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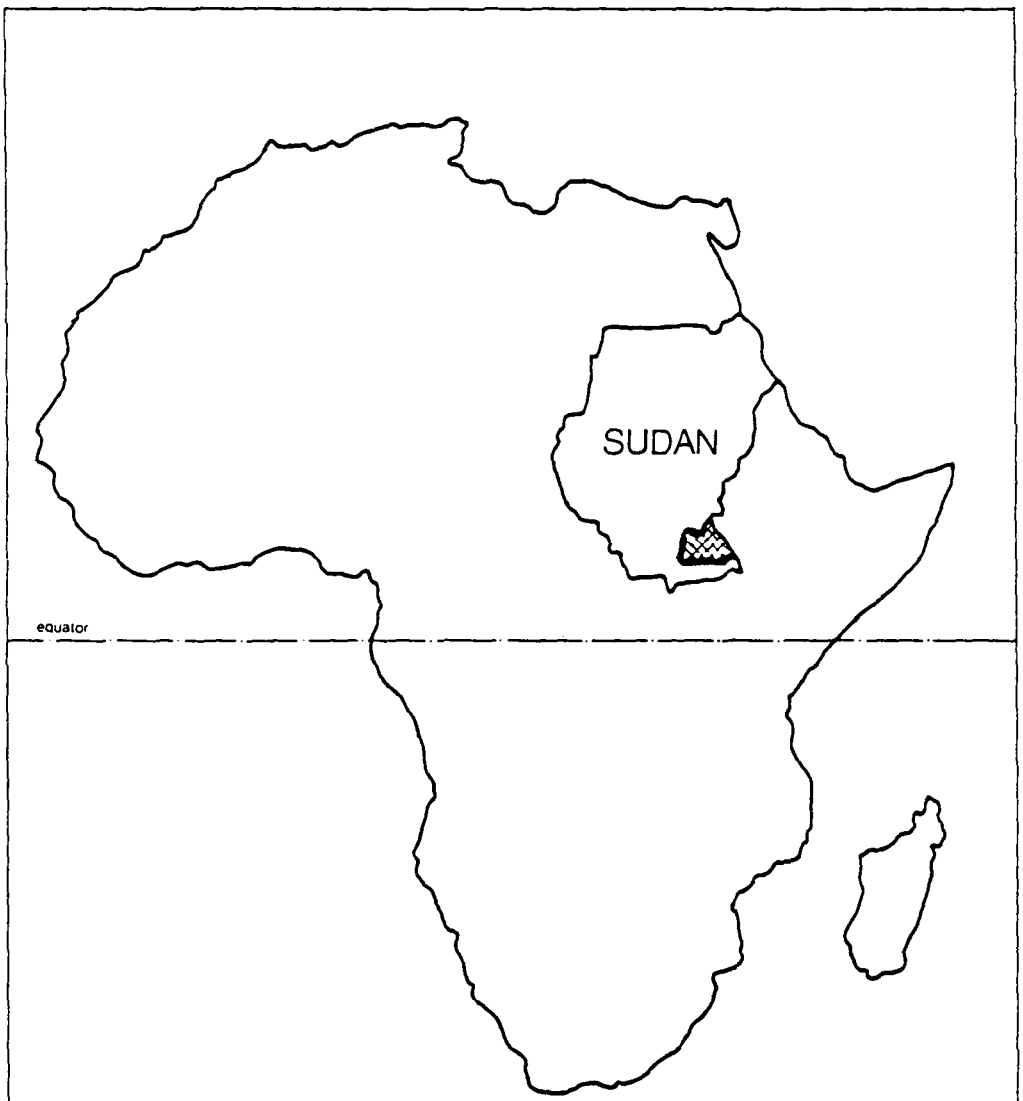
The Bor Rural Water Hand Pump Programme

R824 SDB086

An approach to solving the problems of Third World rural water supplies



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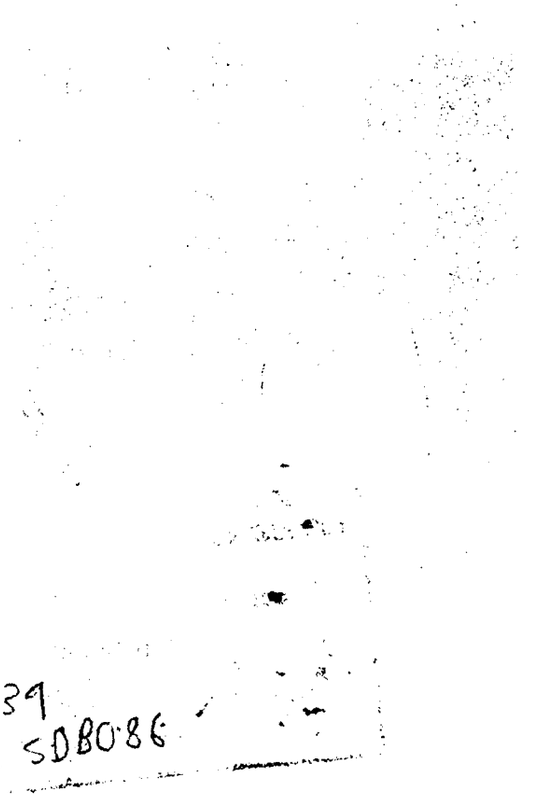

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The Bor Rural Water Hand Pump Programme

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FIGURES.

