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PURPOSE To provide the land preparation and water management technical inputs in preparation of a PP.

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(Use attachment for details.)

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2.
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Etc.

FOLLOW-UP ACTION REQUIRED:
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(List)
1. List of persons contacted.
2. Report on portion of PP dealing with the technical aspects of land development and water management.

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Farm Development and Water Management - Small Farm Development Project, Guyana

Gilbert L. Corey
May 1978

The Guyana Small Farm Development Project is AID's portion of a jointly financed project in the Black Bush area of Guyana. Other donors include the World Bank, IFAD, and Canada. The global project proposes to rehabilitate an existing rice irrigation system and extend it so rice can be double cropped on some 75,000 acres. The AID component will include provision of all consulting services and the technical assistance and imputs necessary to improve crop yields. This report refers only to the land and farm development and water management phases of the AID project.

PROJECT DESCRIPTION

Land and Land Development

The project area consists of low-lying coastal plain having little surface relief. The general gradient is only about 0.5 feet per mile toward the coast. Surface deposits consist of silt and clay of marine and riverine origin. Sandy reefs and beach ridges (9,800 acres) occur more or less parallel to the coast line. These surfaces are two to four feet higher than adjacent low lands and are presently used for coconut production. Because of the extensive land development necessary to convert these reefs to crop production, the intensive management required to maintain them, and the high water requirements of sandy soil, these areas are excluded from the project area and will remain in coconut production.

The soils of the area are predominantly dark colored, fine textured, and slightly to moderately acid in the surface layers and fine textured, light colored and somewhat alkaline in the subsoil. Owing to the high clay content, these soils swell and shrink considerably upon wetting and drying. Most of the Project area consists of low-lying, poorly drained clay soils used primarily for rice production.

Soil infiltration capacity is in general very low, but this is not an unfavorable condition for rice under flood irrigation. For vegetables, however, the soil must be formed into beds in order to permit adequate drainage. Soil fertility is relatively high compared to most humid tropical soils; however, Project soils do respond to nitrogen and phosphorous fertilizers. Some soils especially near the coastline are saline and in some cases alkaline but most of these occu- outside the Project area. There are apparently no minor element defi-

ciencies or chemical toxicities among the Project soils. The soils are well suited for the crops under consideration and should produce relatively high yields.

Surface land slopes are small and the general appearance of the land is flat. However, topographical irregularities do exist on all lands with many fields having undulations with ground elevation differences of as much as one foot. Realization of the production potential on both existing and new land in the Frontlands area will require removal of surface irregularities by land leveling and/or grading. Low areas in fields cause poor stands, excessive waste of water, and problems with harvesting and seed bed preparation because of excessive soil water within these areas. Careful land preparation to permit application of a uniform depth of water over the entire field is essential.

The farm fields vary in size from 0.5 acres on vegetable plots up to 15 acres under rice production. These variations result from size of individual ownership as well as leasing of smaller parcels within individual ownerships.

Seed beds are prepared by tractor powered discs and moldboard plows. A common practice is to plow after harvest, allow the soil to thoroughly dry, irrigate and then plow again in a wet condition prior to planting. Plowing leaves surface undulations which aggravate the unevenness of the surface topography. These localized irregularities should be corrected by floating or land planing prior to planting each rice crop. Land preparation equipment and tractors are either privately owned, or leased from the private sector or the GRB machinery pool. Availability of such equipment on a timely basis is a problem for the farmer who does not own the equipment. Approximately 40 percent of the land preparation and harvesting in the Project area must be accomplished with leased equipment. There is presently no adequate land leveling equipment in the Project area, either privately or government owned.

Water and Water Management

Water supply for the sugar estates, the Black Bush Polder, Block III, and a portion of the Frontlands is presently supplied by pumping from the Canje River. A part of the Canje River supply comes from the Berbice River by gravity flow through the Torani Canal.

