development of an extension service and experimental applied research to determine the most profitable and reliable cropping patterns. Therefore, the fact that major changes have not yet taken place is not a failure in the agricultural sector, but is a logical condition, given the lead time necessary to develop the technological research and institutional capacities that precede planned agricultural change.

CROP PRACTICES ON IRRIGATED AND RAINFED LAND

It is, therefore, more fruitful to evaluate the overall long-term efforts to establish appropriate cropping systems. In general, the project seeks different kinds of agricultural improvement depending on location:

1) In areas too steep or otherwise unsuitable for annual crops, introducing permanent vegetative cover.

2) In areas with better potential for annual rainfed crops, identifying and extending packages of crop varieties and cultural practices to make optimum use of the limited rainfall.

3) Maximizing use of water for high value crops in irrigated areas.

Obviously, much research and analysis is required in each of the above areas before integrated cropping packages are ready for extension to farmers. However, certain elements of the system are taking shape, and there follows a discussion of specific interventions which have been or can be undertaken by this project.

A. Congo Bean

Congo bean or pigeon pea (*Cajanus Cajan*) has been grown in Cape Verde for many years, but populations were severely reduced during the early years of the current drought. MDR's program to encourage the increased cultivation of Congo has met with considerable success, and should be expanded wherever possible. This drought-resistant, perennial crop provides several products--nutritious food grain (21% protein), animal forage, cooking fuel--and serves as a biological means of erosion control. In addition, it has the advantage of adaptability, and was observed growing in various situations from irrigated valleys to rocky ridge tops. Congo does have its limitations, however, and in general is suitable only for slopes in the more humid upper halves of the watersheds. There appears to be a tendency among farmers to adjust the seeding rate of Congo in rainfed areas inversely to the productive capacity for corn of a particular piece of land. Thus, in areas where Congo had been sown in Sao Miguel, lowest population densities were observed on relatively good corn land, and highest densities on marginal slopes and ridgetops. This seems to be a rational decision by farmers regarding the allocation of their resources, and represents a start in the process of convincing farmers to forego cultivation of annual crops in marginal areas.

MDR reported the following [illegible]

Table 4

Congo Seed Distribution

Year	Kg. of seed	Estimated No. of hectares sown at 2-4 kg/ha
1980	200	50-100
1981	600	150-300
1982	800	200-400
Total	1600	400-800

Yields of Congo vary considerably according to the soil and water resources available to the crop. Based on 1981-1982 harvest season data, yield per plant (beginning the year after seeding) was estimated at 0.25 kg of seed and 0.25 kg of pods for animal feed. Firewood value per plant in an established stand has been estimated at 1.3 kg. Because of the amount of variability involved and the small sample size, caution is urged in extrapolating these figures to cover large areas.

Recommendations for the Congo bean program in this project are as follows:

(1) Continue large-scale distribution of seeds in 1983, with special attention to reaching areas and farmers which have not benefited, or benefited only slightly, from previous distribution;

(2) Since there is already a high degree of acceptance of Congo per se, encourage better ways of incorporating it into cropping/soil conservation systems, e.g., sown in conjunction with contour walls and contour ditches; sown in association with firewood tree species. Select pilot areas for carrying out and evaluating these practices;

(3) Collaborate closely with the Division of Plant Production and Protection to collect appropriate data during the 1982-83 harvest, with the objective of quantifying yields of food, fodder, and firewood for the different ecological zones in which Congo is grown.

B. Fruit Trees

A limited amount of fruit tree distribution (guavas, avocados, citrus) has taken place under the project, and the potential exists for considerable expansion of this component. Mango, tamarind, "pinha" (custard apple), coconut, papaya, and banana are trees which grow well here and produce a marketable crop. Many of these varieties are propagated locally and do not require MDR distribution. MDR technicians report that farmers are very interested in planting fruit trees, so much of the labor of planting could be assumed to be provided by the farmers themselves. There are three situations in which fruit tree planting would seem to be particularly feasible:

1) at the edges of new land areas behind the dikes;
2) in small irrigated strips along the main valleys;
3) around houses where supplemental irrigation is feasible.

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Because of their multiple domestic use characteristics--as food, fodder, fuel--they may be particularly useful to farm families planted close to their houses. Technical assistance and training via the extension service should assist in site selection, planting methods, and care after planting. MDR has a division of fruit culture which is available for advice and planting.

C. Other Irrigated Crops

Traditional supplemental irrigated agriculture is a complex system largely based on the reality of a limited and undependable supply of water. Thus, the crops of choice are those which, once established, can withstand long periods without supplemental water: sugar cane, sweet potatoes, cassava, squash. They are also crops which store reasonably well, either in the house, in the ground, or in the bottle.

New irrigated crops encouraged by MDR are potato, onion, tomato, cabbage, and other vegetables. All require a more dependable water supply, increased inputs of labor and materials, a higher degree of technical expertise and/or access to technical advice and services, and adequate markets. If these conditions can be met, these crops offer a high return to the farmer and a more diverse food supply to the consumer. Until they are, a rapid shift to the new crops could be a dangerous course to follow.

Therefore, for the short term, and certainly within the life of this project, the following course of action is recommended for irrigated crops:

(1) Continue to extend techniques which will improve traditional crop production. Examples are phytosanitary treatment of manioc and sweet potato cuttings, closer spacing of planting ridges for greater efficiency of water use and improved on-farm storage.

(2) Gradually introduce higher value crops to replace traditional corn and beans. Potatoes and onions are of higher value, although not as much as bananas and other fruits. They have the advantages, however, of a longer storage life, a larger market in the immediate project area, and can be important staples for the farm family if there are problems marketing them.

(3) To make the transition to crops with the highest potential market value, more attention must be paid both to the marketing of inputs (e.g., seeds and fertilizers) and the marketing of the crops. In both cases, the private sector and the government have important roles to play.

In terms of farming inputs, the government can maintain control over the amount of foreign exchange spent on commodities and over the quality of the inputs through FAP (Fomento Agro-Pecuaria) which presently controls these functions. Final prices to the farmers can be heavily influenced by the GOCV's decision on how high the import duties on the commodities are set. Because the government presently handles these import functions capably, there is no reason for AID to do its own purchasing and importing separately.

Once the fertilizer and seeds are in Cape Verde, the private sector should take over the distribution process. Two distribution systems that should be considered in a plan are:

a) the existing private enterprise system of small shops and stores. This is a potentially an efficient and adaptable alternative to the state distribution of inputs. Sale to individual farmers could easily be undertaken by existing shops in the larger towns (Calheta, Pedro Badejo). These shops should also be considered as locations for distributing basic written agricultural information to farmers buying agricultural supplies.

b) the development of buying cooperatives among farmers. A voluntary cooperative would mean more direct farmer control over inputs and lower prices by eliminating a middleman distribution network. However, a certain level of institutional development is necessary for it to succeed.

The marketing of outputs, particularly of new crops grown on newly irrigated land, also requires an important place in an overall plan. Because cropping practices have not yet changed significantly, it is premature for the evaluation team to make specific marketing recommendations. Certainly, however, the following aspects should be dealt with:

-- What form of farmer organizations are best suited to developing new produce markets and supplying them regularly?

-- How important a priority should building small feeder roads be within the life of the project to speed up and ensure that produce reaches its markets?

-- What steps can be taken to expand export markets and become a reliable enough supplier to interest sellers abroad?

Essentially, the choice of what crops should be grown must be made not only on the basis of how well a crop is agriculturally suited to the cropping cycle, but its potential market and profitability. Marketing thus becomes a critical element in the choice of crop. At the moment, for example, the GOCV and many foreign donors are encouraging vegetable production (Terrafal, Prodessa in Santa Catarina, a Swiss agricultural project, and the Watershed Management Project). Without proper attention to marketing, there could conceivably develop a glut of these crops, many of which are quite perishable. Analyzing the size of the domestic market and its growth potential, and working out methods of developing good export markets hence become important elements in increasing agricultural productivity.

(4) AID and MDR should consider hiring an irrigation agronomist for a period of 9-12 months. Provision of adequate technical assistance is essential when new land is brought under irrigation and new crops introduced. Vegetable crops in particular are subject to a wide variety of pest and disease problems, and require greater attention to fertility levels and more sophisticated water management than

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traditional crops. While the extension component of the project is the primary means for delivering advice to farmers, its effectiveness depends on maintaining strong links to technical specialists. Current arrangements for providing this specialized technical assistance for irrigated crops consist of periodic visits by technicians of MDR's Horticulture Section, based on Praia and Tarrafal. Because the project valleys include only a small part of their areas of responsibility, they will have only limited time to spend on the project. Also, while these technicians are concerned with crop production, their role does not include improved water delivery systems on water management. An irrigation agronomist would, therefore, be important for developing optimal use of the irrigated areas.

The person required for this job should be field-oriented and capable of giving hands-on training to extension agents in water delivery and use and in crop production. She/he should also be able to design and carry out farmer-level experimentation on irrigated production problems. While her/his principal focus would be on irrigated areas in the project valleys, the experimental irrigation area at Tarrafal might also be a valuable facility for his work.

D. Corn/Bean Planting Practices

Relatively little research has as yet been carried out on traditional rainfed corn and bean crops, although a start in this direction has been made. MDR's Division of Plant Production (with donor assistance) has made collections of local strains of corn and begun field testing at research stations of local and imported varieties. Research into sorghum, millet, and cowpeas is also underway.

As for planting practices, a set of modified water harvesting experiments was performed under the Tarrafal project to test methods for the best utilization of rainfall on corn/bean associations. The crops were planted in contour ditches at 1 and 2 meter intervals. The space between ditches was left empty with the expectation that runoff from this surface would collect in the ditches and become available to the crops. Unfortunately, rainfall was so poor in Tarrafal this year that results from these trials are inconclusive. Trials should certainly be continued, in different areas of the watershed valleys, since this combination may be an effective and cheaper alternative to contour walls.

In short, the Watershed Management Project, with its links to farmers through the extension program, offers good potential for he continuation of rainfed crop experimentation at the farmer level. Three specific areas are suggested:

(1) Genetic differences. Compare the performance of the best local corn varieties currently grown in the project area. Use traditional cultural practices.

(2) Planting density. Compare performance of corn/beans planted at normal densities (4 corn seeds, 2 bean seeds per hill) with lower densities (e.g. 2 corn, 2 bean).

(3) Planting method. Continue the experiments begun at Tarrafal on planting in contour ditches.

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FORESTRY AND REFORESTATION

Reforestation was not mentioned as a component of the Watershed Management Project in the project paper. Nonetheless, both AID and MDR agreed that it should be an important element of watershed management, especially given conditions in Cape Verde and incorporated it into the project.

The necessity of restoring the vegetative cover in Cape Verde is well known. It is an effective soil conservation technology, both alone, as a permanent ground cover, and as component of an integrated conservation program in conjunction with contour ditches. In the areas covered by this project, upper watershed revegetation takes on the added significance of protecting the considerable investments already made downstream in terms of dikes, catchment dams, and irrigation systems. Moreover, it is an important new source of fuel. This is important because at present much of the fuel for domestic use comes not from trees but from dried corn stalks and other vegetative matter left in the ground once the harvest is over. This evaluation has recommended that to decrease soil erosion, farmers must be taught not to take these dead plants out of the ground. Hence, a traditional source of fuel will become even scarcer, and the need for an alternative greater. Finally, some varieties of tree can serve as an important source of food.

MDR's national revegetation efforts have focused on tree species providing firewood, fodder, and lumber, and on Congo beans. The Ministry has reported the following data on the number of trees planted in the four project watersheds:

Table 5

Seedlings Planted in Four Watersheds

Year	Santa Cruz	Saltos	Flamengo	Sao Miguel
1980	8202	800	1700	4993
1981	6000	-	12,682	-
1982	16,662	4,500	5,900	6600
TOTALS	30,864	5,300	20,282	11,593
GRAND TOTAL	68,039			

Two forestry seedling nurseries have been established in Santa Cruz and one in Flamengo.