PHOTOGRAPHS.

1. INTRODUCTION.

1.1 The World Setting.

It is an established fact that millions of people die every year, mainly in the Third World, from diseases and ailments that are a direct consequence of inadequate water or sanitation. Moreover, the figures for people whose health is adversely affected runs into the hundreds of millions.

With the present stage of Third World Development there is an emerging technical expertise capable of designing water supply systems to appropriate levels of technology. However, the resultant requirement in terms of human resources for the management and running of the few completed projects has hardly begun to be met.

This situation is illustrated by the fact, that only a very low percentage of commissioned rural water supply schemes in developing countries work to anywhere near their capacity.

It is reasonable to assume that developing countries do not have sufficient resources to make large capital investments in facilities that provide such little return. It is equally reasonable to assume that the same developing countries have limited resources available to treat and care for patients suffering from the water related diseases that are a result of the present unsatisfactory situation.

1.2 The Project.

This note describes how one project in Southern Sudan attempted to meet these challenges to improve the standard of living of the population through the implementation of a water supply project, by placing emphasis within the target communities on related aspects such as its institutional requirements, training of local personnel, health education, sanitation and development of local resources.

The project area included most of the Bor and Pibor areas of Southern Sudan. Unfortunately this area was undergoing a period of increasing insecurity and disturbance due to the activities of guerrilla movements while the project was in progress.

Although the project and its personnel were not affected, it became increasingly clear that further development activities could not take place until more settled conditions prevailed, and the project was eventually prematurely suspended, pending more settled conditions.

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Despite this unsettled background, the programme was considered successful and it is felt that the methods and approaches adopted could be applied beneficially to similar projects in other developing countries.

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2. SUMMARY.

The project included an initial feasibility study, hydrogeological investigations, well design, drilling of 75 boreholes, and hand pump selection and installation.

From a purely technical view point there was nothing particularly challenging about these aspects of the project as they were all relatively straight forward. The main interest however was due to the remoteness and inaccessability of the 40,000 sq. km project area, which every year suffers a cycle of drought followed by flooding. Apart from the resultant logistics constraints, these adverse factors led to the early conclusion that normal methods adopted to cover maintenance and repair were inappropriate for this region. After discussions with the authorities, and village leaders, a new village repair and maintenance system was developed and a pump maintenance school established.

The encouraging results of this approach appear to offer better prospects of providing improved water supplies to the developing world, and provides additional benefits such as the provision of basic health education via the maintenance school, and the introduction of new skills to the population.

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3. DESCRIPTION OF AREA AND BACKGROUND TO PROJECT.

3.1 Location.

The project area of 40,000 sq. km (approx the size of Switzerland) includes most of the Bor and Pibor Districts of Southern Sudan. It is very thinly populated and covers an immense open grass plain.

3.2 Physical Features and Climate.

Physically the area is unusual in that it is extremely flat with small crossfalls and poorly drained soils. Thus when rainfall occurs, the water collects in extensive sheets of shallow water, which has little or no direction of flow, with the result that there is no significant runoff or percolation and the water remains until it dries out through evaporation. This phenomenon, known as sheet flooding results in the area being largely inaccessable for anything up to six months after the onset of the rains in May of each year. For the remainder of the year the weather is hot and dry, and water supplies are largely limited to hafirs, which are large pits dug and maintained by the local villagers to collect surface water. As the dry season progresses, however, these hafirs, which are used by livestock and for domestic water consumption alike, become increasingly polluted and dry out. This forces most of the population to migrate with their livestock to the only remaining permanent water and grazing which is in the Sud marshes formed by the Nile to the west and to the Akobo River to the east.

3.3 Administration.

Administratively the region is split up along tribal lines into three areas, as indicated in the table below, which also gives the best estimates of population available at the commencement of the project.

TABLE I - POPULATION

Administrative Area	Tribe	Population
Bor Rural Area (excluding Jonglei Canal Study Area)	Dinka	45,000
Pibor	Murle	60,000
Pochala	Anvak	18,000

The physical conditions, culture and traditions in each of these areas differ in some respects from one another. However, for the purposes of this article we will concentrate on the Bor area only. Adjustments to the programme were found to be necessary for the other areas to allow for cultural differences, but these adjustments were of a minor nature, and the basic principles evolved remained the same.