During the critical low flow, dry season period when crop water demands are highest, the present system is of insufficient capacity to meet crop demands in 5 out of 8 years. The Project will provide for a 1,000 cfs pumping plant into the Torani Canal, increased pumping capacity at all pump stations from the Canje River into the canal system, and renovation and enlargement of the present canal system. Canal extensions will be provided for the lands not presently under irrigation. There is an adequate water supply in the two river systems for irrigation of

Project lands with sufficient base flow remaining in the rivers to insure that the tidal salt water wedge does not reach pumping plants. If future development of these water resources is contemplated beyond the scope of this Project, however, the danger of salt water intrusion will need to be carefully analyzed.

The quality of water in both the Berbice and Canje Rivers is excellent for irrigation. Even during low rainfall and low flow periods the dissolved solids content rarely exceeds 200 parts per million. The only water quality problem relates to the salt water intrusion upstream from the Canje River mouth. In the past, it has occasionally been necessary to temporarily cease pumping at the downstream sugar estates when the salt content reached 2,000 ppm. The transfer of additional water from the Berbice River will eliminate this problem.

The secondary canal system which delivers water to farms from main canals consists of parallel watercourses from 800 to 1,600 feet apart. Drains run parallel to and midway between watercourses. This permits a water supply at one end of each irrigation unit and a drainage channel at the other end. Drainage channels are equally as important as the irrigation channels since water must be drained to permit good root development and for harvest and land preparation. Also during periods of high rainfall, excess water must be continually drained from the paddy. Since land elevations are less than ten feet above sea level adequate drains and maintenance of them is essential for project success.

Irrigation water is scheduled through the canal system by blocks. The Operations and Maintenance Section of the Hydraulic Division prepares and publishes irrigation schedules. During the irrigation season, this schedule is prepared slightly in advance of field operations and is based on current needs and preceeding period rainfall. Irrigation water is normally provided on a 10-14 day schedule; however, with present facilities and water quantity, only a limited amount of supplemental irrigation water is provided to the Frontlands area.

Watercourses in the Frontlands show considerable deterioration with sloughing of banks and considerable vegetative growth. Many have not been used recently. Because of this general deterioration and improper channel alignment, rehabilitation and revision will be required to improve these watercourses. The realignment will result in less land being used for watercourses and collector drains. Water supply and drainage channels in the Polder and Block III are in fair repair but show signs of poor maintenance.

Irrigation diversions to farms are not measured, consequently application efficiencies cannot be determined quantitatively. Field inspection and present practices, however, indicate that efficiencies are quite low since drains are practically always full of water. In

some cases water is allowed to run off while water is still being applied. Present seed bed preparation methods also require large quantities of water since an irrigation is applied to already plowed fields. This undoubtedly requires at least one acre foot per acre. Uneven fields, draining water off to establish good rooting, and poor timing of irrigation supplies all reduce irrigation efficiencies.

In summary, the major water management problems connected with the existing irrigation system are serious deterioration of facilities in the Frontlands and some deterioration in Block III, insufficient water supplies at periods of peak demands, lack of water control, unlevel farm fields and questionable farm management practices. The major problems associated with the existing drainage system are inadequate main drainage channels and maintenance of the collector drain system.

Better water control to secure an adequate and timely supply and better land preparation for controlled uniform depth of flooding are necessary for improved production. Water delivery control can be improved by timely planting of one variety of rice in each block.

Machinery Services

Land preparation (plowing, discing, and puddling) and harvesting in the Project area are done by machine. At the present time 60 percent of this is done by privately owned equipment operating on the owner's land or leased on a custom basis (Harza Feasibility Report, 1977). The incidence of machinery ownership is high in the area with more than 300 farmers owning tractors and plows in the Polder. However, only a few own combines.

The GRB attempts to provide the balance of equipment needed for the Polder and Frontlands from its main machinery pool and maintenance station at Joanna in the Polder. The machinery pool's inventory of equipment includes: 37 self-propelled half-track combines with 14-food cutter heads; 34 tractors ranging in horsepower from 46 to 75; 28 three-disc plows; 1 moldboard plow; 18 harrows; and miscellaneous shop and field equipment.