Most of the trees have been for firewood, with some fruit trees. Seedlings were brought from local nurseries and from nurseries outside the project area, such as Tarrafal, and distributed under the supervision of the extension advisor with the cooperation of the foremen on the workcrews, another example of successful use of the workforce for extension efforts. The costs to the project of planting these seedlings have been small, essentially the wages of those in the nurseries and the purchase of plastic planting sacks.

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The soil conservation advisor, Dr. Pellek, has undertaken trials of 50 varieties of trees with assistance from the U.S. National Academy of Sciences. This forestry work is useful, as it includes many species not yet tested in Cape Verde. Lack of coordination led to difficulties in getting them planted on time, however, and by undertaking this work, Dr. Pellek was forced to quit working on water measurement tests that were also important to the project.

These trials are useful, as they include many species not yet tested in Cape Verde. To free Dr. Pellek's time for other tasks and to ensure coordination with ongoing forestry activities, these trials should probably be taken over by the FAO reforestation project, which has similar field trials underway.

Issues. As reforestation in the project continues and is expanded, two important issues should be considered:

1. On the basis of energy projects evaluated in Mali, Liberia, Ghana, Senegal, and the Philippines, there are certain advantages to a reforestation program which focuses on household forestry. Farmers are often interested in fruit trees, and women and children responsible for gathering wood are often interested in planting trees for firewood. When trees are located near houses, better care is taken of them, especially in Sahelian countries. They are better watered, as householders nourish them with water first used in washing or other household purposes. The decrease in transport costs to and from fuelwood sources are an important economic consideration: the closer the source to the point of consumption, the lower the costs. This frees up labor for other uses in the house or in agriculture. Furthermore, although farmers are reluctant to give up better cropland to trees, they have been willing to plant trees along edges of fields, on more marginal land and/or near their homes. Mean firewood consumption in rural Cape Verde has been estimated at 130 kg/person/year.

Interviews with workers in Sao Miguel have pointed out the seriousness of the problem of fuel supply in that valley. Virtually all cooking is done with locally scavenged materials (crop residues, brush, tree branches), and collection of these materials requires an average of 2.7 hours per day per household.

2. Reforestation, epecially as a fuelwood source, is only one of many technologies available, however, and the choice of appropriate technology becomes important here. There are possibly many cheaper solutions to the problems of firewood. For example, almost all farm households used a 3-stone open fire for cooking. There is a good possibility that stove improvements would substantially reduce fuel consumption. (This was true in evaluations of energy projects in the countries mentioned earlier.) If that should prove to be the case in Cape Verde, it is important to recognize that the economics are overwhelmingly in favor of a conservation program. For example, data from Senegal indicated that a program designed to increase charcoal conversion yields would have a return over ten times that of a tree planting program. It is simply much cheaper to save trees than to plant them.

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Future Directions. It is difficult to plant large numbers of trees in valleys. Steep topography, difficult access, and population density make the situation extremely complex in comparison to the relatively straightforward program underway in large state-controlled plantations in semi-arid coastal areas. Still, with a coordinated effort and adequate attention to socio-economic realities, there is potential for increasing the reforestation component.

The extension program has a key role to play in an expanded tree planting component by increasing awareness of the problem of deforestation and all its implications; by explaining strategies and techniques for combatting the problem; and by mobilizing individuals and community groups to take part in the program. The extension advisor has contacted the local branch of the natinal youth organization (JAAC) and received their agreement to help with tree planting in Sao Miguel. An example of a less formal community organization which might be useful in the re-forestation campaign is the "junta-mão" (joined hands) tradition. Under this practice, neighbors cooperate in work groups of 5-20 people for certain agricultural tasks, e.g., land preparation, seeding, and weeding. The social survey in Sao Miguel revealed that 73% of the persons interviewed participated in "junta-mao" groups. If the same practice were used in tree planting, it might relieve some of the constraints on individual farmers during a busy agricultural season, and would involve more people in reforestation activities.

A reasonable target for 1983 would be to plant 60,000 trees or about double the number planted this year. To avoid some of the logistical problems encountered in previous years (e.g.) getting the trees to planting sites on the right day), nurseries should be established in central locations in each of the valleys. MDR's Division of Forestry Services will offer a course on establishment and management of forestry nurseries in early 1983. At least one person from each of the four valleys should be selected to attend this course. Commodity needs for nurseries (plastic planting sacks, fencing, watering cans, etc.) will have to be reviewed and arrangements made for their procurement.

Selection of sites for planting and decisions on land preparation techniques to be employed will have to be made by early 1983 as part of the coordinated work plan for each watershed. It is anticipated that Parkinsonia aculeata, Prosopis juliflora, and Atriplex spp. will be the major species planted, but other appropriate trees (e.g. Tamarindus indica, Zizyphus mauritania) may fit well into the climatic/economic situation.

Mixed planting of Congo beans and firewood trees is an idea which warrants implementation on a pilot basis. Yields for such a mixture have been estimated at 0.5 tons/ha/year of beans and 2 tons/ha/year of firewood. Design and implementation of pilot plantings should be undertaken in close collaboration with MDR/FAO project personnel, who have indicated their willingness to cooperate. An integral part of the design should be an evaluation system to be used for measuring technical and socio-economic impacts.

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To summarize recommendations for the reforestation component:

(1) Concentrate on household forestry to the extent feasible.

(2) Make coservation efforts an important element of a fuelwood forestry program.

(3) Significantly increase the tree planting program, setting a target of 60,000 trees for 1983, and perhaps another doubling to 120,000 in 1984.

(4) Establish and/or enlarge nurseries in each valley and ensure that personnel receive adequate training and technical assistance in nursery management.

(5) Establish pilot areas for planting mixtures of Congo beans and firewood tree species.

(6) Encourage greater levels of community participation.

(7) Collaborate with MDR Forestry Services/FAO in all aspects of the reforestation program.

(8) Full advantage should be taken of forestry resources within AID to guide the direction of this component of the project. Suggested sources are the SDPT forestry advisor in Bamako, and the centrally-funded S&T Agroforestry Project.

VII. EMPLOYMENT AND SOCIAL ANALYSIS

PROGRESS

This project was conceived in large measure as a response to the emergency employment needs of farm families debilitated by long years of drought who could no longer make their living solely from farming. Rather than providing farm relief through a food disbursement program, the Ministry of Rural Development and AID developed this project as a temporary work program until drought conditions ended or until the long-term benefits of the project were realized and farms became more productive through soil and water conservation measures. The project called for the employment of 3000 people from the four watersheds to build the physical structures called for in the project.

While the 3000 figure has not been reached, excellent progress has been made. Employment figures on the project are as follows:

1980:	922
1981:	1668
1982:	2470

Employment levels fluctuate, depending on the season; during the short peak farm employment periods, employment on the project all but ceases completely. These fluctuations are graphically displayed for each watershed and the entire project area in Appendix D.

The most important limiting factor is the number of families living in the watersheds, estimated at 3570. Given the eligibility restrictions of the program, the vast majority of eligible families have a member now working on the project. Furthermore, in a sample survey of project employees in Sao Miguel, every worker interviewed lived in Sao Miguel; apparently few people, if any, are employed from outside the watershed area. As an employment project, the Watershed Management project is a success.

Actual employment costs have been much lower than anticipated in the project paper (Table 6). The cost of rural employment has been $2.3 million less than expected. This is primarily because wages were overbudgeted. Wages for unskilled labor were budgeted at 70 escudos a day, rather than the 40 escudos actually paid when the project was implemented. Other factors have also influenced the employment budget. First, about 18 percent fewer people were employed than estimated, lowering the overall cost of wages. Second, disbursements started later than anticipated. Third, the exchange rate has fallen from 40 to 64 escudos per dollar. Inflation of about 12 percent a year coupled with salary increases of almost 50 percent (the basic wage is now 72.5 escudos) have compensated only slightly for these other changes.

TABLE 6

PAYMENTS TO RURAL WORKERS (US$1000)

	1979	1980	1981	1982	Total
Estimated	220	680	1570	1570	4040
Actual	0	326	763	643 (est)	1732
Difference:					2308

Wages are not always paid on time, however. Workers reported delays of up to two months, and the project was fifteen days behind in payments during the evaluation. Considering the importance of this wage to basic family subsistence, new administrative procedures by USAID and MDR should be developed.* USAID is now requesting authorization to pay project funds 90 days in advance, which should resolve the problem. This was the only negative aspect of any part of the Watershed Management project voiced by workers or farmers.

ADMINISTRATIVE PROCEDURES

All workers surveyed were selected for employment by local Comissoes de Moradores, following a well organized, politically neutral procedure. Each commission is composed of three members, elected by zone residents from a list of six candidates put forward by the political party, PAICV. They serve indefinite terms. The members are local residents with detailed knowledge of their communities. The commissions follow specific guidelines in selecting workers. They must be between 18 and 60. Each family can have only one member working on the project, except in the case of very large families.** Families with commercial licenses or with emigrants who send remittances home are ineligible. Preference is given to women who are heads of households. As a guiding principle, the commissions attempt to choose representatives of the neediest families first.

This recruiting system seems to work smoothly and equitably. The workfronts are able to find the number of workers they need, and most families are able to earn one income from the project. The low salaries (some workers said are lower than found in the private sector) and eligibility requirements clearly gear the employment program to the neediest workers.

Workers are assigned to a particular workfront, each of which employs about 25 to 65 workers. There are ten such workfronts in Sao Miguel. Most are employed as unskilled labor,*** although third, second, and first class masons are also employed. Pay scales are low, 72$50 per day for an unskilled laborer, rising to 155$00 for a supervisor. On the job, men and women are paid equal salaries for equal work, but there are very few women in any skilled positions such as masons. Five of the 56 workers interviewed had received on-the-job training to be masons (all men) and nine reported receiving promotions on the workfront (again, all men).

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*At present, MDR presents a voucher to AID months after the work has been done. The bureaucratic procedures within AID requiring processing in Praia, Dakar, and Paris add further to the delay.

**Workers were aware that they were hired as "family representatives." If the regular worker was not available, a family often sent a substitute member to replace him temporarily.

***Some of this labor is hired on a "task" basis, and can leave when the task is completed, often after 4 hours or so of work; others are hired to work a certain number of hours, depending on the work assigned to the workfront. Among the unskilled labor, people were often quite specific when asked their job: "stone roller," "cement mixer," etc.

A contralador and a mestre (ideally the same person) are responsible for supervision and administration at each workfront. The contralador primarily handles administrative responsibilities and the mestre handles the technical aspects. They are trained during an intensive 9-day course which includes engineering, construction, accounting, etc. The contraladores report to a contralador principal in each watershed, and these are responsible to a single coordinator. The entire administrative process seems to function efficiently.

The administration of the program is tied into the GOCV political system in at least two ways: 1) the local Residents' Commissions, responsible for recruiting the workforce, are locally elected from a slate of party activists, and 2) many of the foremen appear to be party activists. One foreman spoke about a party meeting at which he was asked to explain a personnel action he had taken against a laborer, also a party activist. The laborer had complained to the party. At the meeting, the foreman's decision was supported by the party. We found no evidence of politicized decision-making in the employment program, or indeed in any aspect of the watershed management project.

IMPACT OF THE PROGRAM ON WORKERS

Workers in the program are from among the poorest farm families in the project area. About half of the workers interviewed were heads of household, both women and men. Over half had never attended school, and none had gone past fourth grade. The importance of the employment component of the project to the farm families can be seen in a number of ways:

(I) Farm families clearly rely on it as a stable source of income. This was mentioned overwhelmingly as the single greatest benefit to date by workers in Sao Miguel. Although project administrators may see the emphasis on employment as a temporary characteristic of watershed management, the workers and their families view their jobs as much more than a short-term expedient. In Ribeira Seca, where the same workers have been employed for up to five years on watershed construction work, the stability of the jobs (and therefore the risk minimization of having no work) is viewed by the farm families as a major benefit of the project. This points out the difficulty in stopping construction work in any watershed. Workers do not move from watershed to watershed in search of employment. One recommendation is to develop a plan which includes a sequential set of project activities aimed at increasing agricultural productivity in each valley that would continue to employ people until they can again make a living from farming.