3.4 Culture.

The Dinka people are basically pastoralists, forced by nature to migrate annually with their livestock, and their culture is deeply influenced by their way of life. They cannot however, be described as truly nomadic, since permanent settlements are maintained, which fall within an established local government system.

The settled areas tend to be located on the edges of the grass plains, where the vegetation changes towards shrubs and trees, and where the distances to permanent water is not normally greater than about 40km. Cultivation takes place within these settled areas, mainly of Dura, a form of Sorghum, which forms the staple diet of the population. The preparation of the fields for the next years crop is done mainly during the dry season by the old, the infirm or very young, who are left behind when the herds of livestock are taken to the dry season grazing areas. It is during these periods that the worst hardships occur through the lack of water, and the pollution of the dwindling resources results in the major health problems in the area; - guinea worm and gastroenteritis.

3.5 Development.

The area had remained largely untouched by development processes, so that the population, although rich in terms of culture and traditional skills, were poor in terms of commodities, and services such as health, education, communications, and water and sanitation. Thus the basic skills and learning that are normally acquired by a population during such development were practicially non-existant.

The region had previously been identified as an area requiring a development impetus, and a bilateral aid programme with the Netherlands Government, had been established with its headquarters based close to Bor Town. The availability of the workshop, offices and facilities at these headquarters, managed by Ilaco, made a rural water supply project in the area feasible.

The development projects in the area were coordinated by the Bor Area Development Activities (BADA) unit which was responsible for the original conception of a Rural Water Supply Project for the area, and who provided tireless assistance and guidance throughout the duration of the project.

4. PROJECT OBJECTIVES.

4.1 General.

After considering the existing conditions within the project area, it was concluded that the lack of adequate safe domestic water supplies formed a major constraint to the development of the Area, and that a Rural Water Supply Programme should be offered a high if not the highest priority.

The main objectives of such a programme considered in context with the wider objectives of development to improve the standard of living within the area, were as follows:-

4.2 Improvement of Health.

The two most important health problems in the area were found to be guinea worm infestation and gastroenteritis. The provision of safe water on its own would go a long way to reducing the extent to which people suffer from these ailments. However, since these conditions can be largely avoided by following normal hygenic practices, it was decided that the potential rewards of the programme would be many times greater if it was to include an element of health education.

4.3 Reduction in Hardship.

As the availability of water dwindles with the progression of the dry season, people begin to walk long distances to obtain water from the few wells and boreholes that have been constructed in the area, and which are working. The walking distances vary but may be as great as 20km. The hardship involved in this quest for water is considerable, especially when one considers that this is the hottest period during the year with day time temperatures climbing well above the average of 35^{o}C. In addition, the water obtained with so much effort, is understandably used sparingly, for essentials only, which places restrictions on activities such as washing and cooking, and adds considerably to the hardship of the living conditions within the area.

4.4 Increase in standard of living.

By reducing the above hardships one automatically improves the quality of life within the area, but there is also a very definite potential for increasing the economy of the area. The extent of the annual food crop is proportional to the availability of manpower for land preparation during the dry season. Hence by providing water during this period, one should attract more people to remain at the settlements and cultivate an increased area of land. In fact, a limited post-evaluation study indicated that not only was this the case, but in certain

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instances, by planting earlier than usual, some people managed to grow a second crop in the year.

4.5 Development Impetus.

The area has remained a backwater in terms of development, with the peoples' way of life remaining virtually unaltered for hundred of years. If this situation is to change then there has to be a strong impetus for development conceived within the area, and it was felt that a water supply project could become the required medium, especially if the local communities could become closely involved in the programme.

5. MAJOR CONSTRAINTS TO PROGRAMME.

5.1 Project viability.

There were many problems and constraints that were likely to effect the success of a Rural Water Supply Programme in this area, which made the viability of such a project highly questionable both in terms of its implementation, and in terms of its subsequent operation. Therefore before going on to describe how these problems were overcome, it is necessary to identify what the major constraints were:-

5.2 Physical Size of Project Area.

The physical size of the project area made the logistics of working extremely difficult. Simply to drive from the west to the east of the area along the only existing track, required two full days, and with no existing facilities available, all supplies and equipment necessary for living and working had to be carried along with the vehicles.

Whilst it would be wrong to underate the problems during implementation of the project, the main consequences of this aspect was to the difficulties that such conditions would make for the subsequent operation and maintenance of the project.