Availability of equipment on a timely basis is a problem because: a) there is insufficient equipment available; for example there is no proper equipment for land planing either privately or government owned; and b) more than one-half of the equipment in the GRB pool is inoperable.

Repair and maintenance, spare parts supplies, training, logistics, scheduling, and general shop and machinery management are all areas which presently encounter serious deficiencies in the GRB machinery pool. According to the Ministry of Overseas Development Report on the

Use and Maintenance of Government-owned Mechanical Equipment dated March 1978, there are a variety of reasons for poor equipment management including:

1. Equipment inventories are inadequate.
2. The rate of destruction of equipment is faster than the rate of rehabilitation.
3. Operator carelessness and lack of training are contributory factors to the high rate of breakdown.
4. There is a serious shortage of workshop tools and equipment.
5. There is an insufficient number of qualified mechanics.
6. Little attempt is made to give any form of training.
7. Workshop space is being occupied by crashed or broken vehicles on which no work is undertaken.
8. There is a lack of workshop manuals specifying maintenance and repair requirements.
9. Routine servicing of vehicles and machines is inadequate.
10. Workshop records on individual pieces of equipment are inadequate or non-existent.
11. Spare parts stocks are in general inadequate.

It is true that their observations apply to Government-operated machinery pools in general but those listed above appear to apply to the GRB pool in Joanna in particular.

Undoubtedly, the most serious constraint to higher yields in the Project will be the limited availability of machinery to perform timely field operations. The small size of land units in the Project area will continue to preclude individual ownership of tractors and combines. The farmer will continue to be affected by the equipment operator or the availability of equipment from the government machinery pool. If this constraint is overcome sufficiently to allow timely high quality land preparation and harvest, the yields in the Project area would be significantly increased.

It is essential that the GRB machinery pool be improved to provide equipment on a timely basis. Items needing investigation and/or implementation include:

1. Better equipment for land leveling.
2. Adequate supply of spare parts, especially those needed on a regular basis.
3. Improved overall administration of the entire operation for better control and scheduling of equipment, procurement, repairs, and routine servicing.
4. More shop tools so repairs can be made.

5. A system of accounting for the entire operation (maintenance, equipment operation, servicing, repair work, etc.), so programs can be improved and equipment ready on a timely basis.
6. Better organization of farmers into block planting so that logistics of machinery throughout the Project area can be facilitated.
7. Training programs for machine operators, mechanics, and foremen.
8. Full-time employment for combine opera experienced men are always available.
9. Incentive systems and assignment of re so employees are rewarded for equipmen

AID FINANCED PROJECT COMPONENT

Farm Development

Proper land and seed bed preparation is very important in rice production. Sub-standard work results in wasted irrigation water, poor crop stands, excessive weeks, poor germination, and in general non-uniform production over the rice field. The seed bed preparation method is important but equally so is the timing when two crops per year are to be grown. There is only a two month period to harvest one crop and prepare the land for the second crop.

The land development, water management, and machinery service components of the project are all closely related. Seed beds are prepared and the crop is harvested by machine and the technique used for field layout and seed bed preparation greatly effects water use efficiency.

The Project proposed to make appropriate machines available on a timely basis, to demonstrate and implement improved seed bed preparation methods, to document present water management practices, and to test and implement improved production practices to improve water use. This will require new equipment, repair of old equipment, technical assistance, training, and development of a coordinated program of testing and scheduling improved practices into the present farm production system. The technical assistance component is in the area of machinery management and maintenance and in farm water management. The GOG agency with responsibility in these areas is the Guyana Rice Board.

Land smoothing will be accomplished by land planes. Land planes do not move large quantities of soil but do remove high spots by depositing them into low areas. The top soil is too thin in the

Project area to use heavy equipment soil scrapers. Since surface irregularities are small, the land planes are recommended buy planing should be done with each seed bed preparation. Nine land planes and nine appropriate tractors will be purchased under the Project for this purpose.