(2) The benefits even of a project whose thrust was more narrowly defined in terms of employment--the Rural Works project in Ribeira Seca--went beyond employment. Valley residents identified three project benefits in Ribeira Seca:

(a) a new close source of water for domestic use, a well built by the project. This well saved up to six hours a day of time formerly spent carrying water. Although the evidence is only tentative, the few families interviewed ranked the closeness of water for domestic uses as the most important benefit, suggesting that in the farm family's own perceptions, perhaps the Watershed Management program should reevaluate the low priority presently given to constructing wells and water sources for domestic consumption;

(b) a steady source of income;

(c) better, "partially irrigated" land around the new dikes on which they were experimenting, on their own initiative, with new crop combinations.

This experimentation points out one of the strengths of the WSM project in which an extension service can help farmers in this experimentation process. The farmers interviewed felt the new moisture in the soil was still too little to count on.

(3) In the four watersheds covered by the present project, the families with members employed by the project also benefitted from other aspects of the Watershed Management program. Project extension workers have met with Sao Miguel farmers at the workfront sites. After the extension meetings held in four zones of Sao Miguel, the contraladores made up a list of people needing seeds, and their location. As a result 60 percent of those surveyed had received some form of technical or agricultural assistance from the project.

PROGRESS

Organizational Development

The extension component of this project is a critical link, bringing in farmers to take advantage of the changing resource base brought about by the project and increasing their agricultural productivity. At present, only three percent of project expenditures have gone to extension, and few modern inputs have yet been introduced.

The basic organizational structure for the pilot extension service has now been established as the Rural Assistance Program in the Ministry of Rural Development. The organizational chart on the next page summarizes the staff positions in the Watershed Management Project related to the extension program and their relationship to the MDR. The GOCV Project Manager, Horacio Soarès, reports directly to the Minister of Rural Development. Primary responsibility for the Rural Assistance Program, is with the director, Amadeo da Silva, who reports to the chief of the Division of Soil and Water Conservation, under Soares. Organizational progress of the Rural Assistance Program is analyzed here in terms of recruitment, training, and coordination with appropriate MDR and national agencies.

(1) Recruitment. After a slow beginning, recruitment of a qualified extension staff is now underway. The AID extension advisor arrived from the United States in March 1981.* From March 1981 to August 1982, seventeen months, he operated essentially alone, with no counterpart, and, for much of the time, with no extension agents. Difficulties in recruiting and organizing the Rural Assistance Program have been closely related to the GOCV's efforts to establish a national agricultural extension program. It was first assumed by the GOCV that the national extension service and the project pilot extension service would be linked, and no independent WSM extension staff would be necessary.

a) The Director of the RAP. Initially, there were no plans to have a director, on the assumption that the extension component of the WSM project would be integrated with the national program. No RAP director was therefore appointed during the early implementation phase of the project.

There were efforts made in late 1981 by the U.S. extension advisor to involve the new head of the national extension service, Julio Fortes, in the project. The national program was delayed, however; he was transferred to another island, and the effort ceased. Only recently did the GOCV finally decide to divorce the watershed management program from the national program. Finally, in August, 1982, Amadeo da Silva was named Director, a year and a half after his counterpart arrived.

The directorship is not at this time considered a full-time job for him, however; the director also has important responsibilities at the new Center for Agrarian Studies at Sao Jorge. This may detract from his ability to commit himself fully to establishing a functioning extension service. In addition, this means that the AID extension advisor still has no full-time counterpart.

Positions below that of Director were filled somewhat sooner, but not without difficulty:

*After a four-month TDY, he returned for a two-year tour in August 1981.

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b) Coordinator of the Rural Assistance Program. In December, 1981, José Maria dos Santos was appointed coordinator of the RAP. Although he performed his job well, he was a high school graduate with no previous experience in agriculture or extension; after one year, he received a scholarship to a Portuguese university and left. His replacement as the new coordinator, José Maria Tavares, similarly lacks a background in agriculture or extension.

c) Extension agents. The original project design called for training eight extension agents. To date, only two field extension agents have been recruited, on a part-time basis, and their only training has been on-the-job. Recruitment delays were initially due to the difficulty GOCV officials had in finding individuals with the education and training they believed was necessary for the job. A planned one-month training program was cancelled. Two men who worked on the project as a stone mason and a controller were finally selected as the part-time agents. They participated in extension meetings and farm demonstrations during the 1982 cropping season.

During the first year and a half of implementation, therefore, the lack of staff has seriously delayed development of an effective extension institution. At this point, however, the recruitment process has proceded to the stage where administrative plans can be made and decisions taken. The lack of sufficient agents will continue to delay implementation until selections are made. Without trained agricultural extension workers, farmers cannot take full advantage of the improvements in soil and water conservation brought by the project. They remain unawere of changes in cropping patterns and farming, and conservation methods that would lead to higher productivity and profits on their land.

Based on the problems to date in recruitment, this should continue to have a high priority in the project. PRODESSA has had some success in recruiting trained personnel that should be studied. If no trained people are available as field agents, motivated individuals within the project area should be recruited and trained internally. It should be understood that those recruited will work full-time for the project. Institution building, particularly at the beginning requires full-time commitment from both supervisors and field agents. One possible scenario for the recruitment, training, and deployment of extension personnel is found in Appendix E.

(2) Training. Training objectives have shifted during project implementation. The project paper called for training 8 agricultural extension agents, 1 extension technician and 4 watershed management planners; these were "indicators" of the development of the extension service.

In fact, no formal training course has been established within the project for extension workers. Two part-time agents have learned on the job. The former Rural Assistance Program coordinator is currently overseas, and the AID extension technician and RAP coordinator may in the future receive short-term training abroad.

Interestingly, within the overall project there has been one highly successful training program. This was designed for the foremen of the construction works. It is an intensive 9-day course covering elements of engineering, supervision, and construction and other topics. While not part of the extension component, it does illustrate the institutional capability of the MRD to develop such training in technical areas. Lack of training can effectively obstruct the the project, just as lack of manpower or lack of full-time commitment.

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The current plan of action discusses training following the curriculum outlined for extension training at the Center for Agrarian Service at Sao Jorge. The precise training necessary will depend, of course, on the educational and skills level of agents. At all levels, however, some training will be necessary, either within the country or for the project director, program coordinator and extension advisor, abroad. A strategy and schedule of training need to be developed for administrative and supervisor staff, full and part-time extension agents, and farmers. A training specialist hired on a short-term consultant basis should be able to assist in the necessary organization of training.

Training of administrative personnel should continue at several levels. In addition to formal training opportunities overseas, field visits to other extension projects (PRODESSA on Santiago, for example) or visits to extension services abroad (Brazil and Mexico, for example) for short periods should provide those responsible for the extension program with the necessary background and expertise to make informed decisions about the Cape Verdian program. This training effort should begin as soon as possible, perhaps by having AID offices (in the Latin America Bureau, in the SDP Offices in Bamako, Mali) identify good training and field visits. This should be done before the next cropping season.

(3) Coordination

Coordination of the extension service with relevant training and research efforts has been informal, ad hoc, but occasionally highly effective. The small size of the Ministry promotes collaboration among senior administrators and technical staff on specific extension activities, such as farm demonstratins. There is, however, no established coordinating group involved in planning the extension program, or in deciding what technical information should even be given to farmers or through what means. An organization chart of the Rural Assistance Program is found in Appendix F1-F2.

Coordination between the Rural Assistance Program and the Office of Crop Protection, the Office of Agricultural commodities (Fomento Agro-Pecuario) and the new Center for Agrarian Studies at Sao Jorge is now being established. In the Center for Agrarian Studies, the extension agents will receive training, and the research to develop a good "technical" package for teaching farmers will be developed. The extension advisor has established good working relationships with key technical offices.

At this point in the development of the extension program, a formal coordination unit needs to be set up within the Ministry of Rural Development. Technical support from many sections of the Ministry is needed, and representations from these sections, along with administrators in the extension service should be unit members. Meeting periodically, the group can coordinate activities for both the short and long run, prevent technical bottlenecks, and elicit support from a wide range of experts in different fields.

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Activities

In spite of organizational and recruitment difficulties, the extension program has succeeded in reaching at least 683 farmers. This is primarily the result of efforts by the agricultural extension advisor, who worked without counterpart or field agents until recently. The major extension activities include:

a) Meetings. To date, approximately 20 meetings have been held with farmers in the watershed areas. Most of these meetings have been organized through the construction workfronts, which present an easy way of reaching groups of farmers. These meetings have served a number of purposes:

1) transmitting information to the farmers on technical agricultural subject: the importance of reforestation, soil conservation methods, planting of congo beans, and pest control;

2) transmitting information to farmers on the availability of services for them, including the extension service;

3) perhaps most importantly, the meetings are not lectures, but discussions. Farmers make known the problems that concern them most--crop profitability, water problems, and so forth--so that the extension service can develop its own expertise to respond to their expressed needs. The meetings are viewed by the extension advisor very much as a two-way street.

b) Farm demonstration plots. The extension advisor has set up small experimental plots on farmers' lands to demonstrate the advantages of congo bean plantings and pest control for manioc. Testing in the field under real conditions close to farmers has been one of the strengths of this technique. They would doubtless benefit from better coordination with other MDR experts (different mixes of fertilizer or pesticides, for example, worked out with appropriate technical experts) and from further expansion. As a first step, however, they have been very convincing to farmers.

c) Seed distribution. Approximately 1600 kilos of congo bean seeds have been distributed to farmers by the extension service, enough to cover between 500 and 700 hectares. Farmer enthusiasm for congo beans has grown rapidly. In 1981, 81 farmers in the four watersheds received seeds; in 1982, 683. Demand greatly exceeded supply; had seeds been available to all who asked for them, perhaps another 400 hectares of congo beans could have been planted.

d) Development of a preliminary program document. The A.I.D. extension advisor, with the participation of MDR officials has written a plan covering extension activities and a definition of the roles of administrative and technical personnel (Appendix G). This is an important first step in developing an integrated program. In the future it should be further elaborated, and the administrative and technical staff trained to implement it.

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Planning for 1983 should include the following elements:

-- What innovations will be introduced (modifying the July 82 plan to take recommendations of this evaluation into account);

-- The types of extension activities: seed distribution; distribution of pest control chemicals or treatments of seeds; on farm trials; community demonstrations; farmer meetings, etc.);

-- Where the extension work will take place (zones, neighborhoods, workfronts, watersheds);

-- The timing of the activities (This should include schedules for preparatory farmer meetings as well as dates for demonstrations, supervisory visits and evaluations);

-- With whom the extension service will work (individual farmers, local associations, youth groups (JAAC), schools, groups of laborers at construction workfronts, etc.);

-- The type, amount and timing of resources (human and material) needed to implement the program (This should include the use of part-time staff from workfronts and students from the Training School during their periodic field work programs);

-- Where the resources are and how to obtain them (including technical services in MDR and the Agricultural Center);

-- How the work will be supervised and evaluated.

ISSUES

The Rural Assistance Program has already evolved considerably since its indistinct outline in the Project Paper. At this point, the program has certain characteristics which suggest how it should continue to evolve to become an effective extension service.

(1) It is a <u>temporary</u> program. It is being established to assist farmers in the project area take advantage of project benefits and create other benefits. However, once a national extension service is set up, this program will be incorporated into it, probably within four to six years. This requires that attention be paid to recruitment, training, and deployment of agents in the national service, so that incorporation will proceed smoothly--a complex administrative task. Agents hired to work in the Rural Assistance Program, therefore, should have the qualifications to become agents in the national extension service; to the extent possible at this stage, training should follow the guidelines being set up for the national service. While the Watershed Management Project clearly has its own particular needs for farmer assistance in certain areas (including reforestation, agricultural development, and so forth), attention should also be paid to the agricultural needs the GOCV-feels should have a priority in its own extension service. Furthermore, the administration of the program should not become too rigid or self protective to inhibit integration.