5.3 Accessability.

In addition to the sheer size of the area, nature has contrived to make matters worse by making the area largely inaccessable through much of the year due to flooding, as described in chapter 3.2. The only road that remains open for most of the year is the newly constructed Juba to Kongor road which runs along the western boundary of the area, and even this should not be used during wet weather. One track connects Pachala and Pibor to Bor Town, but this becomes impossible as soon as the rains commence, and for the rest of the region, outside of the area close to Bor Town, access is via cattle tracks.

5.4 Personnel.

The lack of development in the area meant that there were no local resources of people trained to do even the simplest of mechanical tasks. This meant that one either had to acquire the necessary personnel either by importing people from outside the immediate area or by training local villagers.

5.5 Management and Maintenance.

The maintenance of the few existing borehole facilities in the area were the responsibility of the Rural Water Departments District Office located at Bor. This office however had only one four wheel drive vehicle, (which remained out of order for almost the entire duration of this project), and had no stocks of fuel or spare parts, with the result that the repair and maintenance of existing installations became rapidly reliant on any assistance that this project could provide.

If the same organization structure were to be utilized for the maintenanace of the pumps installed under this programme, it was estimated that some 600kms of access roads would need to be built in order for mobile maintenance teams to reach within 10kms of each installation. These roads themselves would require maintenance involving graders and other road making equipment, and a maintenance centre would be required in each of the three administrative areas. It became evident therefore, that the cost of establishing and maintaining such an organization was going to be many times greater than for the costs of the project itself and that the trained staff required to run such an organization were just not available.

Other hand pump projects in similar areas which were reviewed, appeared also to experience severe problems in maintaining their pumps in working order with the result that the failure rate of the pumps was universally unacceptable.

The maintenance problems for this project, due to the large distances involved and the poor accessibility, were potentially far worse than for these other projects where this subject had already become a major problem.

It was therefore concluded that the provision of proper maintenance for the hand pumps was the single most important aspect for the viability of the project, and that the existing type of organization relying on mobile maintenance crews was totally inappropriate to the area, and alternative solutions had to be found.

5.6 Overgrazing.

A major problem in the arid and semi arid regions of Africa, is that of over-grazing in the vicinity of water points, due to the attraction of more livestock into the area than the natural vegetation can stand. This has often resulted in the denudation of the land leading to desertification.

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The consequences of such overgrazing can be so disastrous that it would be better not to commence a programme at all, if there was any danger of this process being initiated by the installation of water points.

This subject was therefore investigated in some detail, and it was concluded that the combination of rainfall, grass type, and the small output from the hand pumps offered no dangers to overgrazing, or to the normal nomadic way of life of the people.

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6. PROJECT PREPARATION.

6.1 Basic Strategy.

From these basic objectives and constraints, a strategy was evolved to give the responsibility for the maintenance of the hand pumps to the users themselves.

For this to be achieved it was realised that the communities should become involved with the project from the planning stage onwards so that they would identify themselves with, and commit themselves to the project, as briefly described below.

6.1.1. Community involvement.

Each community would be consulted and involved in the planning stage, to obtain their views, and committments to the project.

6.1.2. Ownership.

A payment towards the cost of the project was designed to establish the communities ownership of the completed well.

6.1.3. Training.

A pump maintenance school would be established to train people selected from each location.

6.1.4. Motivation.

Different methods of motivating the communities would be explored.

6.2 Organization for Management.

Throughout the project preparation period exhaustive discussions were held with all the interested parties, including the Department of Rural Water, local government authorities, area chiefs and village headmen, to ascertain their views on the project and on a workable solution to the problem of maintenance of the pumps.

The final organizational structure agreed, by which the responsibility for the operation and maintenance of the pumps would be given to the users themselves through the existing local-government infrastructure can be illustrated as follows:-

TABLE II : ORGANIZATION STRUCTURE.

Organization	Responsible Person	Responsibility
Rural Water Department-Bor	Commissioner-RWD-Bor	Advice and assistance on
Area Council	Paramount Chief	Purchase of spare parts
		Source of Funds
Court Centre	Elected Foreman	Repair
Village	Trained Operators	Maintenance
		Revenue Collection
		Operation

Three people would be selected from each location by the village headman to be trained at the pump maintenance school. Each Court Centre which had approximately 8 pump locations would thus send 24 people for training. Out of these 24 people, one person was elected by the trainees at the end of their training to become the Court Centre foreman, whose responsibility it was to keep stocks of spare parts and tools required for repair.

The Area Council themselves decided that the foreman should receive a salary, and that to cover the costs for this, and for the cost of spare parts, levies should be made within each location, and a Bank account was opened for this purpose. Requisitions for spare parts would be made out by the foremen, and handed to the Area Council who, if necessary would consult with the Rural Water Department at Bor to place the necessary orders.