Other land preparation equipment being purchased under the Project include: 3-85 hp tractors and 20-65 hp farm tractors, all equipped with disc planes; 4-12 ft. disc harrows, 4 ditchers, and 10 border discs. This equipment will all be available to farmers on a rental basis to prepare seed beds and lay fields out for efficient irrigation.

The machinery specialist (agricultural engineer) working with GRB applied research personnel will develop a demonstration program of proper seed bed preparation. The technique of plow with disc harrows or disc plows immediately after harvest when soil moisture is optimum, harrowing and land planning immediately thereafter will be tested as a possible method of preparing seed beds rapidly without requiring a heavy irrigation prior to final plowing. A border disc will be used to lay out irrigation units within a farm and a ditcher will provide a drainageway through the center of each field. This dry cultivation system would be developed so the farm could be prepared for planting in one operation thus permitting more efficient use of machinery. This method may create problems with weed control and rice planting, however, if done on a timely basis these problems would be minimal.

The improved land preparation program would start with the arrival of the equipment approximately 18 months after Project initiation. It is anticipated that, with proper scheduling of reliable machines, lands can be prepared for planting rapidly enough to promote block planting. Such a program would facilitate equipment scheduling but more importantly would make it possible to greatly improve water management practices and thereby conserve water.

Data would be collected on yield increases resulting from good seed bed preparation and land planning so that these practices can be built into the extension programs.

Water Management

A water management program would be initiated with the arrival of the Water Management Specialist 18 months after the Project initiation. He would, with help from the Agricultural Engineering Specialist, assist the GRB personnel in the applied research and extension programs to develop appropriate practices which would improve scheduling and efficient use of water.

The initial phase of the program would involve an inventory of present irrigation system management to evaluate the existing water management situation. This will be done through the development of

data collection program including worksheets and collection schedules. Information collected will include dates, methods, and duration of all cultural practices including irrigation, size of farms and fields, crop yields, and other relevant information. Sample precise measurements will be made to insure reliability of data. Information will also be collected on the overall scheduling of water through the canal drainage systems.

The data will be analyzed to determine where and how water is presently being misused, the extent of the farmers knowledge in water management and his attitude toward change. Finally, from this analysis, improved practices can be developed land tested on a pilot basis implemented. Programs such as block planting, community water channel maintenance, improved scheduling of irrigation to meet plant needs, more efficient field layout, and less drainage from fields should emerge resulting in improved cultivation practices. Without a data collection process to evaluate the present situation it is unlikely that such technologies could be satisfactorily implemented. It is therefore essential that the extension division be involved in the process by assisting with data collection and analysis.

The water management program will also include training machinery operators in improved methods of seed bed preparation, land leveling, and field layout techniques to advance water/management technology. Initially this activity will be done on the GRB seed farm and extended to farms as techniques are perfected.

Project provided equipment for the water management program includes one 4-wheel drive vehicle for the technical specialist, surveying equipment, and weirs or other devices for measuring water. The scope of work for the water management specialist appears in Annex

Machinery Services

The Project proposes to improve the GRB machinery pool so that it can handle the machinery requirements not now provided by privately owned equipment. The equipment pool's primary responsibility will be to provide services for land planning, seed bed preparation and harvesting. In addition to the equipment listed in the Land Development section above, five rice combines, two trucks, three 4-wheel drive vehicles, three pick-ups, and two mobile service units will be purchased under the Project.

Initially the Project will address the problem of inoperable tractors and combines by overhauling. It will be necessary to purchase spare parts for existing machines in order to accomplish the overhaul. This can be accomplished within AID procurement regulations since most spare parts for existing equipment are manufactured in the U.S. An adequate supply of spare parts will be purchased for this purpose as well as for all new equipment.