(2) The extension component of the project was planned as a pilot extension service. This role assumes an even greater importance given GOCV plans for a national service; lessons learned here may well be applicable nationally. This places a special burden on the Rural Assistance Program. On the one hand, it is the vehicle through which the Watershed Management Project can show some success by assisting farmers increase agricultural productivity. This is a fairly narrow, well-defined goal. On the other hand, as a pilot extension service, it has other goals as well; its major contribution may well be to generate knowledge, ideas and experience which can be transmitted on a large scale to the rural population. In this context the outputs of the program might include:

- Alternative extension strategies;

- Effective, acceptable methods for increasing the productivity of traditional crops; soil conservation and reforestation;

- A program for planning, organizing, supervising and evaluating extension activities at the field level;

- Strategies for increased farmer participation in all phases of local development and;

- Field-level training and ongoing extension-education of local agents and farmers.

The existence of a pilot extension service implies a testing of many ideas and innovations of which only a few are expected to produce significant results. What is important in a pilot effort, however, is an experimental, open-ended approach. Below are a few suggestions for specific extension activities which might be tested during the next few years.

-- Establishing special demonstration plots and educational projects with youth groups (JAAC).

-- Design special sub-projects for women (e.g. home gardens, fuel conservation, domestic water supply). These should be viewed as additions to the project and do not imply reducing female participation in other project activities.

-- Pilot extension-education activities developed in coordination with local schools. This could include classroom presentations, visits to demonstration plots, school gardens (irrigated), reforestation, etc.

-- The systematic use of workfronts as target groups for extension education. This is already underway to some extent, and has been successful. The content of this program will vary according to the period of the year, the availability of water, and the duration of the workfront activity. Specific interventions could range from single demonstrations to extended training in irrigation methods on land adjacent to reservoir tanks and major canals. During the period water is available, the staff should consider allowing 2-3 hours per week for extension education on workfronts. Individuals on each front (skilled or unskilled labor of

both sexes) could be recruited for special training to assist in these activities. Some form of salary supplement or bonus system could be established to provide incentives to their participation and leadership.

-- The construction of community demonstration centers to serve as bases for extension-education programs. This is called for in the project paper and centers should be constructed in one or two ribeiras. The staff should consider the use of intensive labor methods to construct these centers. Local expertise is available and the buildings could be constructed quickly.

-- Farmer field visits to the research plots at the Center for Agrarian Studies and to other zones where extension programs are more advanced. This will increase farmers' awareness of possible improvements and will give them a chance to suggest ways these programs can be adapted to their needs.

These and other possible innovations have implications for the use of project resources including materials and staff. They also underscore the need for careful program planning and systematic evaluation.

(3) Plans for the organization, development, and monitoring of extension staff are still in a most preliminary stage. These are key elements in developing a successful program, as important as adequate training and recruitment. To the extent that the Rural Assistance Program is indeed viewed seriously as a possible model for the national service, it may be necessary either to hire an outside consultant (particularly to design a project information system) or work closely with experts brought in by other foreign donors involved in extension work.

The organization of extension activities used in the PRODESSA program, which have been successful elsewhere, should be carefully examined and adapted to this project. One feature which might be applicable is the development of special skills for each extension agent such as reforestation, irrigation, the organization of youth groups. In practice this means that in addition to general extension activities, agents provide special assistance in their field of expertise. Each agent travels throughout the project area to assist local field agents implement specific projects. This cooperation develops a sense of team work and mutual support among the extension staff.

This approach puts an added burden on the training but yields important benefits in terms of staff motivation and effective project implementation.

In terms of deployment, agents should be assigned to a specific geographic area, and be based in or near the area. This allows them to learn the specific problems of farmers they work with and promotes two-way communication between farmers and the extension service.

Extension activities must also be supervised and monitored.

Project reporting now is limited to several topical reports (a "plan" for the extension program and congo beans) and trimestral progress reports which list activities, accomplishments, problems, and future plans. Because this is a pilot project, it is particularly important to develop a project information system. They system should include information on project activities, the use of resources, and technical, economic and social results. (One important source that should be used is the socioeconomic unit within MCR.) Records should be kept by all staff including field extension agents and special forms need to be developed for each component (e.g. demonstration plots, farmer meetings, youth and school activities. Records of staff activities and meetings are needed and a plan for periodic monitoring and evaluation should be formulated.

At present, a major obstacle is the lack of personnel in Cape Verde who know how to design and train others to use a project information system. If the project administrators take seriously the "pilot" nature of the service, an outside consultant should be contracted to assist the project staff design and implement a project information system. The consultancy should be divided into at least three visits to allow for periodic modification of the system and its effective integration into the full range of project activities and decision-making. Visits should occur before the next cropping season (between February and May) and after the harvests of 1983 and 1984.

An outside consultant in the extension service should be contracted for two functions: both to develop the plan for training administrators and agents and to serve as the information service consultant.

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IX. ANALYSIS OF BENEFITS AND COSTS

Much of the economic analysis of the project to date is found in Section IV. The following implications can be drawn:

BENEFITS

The original project paper highlighted the gains expected from agricultural productivity. It is important to consider in a systematic fashion the many benefits that seem to be accruing from this project, or should accrue if the recommendations in the evaluation are followed. They include:

Institutional Development

(1) Developing a pilot extension service which can serve as an experimental "dry run" for the new national agricultural extension service;

(2) Developing a cadre of trained workers in a variety of skills: water and soil measurement, agriculture extension, and construction trades;

(3) Integrating farm-level assistance and experimentation with long-term research studies necessary for agricultural development in Cape Verde.

Although limited in the project to the four watersheds, the communication/coordination linkages, both within the MDR and between the MDR and other institutions such as the Center for Agrarian Studies, should ultimately benefit many other rural development activities.

Social Benefits

(4) Helping prevent migration from rural areas:

(5) Providing a stable source of employment for farmers unable to make a living income from family farms;

(6) Retaining the long-term viability of private enterprise farming, by providing assistance so that farmers are not forced to abandon their land during the drought;

(7) Cutting down on the human costs within the family of tasks which traditionally consume a great deal of time, particularly water collection and firewood collection;

(8) In the long term, decreasing the isolation of farm families. Rural housing patterns historically reflected the attempts of runaway slaves to hide from the Portuguese. Farms were situated in hidden places, far from one another. Many elements of this project, including group employment, agricultural extension, and possible cooperative action, promote the integration of farm communities.

(9) To promote equitable development, by concentrating on an employment program for the neediest farmers and extension service orientated towards small farmers.

Natural Resource and Environmental Benefits

The terrain of Cape Verde is mountainous, the soils are not compacted, there are many rocks and boulders, and the few rains come in torrents, with a high rate of runoff. If the water can be slowed and spread, erosion can be greatly reduced, more water can infiltrate the groundwater table, more moisture can be retained for the crops, and downstream flooding and silting can be lessened. In the past, floods have left large levels of coarse, rocky deposits which have made potentially irrigable bottom land unarable. Around the structures, the water-spreading should lead to increased moisture and viability of crops. Catchment dams should increase irrigability and productivity. But the structures should also prevent costs by reducing flooding and reducing the work expended on clearing rock deposits on downstream fields.

In other words, the project provides both upstream and downstream benefits. Upstream the structures and plantings reduce erosion and loss of soil fertility and arable land, while raising moisture levels near the structures. Downstream the project reduces flooding and the inflicted costs of silt and stone removal. Additionally, the reduction in runoff would appear to have raised groundwater tables.

Summarizing these benefits,

(10) there is a decrease in runoff;

(11) a rise in the watertable and a recharge of aquifers;

(12) water spreads over a greater area;

(13) There is a decrease in soil erosion, particularly along the steepest slopes, allowing in the long run for an increase in top soil, and reduction in siltation, so that costly, downstream water retention structures need not be built.

(14) Flooding is controlled, resulting in less loss of property and crops;

(15) new cultivable land is created.

Agricultural Benefits

(16) On rainfed lands, there are crop yield increases of traditional beans and corn;

(17) On irrigated lands, there is the possibility for growing highly profitable cash crops;

(18) The project prevents the further loss of productivity of upstream lands;

(19) It provides an increase in fuelwood and forage production from new tree plantings.

These are important benefits to Cape Verde. Many of the social and institutional benefits are not easily quantifiable, and, given the limited knowledge of the natural resource base in Cape Verde, even the environmental and agricultural benefits cannot be accurately quantifiable at this stage. In a project with a long-term vision of improving a nation's resource base, in which many of the most important benefits are not quantifiable, the question arises whether it is worthwhile calculating specific benefit/cost ratios which concentrates on those variables that are roughly quantifiable.

There are some specific advantages in attempting to develop a quantitative analysis:

1) While this project may have large unquanitified benefits, so might other projects to which AID and GOCV development funds could profitably be applied. It is certainly possible that such opportunities exist; in such cases, it is important to compare, among other variables, the expected level of economic return of the projects.

2) Doing a benefit/cost analysis focuses attention on how to make a project economically viable. In the case of this project, more emphasis on certain components already part of the project can be expected to yield high returns. The role of the extension service, as a necessary link to increase agricultural productivity, and of local participation, to assist in maintenance of structures, stand out as two project components with important benefit/cost payoffs, but which might easily be relegated to positions of lesser importance without such an analysis.

3) It focuses on the rational use of appropriate technologies. Often managers are not aware of the relative costs and benefits of alternatives to commonly used technologies, and do not consider shifting to or even testing alternatives. Doing a benefit/cost analysis of individual project components--forestry versus conservation, contour ditches versus contour walls--can lead to a decrease in project costs, a more rational use of funds, and more effective management.

Benefits to Date

The specific benefits already brought into the project have been discussed in detail in other sections of the report. Briefly, some (largely unquantified) improvement has occurred in the environment; institutional development is just now getting underway; the employment component has, in fact, been providing many of the social benefits envisioned.

Agricultural benefits are so far least in evidence. This can be explained in part because increases in productivity and changes in cropping patterns will develop only as all other components are successfully integrated into an overall plan; agricultural benefits depend on first having the improved resource base, then the technical expertise and extension service to assist farmers make use of it. The number of irrigated hectares added is less than expected, and modern inputs to further raise yield have not been forthcoming as assumed; hence cropping patterns have not shifted into high-yield cash crops at the rate expected.

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COSTS:

Estimates of actual GOCV and USAID costs from January, 1980 to June, 1982 by the team compare with Project Paper estimates as follows:

Table 7

YEAR	PROJECT PAPER ESTIMATE		EVALUATION TEAM ACTUAL	
	GOCV	AID	GOCV	AID
1980	540	2096	135.3	747.8
1981	540	2096	135.3	1109.4
1982	541	2097	135.3	628.6 (1st half)

(SOURCE: Project Paper, APPENDIX B; calculations from project quarterly reports.)

As the critique in Section IV pointed out, actual expenditures have been less than expected because (a) fewer people have been employed than expected (b) there was a delay in starting the project and (c) unskilled labor was overbudgeted. Furthermore, there was no shadow pricing of labor.

CONCLUSIONS

By updating the original cost/benefit analysis, changing project assumptions proven inviable, and looking at realized costs and benefits to date, the following conclusions emerge:

1) Based on actual cropping patterns, probable yield increases, probable hectares brought under irrigation or improvement, and actual costs, computer analysis indicates that the project cannot be justified, as the original was, on the expected agricultural increases from irrigated lands. The increases which would accrue only from increased usage of modern inputs are crucial in making the project more viable, as are more rapid changes in the cropping pattern to higher-value cash crops.

2) Changes in the cropping pattern and in use of modern inputs are necessary to make the project more viable. The changes will not occur without an effective extension service which can provide knowledge of an effective package of inputs, the inputs themselves, and possibly credit. Refocusing the administration of the project in this direction, while retaining current employment and natural resource management components, will have a positive economic payoff.

3) Finally, this analysis shows the necessity for extending the project beyond its current completion date. The natural sequencing of activities--first, improvements in the resource base; second, programs to help farmers take advantage of these improvements and continue them--logically means that improvements in agricultural productivity will only slowly follow cost inputs. Only now, as

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environmental improvements have occurred can agricultural extension bring in the project's potential benefits. More time is obviously needed for this: to train workers, to experiment with field trials and give extension agents field experience, and to establish an overall agricultural development plan for the watershed areas. In addition, agricultural advice can only be made appropriately with a better understanding of the changes the project has brought to the resource base. To establish and monitor data collection requires more time--but the feedback to the project should increase potential benefits greatly.