This organization structure was met with enthusiam by all the interested parties, except for the Rural Water Department, who initially resisted these proposals, since they felt that the management of the project should remain under their jurisdiction, and by taking this responsibility away meant that their very existance was being questioned. Their ultimate approval and agreement to these proposals was therefore regarded as being particularly significant.

6.3 Community Involvment.

To ensure their active participation and support for the project, extensive discussions were held with the Chiefs and village headmen to explain the responsibilities and commitments that they would be taking upon themselves, and to ensure that they were willing to do so. It was felt that an essential element in this process of motivating the people to want to repair and maintain the pumps themselves, was ownership of the installation. For this reason, a payment was requested from each location towards the cost of the installation, so that each community would not only consider that they owned the final installation but also that they felt they had already made a significant commitment towards it, and that they would therefore be much more likely to

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to be committed to its maintenance.

Before a location was included into the final drilling programme, an agreement, from the target community was obtained on each of the following aspects:-

1. Payment of £S 300. The level of payment was considered sufficiently high to ensure village committment, but not too high to deter needy locations.
2. The community should supply the necessary labour free of charge to assist the drilling crew in digging mud pits.
3. Three people from the community were selected to attend the pump maintenance school.
4. The community would be able, and willing to meet all ongoing operation and maintenance costs.
5. A suitable location was agreed for the hand pump with the community elders.

6.4 Implementation Programme.

The implementation programme depended heavily upon outside influences, mainly on the extent and duration of the rainy season. For this reason the programme had to remain flexible. A programme was therefore drawn up after consultation with the local communities, the Area Council, and the Department of Rural Water Development, to cover a three year period. The provisional nature of the programme was stressed however, in case expectations could not be achieved and community disillusionment result.

Immediately prior to drilling in any particular area, a more detailed programme was drawn up, and the local communities contacted to warn them when they would be required to provide assistance to the drilling crew.

6.5 Organization For Implementation.

The availability of a trained drilling crew from the Department of Rural Water Development, together with the lack of sufficient suitable contractors, meant that the decision to implement the project by direct labour, rather than by Contractors, was an automatic one. Additional advantages of this arrangement were that a greater control could be maintained over the programme, adjustments could be made to suit developments and greater attention could be given, and allowances made for other factors such as training, and sociological requirements.

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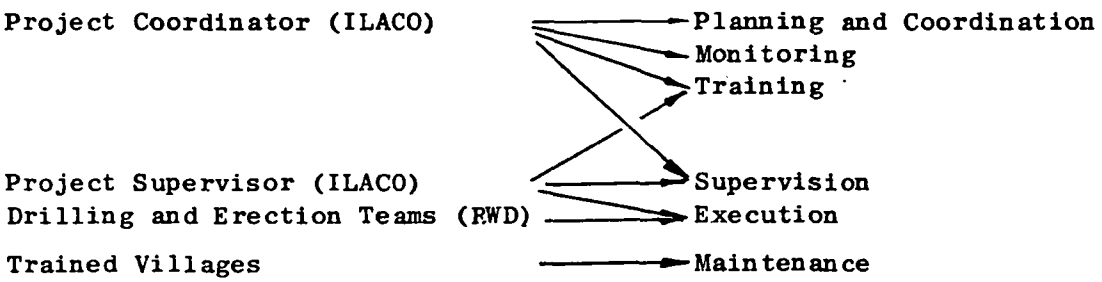
From experience with other similar projects in the area, it was found that perhaps the major restraint on the installation performance was the lack of authority that the drilling and erection crews had with local officials. They therefore found it very difficult to resist requests made by such officials to deviate from their established programme and this too often resulted in alterations and changes, their never being able to satisfy everyones wishes, and with consequent loss of morale of the drilling crew.

It was therefore decided, that although a maximum use would be made of local personnel, to avoid unfair pressure being put to bear on them, the responsibilty for the execution of the programme must be retained by the project, in the form of a project supervisor who would also be responsible for the technical soundness of the work.

The resultant organization structure can be summeriased as follows:-

TABLE III : IMPLEMENTATION RESPONSIBILITIES



The resultant project staffing was composed of 22 full time Sudanese, one full time supervisor, and two part time technical assistance personnel as follows:-

PROJECT COORDINATOR	-	ILACO	-	PART TIME
MECHANICAL ENGINEER	-	ILACO	-	FULL TIME
DRILLING CREW	-	RWD		10
ERECTION SUPERVISOR		RWD		1
ERECTION CREW		RWD		7
DRIVERS		RWD		4
PROJECT SUPERVISOR	-	ILACO	-	FULL TIME

6.6. Development of Pump Maintenance Training School.

The establishment of a training school was not included in the original terms of reference for the project. However, as plans evolved for the project the need for such a school became more and more evident. It was therefore decided to go ahead despite the fact that there appeared to be little information on what performance one should expect from such a school.