The presently inadequate and critical factor which will be address by the Project is the establishment of a system of machinery and spare parts inventory, machinery monitoring, timely service and repair, and maintenance. This will involve the establishment of an accounting procedure for machines and spares so that maintenance and servicing can be monitored on a weekly basis. It will also involve initiation of a routine maintenance scheduling and records keeping program for each piece of equipment; development of two field service units so minor repairs can be done in the field; establishment of a maintenance and repair program for combines in the off-season so that all machines are in good running order at the beginning of each harvest; development of a machine work schedule system to program machines onto farms in a way which minimizes travel time from farm to farm; and finally an overall management system which establishes work teams and assigns responsibilities for machine servicing, machine repairs, machine operation and scheduling of machine operation.

The project will finance 36 months of technical assistance by an agricultural engineer with farm machinery background who will serve as a technical advisor to the GRB machinery pool. Arrival of the agricultural engineer is scheduled approximately nine months after Project initiation. He will assist the GRB in the preparation of specifications for new equipment, tools, and spare parts. He will assist with planning, developing, implementing, and provide training for establishment of the shop and machine operation programs described above. He will also assist and cooperate with the applied research team in developing improved land development procedures and techniques. See Annex for Scope of Work.

Design of the equipment pool system and arrival of the necessary equipment is scheduled approximately nine months subsequent to the arrival of the agricultural engineer. At that time a machinery specialist (see Scope of Work Annex) will arrive for a one-year period to develop and conduct, together with the GRB, a training program for shop foremen, machine operators, mechanics, machinists, and tractor drivers. The training program will consist of several parts since not all teams need specifically the same training. Basically there are three groups; combine operators, tractor drivers, and mechanic/machinists. Routine maintenance and servicing of equipment training will be given to all shop and field personnel. The training will be done at sight and foremen will get on-the-job instruction as they implement the machine management system. During the course of each training session a method of record keeping will be presented and explained so that after training the machine records system will be in place. With some 35 combine operators, 50 tractor drivers, and 20 mechanics and machinists needing training it is anticipated that several training sessions will need to be held for each group.

The GRB presently has a Preventative Maintenance Officer whose responsibility is to provide machine maintenance training . . . all GRB owned equipment in Guyana. He works out of Georgetown and spends extended periods at the several locations of GRB machinery pools throughout the country. Although he has extensive experience and is highly qualified, additional staff is required to meet the job demands of providing the necessary follow-up advice and monitoring. It is contemplated that his expertise will be utilized in the Project area to assist with necessary training and development of the machinery servicing and maintenance programs.

The GRB machinery pool at Joanna in the Black Bush Polder presently has neither sufficient staff nor appropriate machines and hand tools to service and repair the equipment currently on hand. Adequate tools and minor shop renovation (concrete floor and siding and roof for storage area) will be provided under the Project.

With the purchase of the new equipment the pools' farm equipment enventory will include: 42 rice combines; 66 tractors; 51 disc plows; 18 harrows; 9 land planes; 10 border discs; 4 disc harrows; and 4 ditchers. Since approximately 40 percent of the gross project area will need to be serviced by the GRB machinery pool, it is essential that most of the equipment is kept in operating condition. The pool will serve approximately 30,000 acres twice annually with land preparation and rice harvesting. To accomplish this in the 30-50 day period between harvests will require 50 tractors plowing at an approximate rate of 20 acres daily, and 30 combines harvesting at the same acreage rate. Land planes would service more gross area since there are none privately owned. However, they would not be used on the vegetable crop lands. The nine land planes should readily service 3,500 acres in a 45 day period. The equipment purchased under the Project is primarily for the extension of the machinery pool service to the Frontlands area. The GRB is committed to giving preference to that area.

The systematic operation of the Joanna machinery pool will be a practice that can be replicated in all GRB machinery pools in the country This aspect of the Project therefore will be of great value to the rice production system of Guyana, since one of the major constraints to increase rice production has been the lack of an effective machinery service capability within the GRB.