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X. PLANNING

One of the most important shortcomings of the Watershed Management Project to date has been the lack of systematic planning. This was clearly assumed to be of paramount importance when the project was designed. In the Project Grant agreement between the GOCV and AID the first specific activity to be carried out is the "development of a watershed management plan" for the project area. In spite of this, the project paper made clear that planning could take place only after the beginning of implementation. The discussion in Section IV discusses this problem.

Because planning is indeed central to the success of the project, it should be considered by project administrators as a priority project component, rather than a tacked-on consideration for individual project components. Even without integrated planning, as this evaluation has shown, the project has accomplished a great deal; its construction, employment, agricultural and extension activities have been laudable. The administrative staff has been action oriented, spending much time in the field. One of the most positive attributes of the project administrators has been their willingness to understand and take part in the details of day-to-day operations--the antithesis of office-bound bureaucrats with little appreciation of the reality of project development. Nonetheless, the other side of the coin is that an administrative staff already thinly spread over numerous activities has had little time or orientation towards developing long-term planning.

Watershed management is a systems analysis tool which offers the opportunity to undertake integrated planning. Using a watershed as a definable system in which natural resources can be assessed and potentialities defined, developmental alternatives become clearer and decision-making more complete. The concept of this project, by moving away from a narrow soil conservation concept (in contrast to earlier projects such as the Rural Works Project), clearly included the idea of long-term planning.

Overall planning, however, is still lacking in the project. A high priority for the project must be to develop a 1983 Plan incorporating all elements of the project. The present administrators have the technical expertise and vision to undertake this, if they are willing to make the time commitment to it. This evaluation cannot spell out all of the details of what such a plan should include, though the recommendations offer some indication. The following issues should be among those considered:

A) Proper timing and sequencing of project components. In general, there is a basic logical sequencing of project activities:

```
research and data collection
    (--soil and water          )
    (--socio/economic          )-------------> development of appropriate
    (--agricultural/marketing)                 soil, water conservation  ----->
                                               and agricultural techniques
                                                                          ^
--appropriate training of extension                                       |
  workers                                  --------> working with farmers to |
                                                     practice best agricultural
--implementing of public works            <--------  and soil/water conservation
                                                     techniques
```

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Not all research needs to be carried out before the other steps are initiated, of course; when basic information useful to farmers is known, the process can get underway. Nonetheless, the flow chart illustrates that the project cannot develop simultaneously on all fronts. The system is even more complicated with the addition of a feedback loop, as farmers' own knowledge and skills and attitudes affect applied research and public work decisions.

B) An appreciation of the need for greater technical assistance and expertise, both to provide technical advice and to develop local expertise through training. In specific recommendations, the evaluation has noted the need for short-term consultants, and the need to more effectively use the AID technical advisors presently in Cape Verde, and the technical expertise found in other sections of MDR. A balance must be struck by experts between "getting the job done" and training Cape Verdians who, in the long run, must take responsibility for maintaining the project. At present, the balance is too heavily weighed towards the former. Some redress of this problem is found in the new scope of work of the soil conservation specialist; now, in addition to working on mapping, he is to help prepare a Watershed Management Plan and conduct a training program. The emphasis of the project should continue to shift in this direction.

C) Coordination and integration, especially among divisions of the Ministry of Rural Development, including the Center for Agrarian Studies, Forestry Services, Crop Protection, Horticulture, Rainfed Crops, Agrometeorology and Hydrology, Groundwater, and Socio-economic Studies.

Probably the most important linkage in this regard is that between the project and the Center for Agrarian Studies (CAS) at Sao Jorge. A mutually supportive relationship will be a first step toward a program of farming systems research and extension. As the principle implementor of agricultural investigation in the country, the recently established CAS has the staff and facilities to begin making an important contribution. (AID's new Food Crop Project will further strengthen the capacity of CAS to design, implement and coordinate a national research program). Maintaining close connections to the field will be essential in identifying the key problems, devising workable solutions, and, after initial testing of proposed technologies at the research station, testing them at the farmer level. The project extension component will be a major means of channeling farmer input into the research process.

The basic data-gathering underway in the project (e.g., measuring crop yields, soil testing, collecting hydrological information) requires significant Sao Jorge support, both in the field collection phase and in subsequent laboratory analysis. On the other hand, the opportunity to become involved in these activities offers a practical training experience for the predominantly young CAS staff.

In extension training, the relationship between the project and Sao Jorge is also a complementary one. The new course for extension agents is designed to balance classroom instruction with field experience, and some of the trainees will be assigned to the Watershed Management project for their field training. In the future, it is hoped that agents currently employed in the project will be sent to Sao Jorge for formal training.

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D) Maintenance and local participation. These are two issues important for the long term effectiveness of the project. They are also related to one another. At present, there is no specific maintenance budget or estimates of breakdown, although maintenance is carried out after major storms. This has negative consequences:

-- There is no plan for what will happen when the project is over. Will maintenance simply be taken over by the government, without estimates of manpower or time needed?

-- Project alternatives that require heavy maintenance or participation are not seriously considered. This is the case with contour ditches, for example, where the question of maintenance is important. Even with maintenance, ditches seem to be much cheaper than alternative technologies, but without serious consideration of maintenance they have not been seriously considered.

In the long run, many aspects of project maintenance must be undertaken by the farmers themselves, which will require appropriate training and developing techniques that are in the farmers' self-interest.

Some elements of the project already include local participation, particularly the employment program and the field activities of the extension program. Other issues of participation that should be considered include:

- Farmers should take part in the selection of local individuals to participate in any training programs developed for agricultural production.

- Farmers and local associations should assist in preparing plans for water made available for irrigation and other uses.

- Management of water distribution should be coordinated and supervised by water user associations which may have to be organized to assure equitable allocation of water resources.

- The project should avoid free or subsidized distribution of inputs for agricultural production except for experimental demonstrations. The best test that a new technology or food product is beneficial is when farmers are willing to pay for it.

- As part of the planning process the staff should outline specific ways in which local participation will be encouraged and the nature of local resource contributions to project activities.

E) Many other issues of planning have been discussed in the body of the evaluation. As a final note, while the watershed management project cannot undertake all developmental activities in the project area, there are activities--agricultural education in the schools, energy conservation projects to decrease home fuel consumption, for example--which would significantly enhance the success of this project. The project should encourage the GOCV or other organizations to undertake them when appropriate, and coordinate activities when possible.

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Appendix A

THE IMPACT OF THE PROJECT ON CORN YIELDS

Table 1 Corn Yield Behind Dikes and in Control Areas

Table 2 Plant Height of Corn in Relation to Contour Walls

Table 3 Corn Yield in Areas with Contour Walls and in Control Areas

Table 1

Corn Yield Behind Dikes and in Control Areas

Location	Sample	Grain weight, oven-dry (gm.) Behind Dike	Grain weight, oven-dry (gm.) Control	Yield at 15% moisture (kg./ha.) Behind Dike	Yield at 15% moisture (kg./ha.) Control
1	1	212.5	268	376	272
	2	254	70		
2	1	332	68	555	89
	2	196	68		
3	1	330	93	527	306
	2	209	221		
4	1	173	173	344	121.5
	2	297	39		
AVG.		250.4	125	450.5	197.1

Table 2

Plant Height of Corn in Relation to Contour Walls

Location	Below Wall	Above Wall	Between Walls	Control	% increase near walls
1	110.8	107.0	91.6	90.9	19.8
2	132.4	135	111.4	109.2	22.4

Table 3

Corn Yield in Areas with Contour Walls and in Control Areas

Location	Sample	Grain weight, oven-dry (gm.)		Yield at 15% moisture (kg./ha.)	
		Contour Walls	Control	Contour Walls	Control
1	1	55	77	111	135
	2	194	119		
2	1	104	165	112	113
	2	90	66		

APPENDIX B

QUESTIONARIO PARA TRABALHADORES
Dezembro 1982
USAID/MDR

(56 interviews)

DADOS PESSOAIS

1. Nome: _____

2. Nome do chefe da familia: (46% heads of families)

3. Sexo: F M

4. Idade: _____

5. Estudos: (56% no schooling 20% up to 4th grade)

6. Morada: _____

7. Controlador: _____

****

EMPREGO

8. Qual é o seu emprego no projecto? _____

9. Ha quanto esta trabalhando no projecto? _____

10. Mais algum membro da sua familia trabalhou para o projecto? Sim Nao

11. Se sim, ha quanto tempo? _____

12. Como conseguiu emprego no projecto?

13. O que faz voce com o dinheiro que ganha atravez do projecto?

14. Antes deste emprego, como satisfazia as necessidades que presentemente satisfaz com o salario que o projecto lhe paga?
16 - only farm income
11 - other jobs
10 - family helped
6. emigrant income

15. Quanto ganha? _____

16. Ja foi aumentado o seu salario alguma vez? Sim Nao
9

17. Se sim, por que razao?

61

18. Voce ja recebeu algum treino no emprego? Sim 5 Não

19. Se sim, qual? masons

20. Voce ja teve oportunidade de pôr em prática o que aprendeu trabalhando para o projecto?

SIM NÃO

21. Se sim, explique.

****

TERRENO

22. E cultivador agrícola? Sim all Não

23. Se sim, por conta própria _____

rendeiro _____

parceiro _____

24. A terra é de sequeiro ou regadio? Sequeiro_____litros

12 had irrigated land (.5 liter average) Regadio _____litros

25. Que tipo de combustível usa para fins domesticos, por ordem de importância?

lenha ✓ _____

petróleo _____

outros (explique) _____

26. Paga para o combustível? SIM NÃO

27. Se sim, quanto por dia? _____

28. Quanto tempo leva na procura diária de combustível?

29. Qual a orígem da água que usa em casa?

30. Quanto tempo leva a apanhar água?

31. Quanta agua usa por dia, em latas? _____

32. Quem cuida das criancas enquanto você trabalha no projecto?

33. Antes do emprego, era a mesma pessoa? SIM NÃO

34. Se não, quem era? _____

35. Acha que o projecto criou mundancas na sua maneira de viver, na vida da sua família, ou na sua comunidade? Explique.

36. Voce trabalha com outras pessoas da comunidade para resolver problemas de água ou outros problemas? Explique.

37. Voce recebeu alguma assistência técnica do Ministério de Desenvolvimento Rural?

SIM NÃO

38. Se sim, foi assistência para terra de sequeiro ou terra de regadio?

sequeiro _____

regadio _____

39. Indique o tipo de assistencia que ja recebeu:

_____ contrôle de pragas

_____ distribuição de sementes

_____ distribuição de árvores

_____ outras assistências (explique)

40. Voce ja fêz alguma coisa diferente na sua terra devido ao projecto?

SIM NÃO

41. Se sim, indique o que você fêz de diferente:

_____ plantou mais árvores

_____ construiu poco

_____ construiu levadas

_____ construiu socalços

_____ outras coisas (explique)

42. Mais importante, que é que voce gostaria de receber do Ministério, em termos de conselhos ou ajuda?

43. Pensando nesse projecto, quais os benéficios e problemas criados por ele?

BENEFICIOS:

PROBLEMAS:

APPENDIX C

BENEFIT-COST ANALYSIS OF CONTOUR WALLS AND CONTOUR DITCHES UNDER DIFFERENT ASSUMPTIONS

Table 1: Benefit/cost analysis of contour walls with one benefit: the increase in agricultural productivity of traditional crops due to water spreading. Uses total estimated costs.

B/C ratio: .1/1 (one dollar in costs for ten cents in benefits)

Table 2: Benefit/cost analysis of contour walls with two benefits:

(1) the increase in agricultural productivity of traditional crops.

(2) estimated benefits of decreases in erosion.

Uses total estimated costs.

B/C ratio: 1.0/1.0 (one dollar in costs for one dollar in benefits)

Table 3: Benefit/cost analysis of contour walls as above, but with lower benefits from decreased soil erosion and costs estimated at half present estimates.

B/C ratio: 1.1/1 ($1.10 in benefits for every $1.00 in costs)

Table 4: Benefit/cost analysis of contour walls with two benefits as above, assuming full costs, but different figures for erosion benefits.