As discussed earlier, the selected people from the communities attended the school, by Court centres, which resulted in approximately 24 people per session.

A borehole was drilled in the Bor Hospital compound, so that on completion of the school it would be handed over to the Hospital. A hand pump was erected on this borehole for use by the school.

Although it was originally thought that a four week course would be necessary, it was quickly found that three weeks was more than enough to train the participants to become very competant in all the necessary skills, and a three week programme was therefore settled upon.

Certain objectives were stressed during the course such as the importance of reliable good quality water on the communities health, health education, potential benefits from reduction of hardship and in the releasing of time previously spent collecting water for more productive use. The importance of each participant and their role in the development of their community was also stressed.

Short talks were arranged from the Chief Executive Officer, of the Southern Area Council, from medical staff attached to the Primary Health Care Programme and from the social anthropoligist attached to the Bor Area Development Activities.

As far as possible these talks were arranged during the first week of the course with the intention that the talks would help to motivate the participants. Otherwise, the first week concentrated on familiarisation with the various pump parts and tools, and in learning their names, and going onto erecting and dismantling the various components.

The second week concentrated on routine maintenance and repair, and diagnosing faults.

In the third week the group was divided into three teams to compete against each other to see how well they could perform different tasks set them, without any help.

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the three week session, a small ceremony was held when the Chief
cer kindly agreed to make a closing speech, and award all the
dents certificates, and give them a cap which they could wear
hey had successfully completed the course. The person selected
entre Forman was also given a bicycle and additional tools.

on of Equipment.

Drilling Rig and Vehicle.
.ce of drilling rig was basically between a rotary type rig, and
of a simpler percussion rig, generally regarded as being more
.ate for use by local personnel in developing countries.

r disadvantage of the use of a percussion rig is the extra time
for drilling, and it was estimated that unless two or more
on rigs were purchased, then the planned duration of the programme
ve to be considerably extended, with resultant cost increase.
s also recognised that the logistics problems of keeping even one
ational in this area were going to be very difficult, it was
that it would not be wise to increase these problems by operating
a one rig. Other factors which helped towards this decision
availability of trained Sudanese operators, for rotary rigs
Department of Rural Water Development and the existance of
rkshop facilities close to Bor, at which this project was to
headquarters.

ning vehicles were chosen in order to standardise spares and
ice with existing plant and equipment used in other development
n the area

1 - No. water tanker on DAF 4 x 4 Chasis
1 - No. tipper track on DAF 4 x 4 Chasis
2 - No. 4 x 4 toyota landcruiser pickups

Selection of Hand Pump.
ity of existing installations in the region used the India Mk II
, but experience had shown that they had a poor reliability
ith the result that the Department of Rural Water Development
that consideration should be given to using the Duba II pump

Before a decision was made however, tenders were invited from a number of hand pump manufacturers and an evalution of the quotations made.

The Duba II pump came out to be the most expensive, but on a system for awarding points on robustness, reliability and ease of maintenance, it was decided that the potential rewards in terms of increased reliability and reduced maintenance costs outweighed this extra cost, which, when compared to the overall cost of the programme made only a relatively small percentage increase.

An important factor influencing the choice of this pump was the ability to remove the pump cylinder from the bottom of the borehole, without removing the rising main. This facility considerably simplifies and reduces the amount of work required for many of the most frequent repair and maintenance operations.

6.7.3 Well Casings.

Tenders were invited for the supply of well casings. An evalution of the tenders indicated that the cost advantage of using UPVC Casings far outweighed the advantage of using higher quality casings, for which the conditions did not appear to warrant.

Some of the boreholes were located at Court Centres, which although not yet developed into significant centres of population, were likely to form the nucleus around which market and trading centres would grow. At these positions therefore, 150mm dia casings were planned so that the hand pumps installed in this programme could be upgraded to motorised pumps should the future conditions suggest that such a development was feasible. All other casings were 100mm dia, suitable for use with hand pumps. It may be of interest to note, that cost savings on the well casings compensated for the more expnsive hand pumps selected.

7. IMPLEMENTATION.

7.1 Overview.

Although the programme was intentionally kept flexible because of the unreliability of the seasons and poor accessability, the main causes for changes were due to other factors, mainly the deteriorating security situation in the area.

The first seasons drilling started late, due to delays in delivery of the drilling rig, however once drilling commenced the rate of progress exceeded expectations, and by the end of the season some thirty five boreholes had been completed, against thirty three planned.

At this time however in May 1983, some distrubances occured at Bor, which brought a stop to all activities for a while, and which was to result in the start of another period of civil strife in the Southern Sudan, which was eventually the cause of suspending this project prematurely a year later.

During the following year, every effort was made to continue with the programme, and very worthwhile achievements were made, especially with the pump maintenance school, but with the situation gradually deteriorating, and with movements being restricted to within the immediate Bor area, it was eventually decided in April 1984 that the situation had gone beyond the point where further useful progress could be achieved. The project was therefore suspended, with the intention of recommencing as soon as the situation allowed.

At the time of suspension, some 56 boreholes had been completed, which was on target with the original programme, as far as numbers were concerned, but most of those drilled in 1984 were on a revised programme, since it was not possible to enter into the areas intended.

7.2 Drilling.

The drilling of the boreholes took place entirely within Tertiary to Quaternary sedimentary deposits of the Um Ruwaba Formation. These consisted of unconsolidated sands, sometimes gravely clayey sands and clays, and which presented few problems for drilling.

The major problems were the logistics of supplying the crew with all necessary supplies to keep the rig working without delays, and the accessability of the borehole locations especially in the rainy season.

At least one week before drilling was due to commence at any location, the site would be visited again, together with the community headman, and the Chief executive officer from the Southern Area Council. The site of the

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borehole was then confirmed, and tools given to the community to dig the necessary mud pits.

The process of setting up the rig, drilling, installation of well casing, development and moving to the next location was originally estimated to take about one week, but when locations were fairly close, with relatively easy access it was found that this time could be shortened.

On completion, the casing was grouted in up to ground level, and securely capped to protect if from any potential contamination, that might occur prior to hand pump installation.

7.3 Hand Pump Installation.

As soon as possible after completion of the borehole the pump erection team arrived to start construction of the hand pump installation. To ensure good drainage away from the pump the ground was raised using compacted fill, before the concrete apron slab was poured.

After laying the apron, the installation team left the site for a minimum of seven days to let the concrete cure, before pump erection commenced. During this period, the plinth was covered with sand and the villagers instructed to keep the sand wet to ensure that the concrete was cured properly. An old oil drum filled with water was left for this purpose. Villagers were also requested to clean out the mud pits so that surplus drainage from the hand pumps would discharge in to the pit for use of livestock.

The actual installation of the hand pump would usually be done in one day. The most difficult exercise was installing the rising main, for which a tripod and pulley hoist was necessary. The installation of connecting rods, positioning and final bolting down of the handpump were relatively simple jobs to perform.

To aid future repair and maintenance of the pumps, a lifting pole was added to the installation by bolting a wooden pole to the back of the pump. This arrangement was found to be perfectly adequate, and is recommended for future projects.

7.4 Pump Maintenance School.

It was found that the most difficult aspect of running the pump maintenace school, was in actually getting all the participants to travel to Bor where the school was established. This was mainly due to the fact that this was during the wet season, when access and communications with the communities was very poor, but also due in part to the selected villagers tending at first

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to be rather reluctant to attend. Whilst at the school, two meals a day were provided free of charge to each participant, and arrangements made with the help of local officials, for accommodation at local schools.

Most of the detailed instruction to the students, was given by the local staff from the errection crew, who would otherwise have been underemployed since due to the wet weather during this period, access was not possible to the rural areas. Overall direction was provided by the project supervisor.

It was encouraging to note that many people, not directly involved with this programme, were willing to devote time and effort to assit with the school and to give valuable talks. The fact that this was appreciated, was shown by the enthusiasm that the participants attended the school.

It was equally encouraging to note how quickly the people assimilated the necessary skills and knowledge to repair and maintain the pumps, bearing in mind that most of them had never previously seen, let alone handled mechanical tools, and at the end of the fairly intensive three week course many of the participants were proving to be just as competant as their instructors.

8. EVALUATION AND DISCUSSION.

8.1 Choice of Equipment.

8.1.1 Drilling Rig and Vehicle.

Apart from some minor faults and shortcomings the Rig and support vehicles proved to be reliable and efficient for the duties required. The plant provided was close to the minimum requirements, with the result that it was frequently felt that an additional vehicle and some extra supporting equipment would have greatly helped towards more efficient implementation.

8.1.2 Hand Pump Selection.

Before discussing hand pump selection, it is probably worthwhile mentioning here that despite manufacturers claims, there is no such thing as a maintenance free hand pump, and neither is there likely to be one. The success of the pump maintenance school initiated by this project, has lead to a re-evaluation of the basic criteria for hand pump selection, and to the philiosoply involved.

It is considered that the initial choice of a robust, reliable pump, though expensive, was the correct one on the information available, However the success of the maintenance school has meant that an alternative philosophy of providing a cheaper, less reliable pump, requiring more regular maintenance and repair, could be valid, since it is argued that a regular maintenance programme will keep the people in practise and help to avoid the loss of skills such as learnt at the maintenance school. There is much to be said for this philosoply and the results of this project have given additional credance to such a policy, but it is best applied when local manufactured spare parts are readily available in the market place. As the possibility of such local manufacturing potential however, cannot be foreseen in the immediate future, it was concluded that this philosophy should not be applied to this region at its present stage of development. There is a strong arguement for the development of a local industry capable of manufacturing hand pumps, but for the time being the approach recommended is as adopted in the programme, of presenting the local responsible authorities with the various alternatives, for them to choose, so that they are responsible for the selection and have the opportunity to standardise on equipment and spare parts.