B/C ratio: 1.0/1.0.

Table 5: Economic Analysis of Contour walls versus contour ditches, showing ditches as one-half the price of walls, including all construction and maintenance costs.

Table 1: B/C analysis of contour walls with one benefit (increase in ag. productivity of traditional crops due to water spreading) and total estimated costs.

(B/C: .1/1)

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ANALYSIS OF ARRETOS (CONTOUR WALLS)

I. BENEFITS

CROPS	HAS./KM.S	MT/HA	$/MT	% INCREA	BENEFITS/KM/YR
CORN	.5	.4	57	.49	5.586
BEANS	.5	.2	310	.49	15.19

II. COSTS

COST/CU. METER	KM.CONSTRUCTED	CU.METERS	EST. COST/KM.
3.2	89.0	3564.0	1270.022

YEAR	BENEFITS	COSTS	DISCOUNT	DIS. B	DIS. C
1	20.776	1270.022	.8695652	18.066009	1104.367
2	20.776	0	.7561437	15.70964	0
3	20.776	0	.6575162	13.66056	0
4	20.776	0	.5717532	11.87575	0
5	20.776	0	.4971767	10.32934	0
6	20.776	0	.4323276	8.982038	0
7	20.776	0	.3759370	7.810469	0
8	20.776	0	.3269018	6.791711	0
9	20.776	0	.2842624	5.905836	0
10	20.776	0	.2471847	5.135509	0
11	20.776	0	.2149432	4.465660	0
12	20.776	0	.1869072	3.883187	0
13	20.776	0	.1625280	3.376681	0
14	20.776	0	.1413287	2.936244	0
15	20.776	0	.1228945	2.553256	0
16	20.776	0	.1068648	2.220222	0
17	20.776	0	.0929259	1.930628	0
18	20.776	0	.0808051	1.678807	0
19	20.776	0	.0702653	1.459832	0
20	20.776	0	.0611003	1.269419	0
21	20.776	0	.0531307	1.103843	0

BENEFIT-COST RATIO IS: .1127537

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decrease in soil erosion) and total estimated costs.

(B/C: 1/1)

ANALYSIS OF ARRETOS

BENEFITS AGRICULTURAL INCREASES DUE TO WATER SPREADING

CROPS	HAS./KM.	MT/HA	$/MT	%INCREASE	BENEFITS/KM/YR
CORN	.5	.4	57	.49	5.586
BEANS	.5	.2	310	.49	15.19

BENEFITS PREVENTION OF EROSION

CROPS	HAS./KM.	MT/HA	$/MT	%INCREASE	BENEFITS/KM/YR
CORN	50	.4	57	.037	42.18
BEANS	50	.2	310	.037	114.7

N.B. YIELDS, PRICES FROM PROJECT PAPER
ASSUMED DIRECT EFFECT ON 2.5 M. STRIP EACH SIDE OF ARRETO
ASSUMED PREVENTION ON 500 M. STRIP EACH SIDE OF ARRETO
SINCE ARRETOS ARE OFTEN IN GROUPS OF THREE, THE INFLUENCE PER ARRETO IS PROBABLY CONSIDERABLY LESS THAN THIS
SO FOR THIS ANALYSIS THE EFFECT/ARRETO WAS HALVED.
WITH A TYPICAL THREE ARRETOS AFFECTING 1.5 KMS. DOWNSTREAM

II. COSTS

COST/CU. METER	KM.CONSTRUCTED	CU.METERS	EST. COST/KM.
3.2	89.9	25640	1070.022

N.B. KM. CONSTRUCTED, CU. METERS FROM WATERSHED MANAGEMENT PROJECT REPORT, MRD, DSCSA-1980/32; COST/CU. METER FROM PP

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YEAR	BENEFITS	COSTS	DISCOUNT	DIS. B	DIS. C
1	177.656	1270.022	.8695652	154.4835	1104.367
2	177.656	0	.7561437	134.3335	0
3	177.656	0	.6575162	116.8117	0
4	177.656	0	.5717532	101.5754	0
5	177.656	0	.4971767	88.32643	0
6	177.656	0	.4323276	76.80559	0
7	177.656	0	.3759370	66.78747	0
8	177.656	0	.3269019	58.07606	0
9	177.656	0	.2842624	50.50092	0
10	177.656	0	.2471847	43.91385	0
11	177.656	0	.2149432	38.18595	0
12	177.656	0	.1869072	33.20518	0
13	177.656	0	.1625280	28.87407	0
14	177.656	0	.1413287	25.10788	0
15	177.656	0	.1228945	21.83294	0
16	177.656	0	.1068648	18.98517	0
17	177.656	0	.0929259	16.50884	0
18	177.656	0	.0808051	14.35551	0
19	177.656	0	.0702653	12.48306	0
20	177.656	0	.0611003	10.85483	0
21	177.656	0	.0531307	9.438984	0

BENEFIT-COST RATIO IS: 1.015465

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Table 3: B/C analysis of contour walls with the same two benefits (a lower estimate of benefits from soil erosion), with cost estimates halved.

(B/C: 1.1/1)

ANALYSIS OF ARRETOS

BENEFITS AGRICULTURAL INCREASES DUE TO WATER SPREADING

CROPS	HAS./KM.	MT/HA	$/MT	%INCREASE	BENEFITS/KM/YR
CORN	.5	.4	57	.49	5.586
BEANS	.5	.2	310	.49	15.19

BENEFITS PREVENTION OF EROSION

CROPS	HAS./KM.	MT/HA	$/MT	%INCREASE	BENEFITS/KM/YR
CORN	50	.4	57	.01	11.4
BEANS	50	.2	310	.01	31

N.B. YIELDS, PRICES FROM PROJECT PAPER
ASSUMED DIRECT EFFECT ON 2.5 M. STRIP EACH SIDE OF ARRETO
ASSUMED PREVENTION ON 500 M. STRIP EACH SIDE OF ARRETO
SINCE ARRETOS ARE OFTEN IN GROUPS OF THREE, THE INFLUENCE PER ARRETO IS PROBABLY CONSIDERABLY LESS THAN THIS
SO FOR THIS ANALYSIS THE EFFECT/ARRETO WAS HALVED.
WITH A TYPICAL THREE ARRETOS AFFECTING 1.5 KMS. DOWNSTREAM

II. COSTS

COST/CU. METER	KM.CONSTRUCTED	CU.METERS	EST. COST/KM.
1.6	89.8	35640	635.0111

N.B. KM. CONSTRUCTED, CU. METERS FROM WATERSHED MANAGEMENT PROJECT REPORT, MRD, DSCSA-1980/82; COST/CU. METER FROM PP

YEAR	BENEFITS	COSTS	DISCOUNT	DIS. B	DIS. C
1	63.176	635.0111	.8695652	54.93568	552.1836
2	63.29000	0	.7561437	47.85633	0
3	63.40514	0	.6575162	41.68991	0
4	63.52143	0	.5717532	36.31858	0
5	63.63889	0	.4971767	31.63977	0
6	63.75751	0	[illegible]	27.56417	0

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10	64.24401	0	[illegible]	[illegible]	[illegible]
11	64.36869	0	.2149432	13.83561	0
12	64.49462	0	.1869072	12.05451	0
13	64.62181	0	.1625280	10.50285	0
14	64.75026	0	.1413287	9.151068	0
15	64.88001	0	.1228945	7.973395	0
16	65.01105	0	.1068648	6.947390	0
0	63.06313	0	1	63.06313	0
1	63.176	0	.8695652	54.93565	0
2	63.29000	0	.7561437	47.85633	0
3	63.40514	0	.6575162	41.68991	0
4	63.52143	0	.5717532	36.31858	0

BENEFIT-COST RATIO IS: 1.128927

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Table 4: B/C analysis of contour walls, with the same two benefits as before, assuming different benefit figures for soil erosion but full estimated costs.

(B/C: 1/1)

ANALYSIS OF ARRETOS

BENEFITS AGRICULTURAL INCREASES DUE TO WATER SPREADING

CROPS	HAS./KM.	MT/HA	$/MT	%INCREASE	BENEFITS/KM/YR
CORN	.5	.4	57	.49	5.586
BEANS	.5	.2	310	.49	15.19

BENEFITS PREVENTION OF EROSION

CROPS	HAS./KM.	MT/HA	$/MT	%INCREASE	BENEFITS/KM/YR
CORN	50	.4	57	.035	39.9
BEANS	50	.2	710	.035	100.5

N.B. YIELDS, PRICES FROM PROJECT PAPER
ASSUMED DIRECT EFFECT ON 2.5 M. STRIP EACH SIDE OF ARRETO
ASSUMED PREVENTION ON 500 M. STRIP EACH SIDE OF ARRETO
SINCE ARRETOS ARE OFTEN IN GROUPS OF THREE, THE INFLUENCE PER ARRETO IS PROBABLY CONSIDERABLY LESS THAN THIS
SO FOR THIS ANALYSIS THE EFFECT/ARRETO WAS HALVED.
WITH A TYPICAL THREE ARRETOS AFFECTING 1.5 KMS. DOWNSTREAM

II. COSTS

COST/CU. METER	KM.CONSTRUCTED	CU.METERS	EST. COST/KM.
3.2	89.9	35640	1270.022

N.B. KM. CONSTRUCTED, CU. METERS FROM WATERSHED MANAGEMENT PROJECT REPORT, MRD, DSCSA-1980/82: COST/CU. METER FROM PP

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YEAR	BENEFITS	COSTS	DISCOUNT [illegible]	[illegible]	[illegible]
1	169.176	1270.022	.8695652	147.1096	1104.367
2	170.5725	0	.7561437	128.9773	0
3	172.0179	0	.6575162	113.1045	0
4	173.5139	0	.5717532	99.20710	0
5	175.0622	0	.4971767	87.03684	0
6	176.6647	0	.4323276	76.37702	0
7	178.3233	0	.3759370	67.03833	0
8	180.0399	0	.3269018	58.85538	0
9	181.8167	0	.2842624	51.68365	0
10	183.6556	0	.2471847	45.39686	0
11	185.5589	0	.2149432	39.88467	0
12	187.5288	0	.1869072	35.05047	0
13	189.5676	0	.1625280	30.81004	0
14	191.6778	0	.1413287	27.08957	0
15	193.8619	0	.1228945	23.82456	0
16	196.1224	0	.1068648	20.95858	0
17	198.4620	0	.0929259	18.44226	0
18	200.8836	0	.0808051	16.23242	0
19	203.3898	0	.0702653	14.29125	0
20	205.9838	0	.0611003	12.58567	0
21	208.6686	0	.0531307	11.08670	0

BENEFIT-COST RATIO IS: 1.018722

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Table 5

ECONOMIC ANALYSIS OF ARRETOS (CONTOUR ROCK WALLS) VS. CONTOUR DITCHES

	COST/M(US)	COST/HA.
ARRETOS	1.27	2540
CONTOUR DITCHES	.0520833	520.833

N.B. CONTOUR DITCHING RATES OF 1 WORKER = 30 M./HR.
WITH 210 M./DAY AT 70 ESC./DAY
AND THEREFORE ONE HA. OF FURROWS AT 1 M. INTERVALS = 3300 ESCUDOS

WAS OBTAINED BY EVALUATION TEAM MEMBER PATRICK BYRNE FROM KERN STUTLER, CID/UTAH STATE U., ON INFORMATION FROM THE TARRAFAL PROJECT

DATA THERE INDICATED THAT CROP PRODUCTION IMPACT WAS INCONCLUSIVE. ALTHOUGH THERE WAS AN INDICATION THAT PLANT HEIGHT WAS GREATER IN FURROW

"EVALUATION OF CONSERVATION PRACTICES ON AGRICULTURAL LANDS IN TARRAFAL, MARCH, 1982, NOTES: "OBSERVATIONS MADE ON THE EXPERIMENTAL WATERSHED ON MONTE COVADO DURING THE PAST 3 YEARS INDICATED NO RUNOFF FROM AREAS WITH LEVEL CONTOUR FURROWS EVEN ON THE STEEPER SLOPES OF 25-30%.

BECAUSE THE RATE OF 1 METER PER 2 MINUTES FOR 7 STRAIGHT HOURS/DAY SEEMED HIGHLY IMPROBABLE TO THIS ECONOMIST, GIVEN THAT CONTOURS HAD TO BE ESTABLISHED, AND GIVEN THAT OTHER COSTS WERE NOT INCLUDED, A RATE OF 4 TIMES THAT LEVEL WAS ARBITRARILY CHOSEN AS A STARTING POINT FOR THE ANALYSIS. THE REPAIR RATE OF 20% PER YEAR IS ALSO ARBITRARY.

ACTUAL ASSUMPTIONS USED WERE: 10 ESC./HR., 54 ESC./US$, 10 MIN./METER, 100% OVERHEAD COSTS IN SUPERVISION, CALC. OF CONTOUR COSTS PER HA. ON EST. OF WALLS SPACED AT 10 METERS' DITCHES AT ONE METER

BENEFIT-COST OF ARRETOS VS. CONTOUR DITCHES

ARRETOS COSTS	DITCHES COSTS	DIS.C ARRETOS	DIS.C DITCHES
2540	520.833	2538.696	452.39833
0	130.2083	0	98.45614
0	130.2083	0	85.61404
0	130.2083	0	74.44699

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BENEFIT-COST OF ARRETOS VS. CONTOUR DITCHES

ARRETOS COSTS	DITCHES COSTS	DIS.C ARRETOS	DIC.C DITCHES
2540	520.833	2208.696	452.8983
0	130.2083	0	98.45614
0	130.2083	0	85.61404
0	130.2083	0	74.44699
0	130.2083	0	64.73651
0	130.2083	0	56.29262
0	130.2083	0	48.95010
0	130.2083	0	42.56531
0	130.2083	0	37.01331
0	130.2083	0	32.18349
0	130.2083	0	27.98750
0	130.2083	0	24.33485
0	130.2083	0	21.16240
0	130.2083	0	18.40216
0	130.2083	0	16.00188
0	130.2083	0	13.91467
0	130.2083	0	12.09972
0	130.2083	0	10.52149
0	130.2083	0	9.149124
0	130.2083	0	7.955760

SUMS OF DISCOUNTED COSTS ARE:

2208.696 1154.690

(Fully costed, including maintenance costs, ditches are approximately half as expensive as contour walls.)

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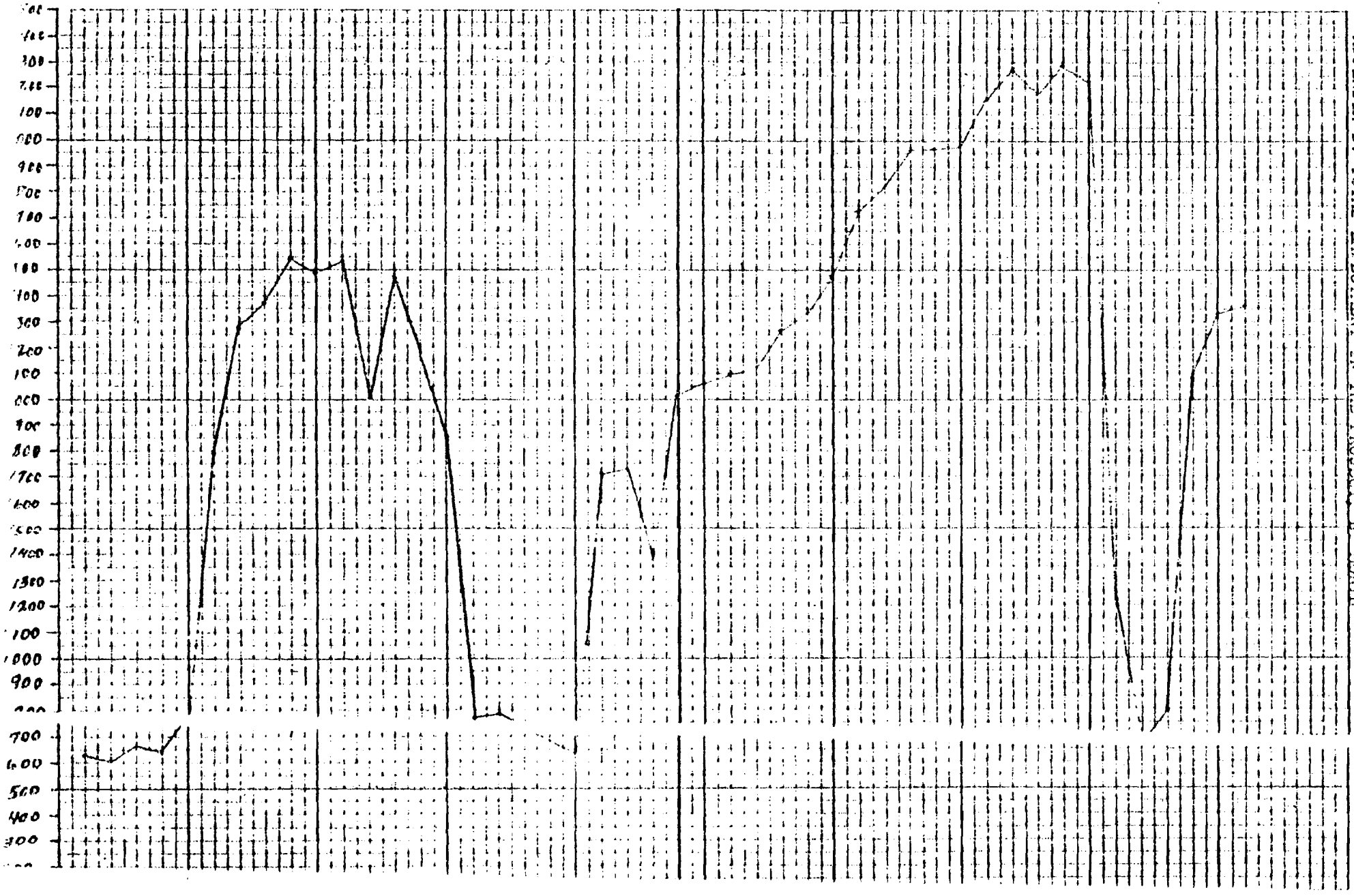
APPENDIX d

TOTAL EMPLOYMENT IN THE FOUR WATERSHEDS



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APPENDIX E

ORGANIZATIONAL DEVELOPMENT OF THE RURAL ASSISTANCE PROGRAM

Charts 1 and 2 represent the present organization of the Rural Assistanc Program and one possible scenario for its further development in 1983 and 198 Although hypothetical, the chart is designed to illustrate the administrative relationships that must be considered as the extension program grows.

The pattern can be summarized as follows:

Growth Stage 1983-4

The addition of a full-time extension specialist from the new National Extension and Animation Service. He/she will serve as assistant to the project director or similar post.

Recruitment of four to eight (2-4 in 1983: 2-4 in 1984) full-time exten sion agents. The project should continue to use construction personnel on a part-time basis to help coordinate and implement extension-education program Ties to the research and training activities at Sao Jorge should be strength Sao Jorge trainees should be part of the field program in a research-learnin role (community needs, traditional soil conservation and agricultural practi

Phase Out Stage 1985-6

Graudates of Sao Jorge assume roles as extension agents and work with experienced field personnel. Several qualified WSW extension agents are ser each year to Sao Jorge or other institutions for long-term training. The us of construction personnel as extension assistants on a part-time basis conti

After 1987 or 1988

The WSM extension program is integrated into the new Rural Animation a Extension Service. An extension coordinator will probably remain within th Division of Soils and Water Conservation and there will be technical extens specialists (also graduates of Sao Jorge) assigned to the division who will work in cooperation with local field agents.

The outline suggests the need to take a long-range view of the extensi component and, at all costs, avoid the establishment of a mini-agricultural extension buresucracy within the Division of Soil and Water Conservation. The long-range Cape Verdean plan calls for an integrated extension approach using broadly trained field agents supported by technical specialists. The WSM extension project should contribute to the effective implementation of this approach.

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Chart 1

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WSE Extension Component

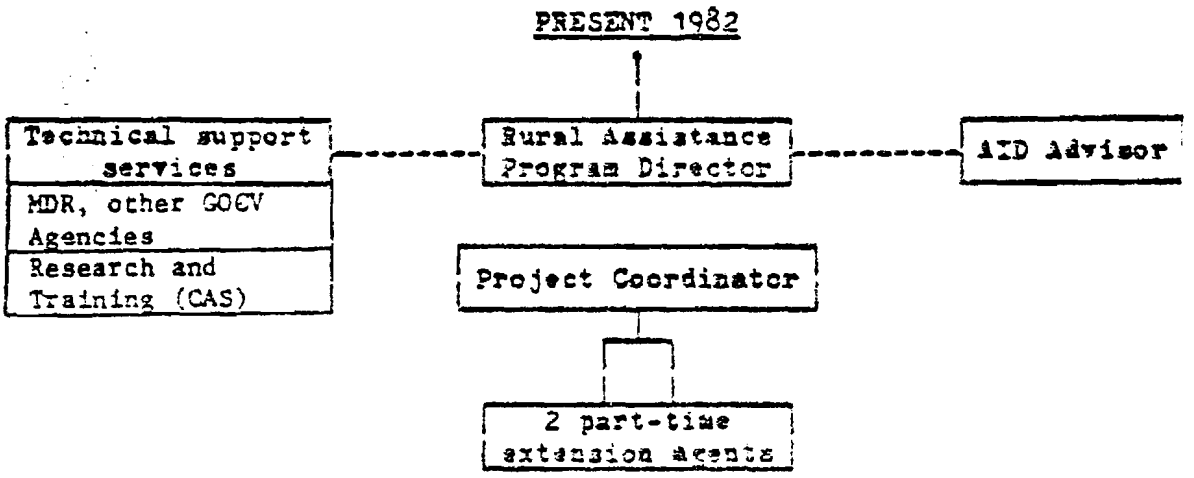
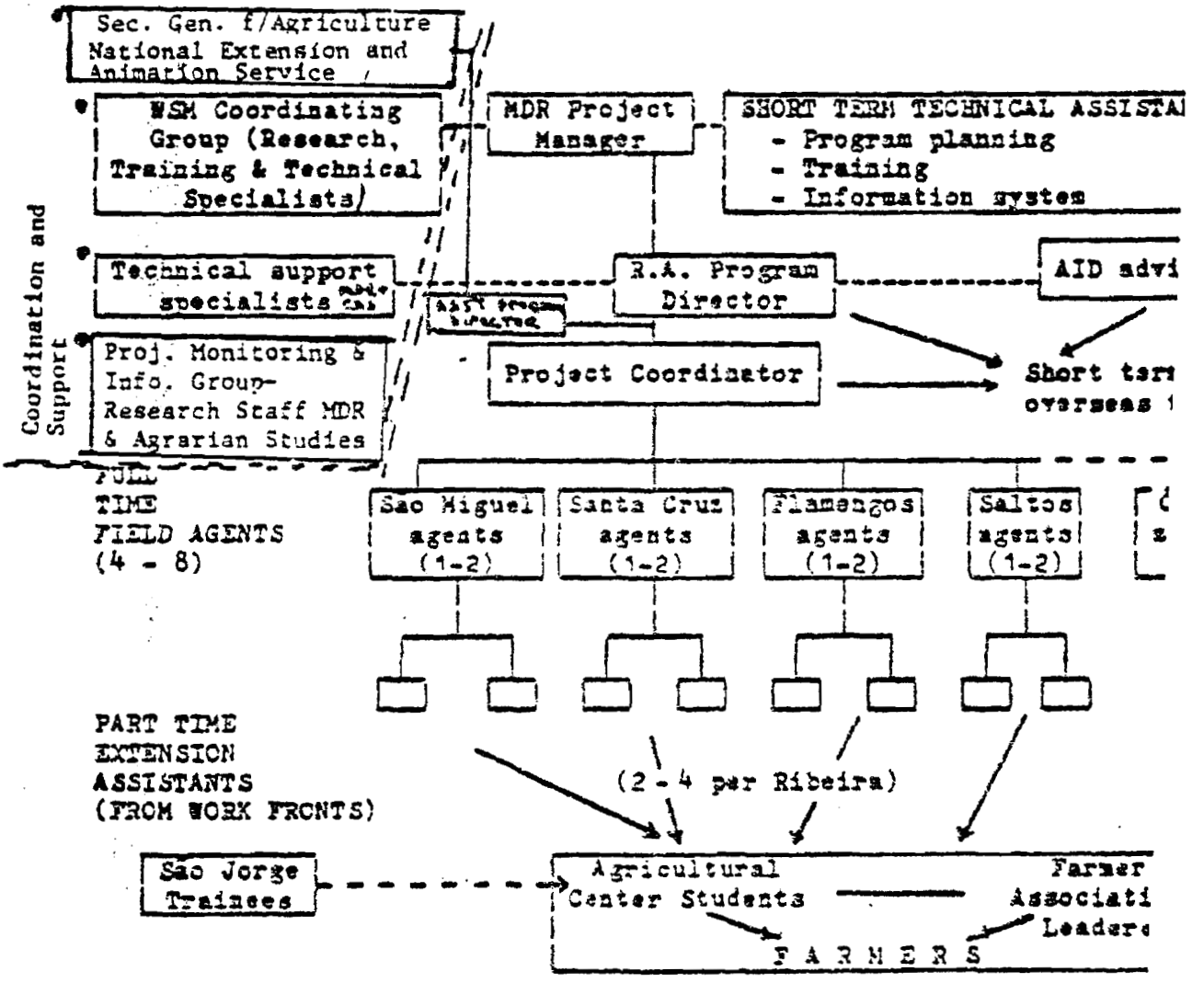


Chart 2

GROWTH STAGE 1983 - 84



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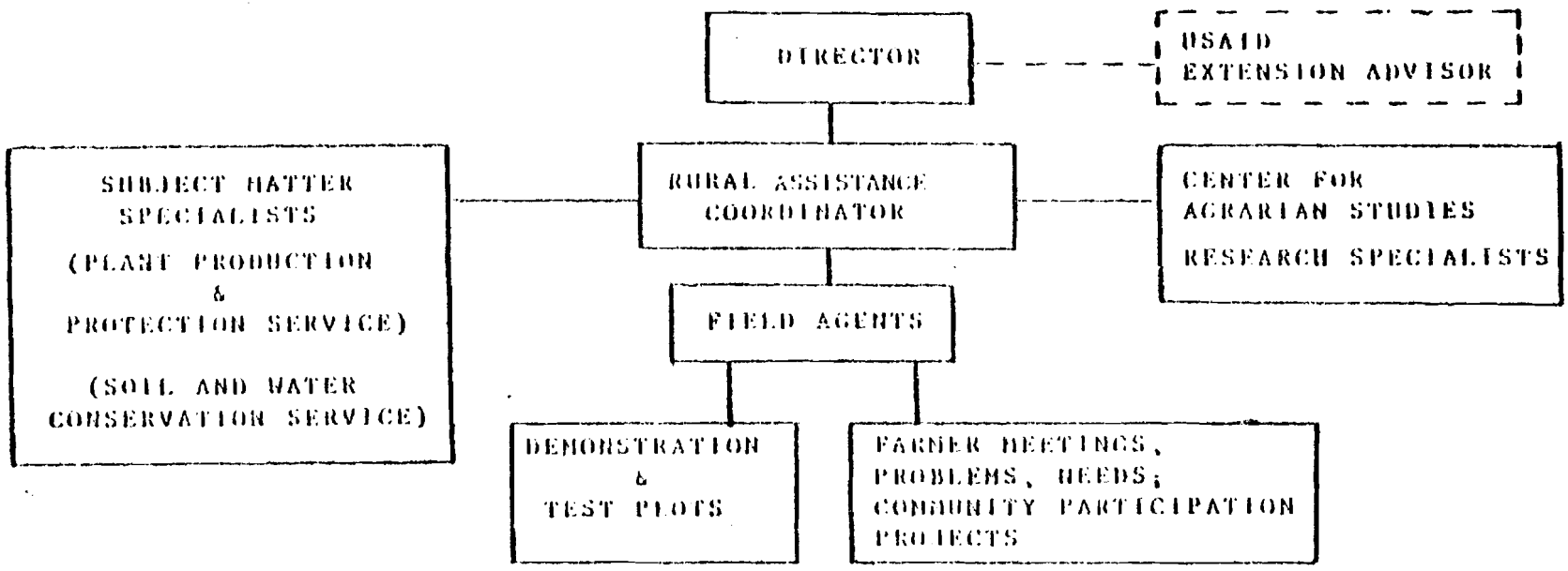
CAPE VERDE
WATERSHED MANAGEMENT PROJECT
RURAL ASSISTANCE PROGRAM



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CAPE VERDE WATERSHED MANAGEMENT PROJECT

RURAL ASSISTANCE PROGRAM

July 1982 - H. Bedolfe

DESCRIPTION:

The Watershed Management Project, through the newly constructed s and water conservation structure, is creating a new agronomic regime in project area. New arable land is being developed, sloping rainfed land ing improved, and more water is becoming available for irrigation.

The reasons behind the creation of a Rural Assistance Program are
1) to support and reinforce the consequent augmented agricultural tion and ensure its effectiveness through planned field tests, stration plots and training of personnel;
2) help farmers make sound agronomic decisions; and
3) increase food production and improve the welfare of the residen the valleys.

PURPOSE:

The program will be assisted by a U.S. Agricultural Extension advi The technical advisor will work with Cape Verdean technicians in terms tension methods, as well as obtaining resource data and carrying out te demonstration plots in the field. He/she will also cooperate with other search in crop variety and other cultural techniques.

The program will focus on several areas:
1) Community reforestation programs, using especially parkinsonia and prosopis juliflora. The increased area planted with trees w vide for fuel wood, forage for farm animals, shade and also hel serving the soil on the steep slopes.
2) Increased area planted to the legume cajanus cajan. This is a d resistant plant which holds soil in place, produces a high prot which is becoming a part of the Cape Verdean diet, provides for animals and fuel wood for cooking.
   These two points will do much to take some of the demographic ing pressures off of the already fragile environment.
3) Increased cultivation of fruit trees.
4) Improved cultural practices for irrigated crops.
5) Biological control of insect pests.
6) Increasing the amount of community participation in the variou taken. Regularly scheduled farmer meetings will be held and fe discussion of farmer priorities, needs and problems will be en

WORK SCOPE OF PROGRAM PERSONNEL:

A. Director
   The Director will be selected to oversee the program activities a responsible for the administration, policy, philosophy and the ob of the Rural Development Program.

B. USAID Agricultural Extension Advisor
   Working together with the Program Director, the Agricultural Exte visor will help design, organize and implement the Rural Developm gram. He/she will work with all of the Cape Verdean technicians i the project in terms of extension methods, as well as obtaining r data and carrying out test and demonstration plots in the field.

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operate with other departments within MDR on research in crop varieties and other cultural techniques.

C. Rural Assistance Coordinator
This person will be based in Praia and will work with and oversee the activities of the field agents while also giving guidance and motivation. The coordinator will work with the field agents on the test and demonstration field plots and will take part in the farmer meetings. Together with the field agent, the coordinator will assess the priorities of the local farmers and relay them to the director.
In broad terms the coordinator is the vital link between the field, its needs and problems, and the Praia and Sao Jorge based technicians. It is especially important for this person to possess good communication skills.

D. Subject Matter Specialist
Depending on the person's work load, he/she will have other responsibilities outside of the work in the Rural Development Program. The SMS will be a technician within one of the divisions of the MDR (Plant Protection and Production, Soil and Water Conservation or the Center for Agrarian Studies) and will act as a source for technical expertise when the need arises from the field. Although this person will report to the head of his/her respective division, the SMS will be available for consultation and "part-time" work with the program. When problems arise in the field which cannot be addressed at that level, the SMS will be requested through the program coordinator, to advise and help with a solution.
The specific person in each division to fill this slot will be named by the head of each division.

E. Research Specialist
This person will be based in Sao Jorge and be under the direct supervision of the Director of the Center for Agrarian Studies. The research specialist, like the subject matter specialist, will also have resposiblities outside of his work within the program.
Through regularly scheduled meetings with the director and the coordinator and visits to the field, decisions will be made on where to place research emphasis. In this way the researcher will have good contact with the rural situation and will become more aware of the problems and possibilities of food crop production in the field.

F. Field Agent
The field agent is at the grassroots level of the Rural Development Program. This is the person with everyday contact with farmers and their families. Through regularly scheduled farmer meetings, the agent will be aware of the true situation in the field.
Immediate supervision comes from the coordinator. A close working relationship between these two is essential, for the insights of the field agent into the needs of the farmers must be transferred through the coordinator to the proper specialist.
Besides conducting farmer meetings and encouraging feedback from the participants, he/she will also monitor and take care of the field test and demonstration plots, and be available to the farmers for consultation. What the field agent cannot solve in the field will be referred to the coordinator.
As new community activities are decided upon, the field agent will explain the activity (ie. community tree planting on Arbor Day), organize and divide the work.

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To begin there will be one field agent in each of the four valleys and after 6 months another person will be added to each valley but in a different zone. At the end of the project there will be 8 trained field agents. The field agent will be someone who lives in or near the project area, has a good knowledge of local farming practices, an open mind to learn new techniques and must be respected by the community.

LONG TERM BENEFITS:

1) The people of the project area will benefit through better knowledge of farming provided by dissemination of test and demonstration plot results and other educational activities.
2) The people of Cape Verde will benefit by the experience gained through this program which can be repeated in other parts of the islands.
3) A greater pool of trained extensionists and farmer leaders will result, with a greater awareness of research and demonstration methods, and a greater awareness of their environment and how to protect it.
4) A more stable food supply and an improved diet should result.

OBJECTIVE VERIFIABLE INDICATORS:

1) 1500 farmers benefitting from the Rural Development Program.
2) 8 field extensionists trained (2 in each valley).
3) 1 Director and 1 Coordinator trained in extension methods.
4) 1 extension technician trained overseas.
5) 100 hectares planted in *Gatanus cajan*.

IMPLEMENTATION SCHEDULE:

August 1982.....Program Director named
August 1982.....Program Coordinator named
August 1982.....4 field agents named
January 1983.....4 additional field agents named
January 1983.....Overseas extension training for 12 P/M

Total = 10 people trained in extension methods by June 1983.

CONCLUSION:

In Cape Verde, where there is a shortage of personnel to fill the many specific job slots created by rapid development, this plan makes the most of Cape Verdean talents:

1) Specialists are available to the program but not tied to it which would inhibit their performance of other important tasks.
2) The chain of action stretches from the farmers at field level up to the technicians in Praia and Sao Jorge. With links directly to the field, the technicians will have an added awareness of everyday farming techniques and thus, a better understanding of what can and should be done.
3) The lines of communication are direct and simple. New developments which arise in the field can be communicated quickly from the field agents to the coordinator to the proper specialist. Most important, the communication system is not solely "top-down" but also from the field level up.

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APPENDIX H

A NOTE ON VEHICLE USE AND MAINTENANCE

Vehicles

Timely transportation of personnel, equipment, and materials is crucial to the success of all components of the project. Thus, the importance of maintaining a reliable fleet of vehicles and a sufficient stock of spare parts cannot be minimized. With 3 Ford dump trucks, 5 International Scouts, and 5 motorcycles purchased under the project, there would appear to be sufficient vehicles available. Currently, however, some of these vehicles are tied up for other purposes. As the Scouts used by the PASA technicians are frequently out of service for repair or maintenance, it is suggested that one of the other Scouts (e.g., the one used at Sao Jorge) be made available to them when needed. If any new technicians are assigned to the project, then additional vehicles should be ordered for their use.

The issue of spare parts and equipment, especially tires, needs added emphasis. Tires typically wear out after 8-10,00 km. and speedier replacement is a vital concern. Also, the rough roads and off-road situations cause excessive wear and tear on springs, doors, and shock absorbers. A greater awareness of parts needs vs. lead time is called for.

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