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The actual hand pump selected, the Duba II pump proved to be particularly reliable. Over the 38 cumulative pump operating years, the only two failures that we are aware of when repairs were necessary, were not due to the type of pump installed. In comparison, over the 25 operating years for the India Mk II pumps within the area, some 22 faults were reported, 7 of which were serious defects mainly on the plunger rod and linkage.

We had two minor criticsms of the Duba pump. Firstly the handles often came unscrewed from the flywheels, and required tack welding to ensure that this didn't happen. Secondly, the spout was designed for discharging into a bucket, and was not suitable for the narrow openings to the water containers used in this area. A smaller diameter nozzle was therefore fitted at the correct height to discharge into the water containers without wastage.

8.1.3 Well Casings.

The small diameter UPVC well casings used were found to be favourable for the conditions encountered. The choice resulted in substantial savings, and the casings were light and easy to handle. The only disadvantage being that on the very rare occassion when it was required to remove them, this was not possible without breakages.

8.2 Implementation and Staffing.

Without the active assistance from the BADA Unit, the Ilaco personnel, and their facilities located at Bor, the implementation of the project would have certainly been more difficult and additional staff would have been required.

A full time assistant would have been required to assist the Project Superviser to help deal with local authorities and with the discussions with the local communities, full time mechanical engineer would also have been needed to keep all the plant and vehicles serviced, fueled and repaired.

As it was, the drilling crew and the pump erection crew were frequently working in entirely different areas, and as the project supervisor was also required to be visiting communities ahead of the drilling crew, and to hold regular liason talks with the local authorities, it meant that the local staff were left to proceed frequently on their own and without constant supervision, The fact that they worked diligently was largely to their own credit, and not entirely due to the incentive payments that were made.

With the possible exceptions mentioned above, the organization and staffing of the project proved to be optimum.

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8.3 Organizational Structure.

As mentioned in section 6.2 the Organization required for the satisfactory management of the operation and maintenance of the finalized project was given considerable attention. The fact that the project was prematurely suspended, and that the basic conditions of stability in the area required for effective management, ceased to exist, meant that this organization was never fully tested.

No definite conclusions can therefore be drawn as to the applicability of the organization evolved. However it can be said, that at the time the project was suspended, there existed within the area, a definite desire and willingness at all levels to see that the project should remain a success, and it was with a reasonable degree of confidence that such a success was expected.

8.4 Pump Maintenance School & Health Education.

The initial results of the pump maintenance school appear to be particularly rewarding. At the time the project was suspended, the cumulative operating time for the pumps installed in the areas covered by the school was 38 pump years, all pumps were working, and not a single request had been received for assistance. If one compares this situation with the continual requests during this same period received from the Rural Water Development's Office in Bor, for spare parts and fuel for their own installations, one does not have to look much further for justification for the methods and policies persued.

It was found that the three week training period was adequate for the trainees to learn to undertake all normal repair and maintenance tasks entirely on their own without assistance. The participants exhibited a suprising interest and enthusiasm, and there was not a single absentee throughout the whole duration of the school.

Before the commencement of the pump maintenance school, the views of the communities were sought to obtain their ideas on the benefits of the project, which, in order of importance are listed below:

1. Socio-economic improvements due to more people being able to stay in the day season to:-
   a. Enlarge cultivated areas.
   b. Reduce influx of people to Bor Town during dry season.
   c. Reduce hardship to old people who no longer migrate
2. Reduced walking distance
3. Retain small dairy herd of mainly small stock within settled areas during the dry season
4. Avoid sick cattle having to migrate to the dry season grazing grounds.

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Noticeable by its absence from the above list is any mention of benefits to health. This was due to the people's lack of any basic health education, and that they were generally unaware of the dangers to health of drinking polluted water.

This is illustrated, by the frequently expressed views that water quality was far more important with respect to their cattle, and that borehole water was not initially favoured since it lacked taste. An even more striking fact was that the people were completely unaware of how they contracted guinea worm, which was found to be particularly prevelant in some communities.

It was therefore interesting to note the reaction of the students on the health education talks, and that when interviewed at the end of the course nearly all students then regarded health as one of the main potential benefits of the project.

As part of the routine maintenance the students were taught to keep the concrete apron clean, to keep livestock away from the pump and to fill in any puddles that form around the concrete apron with sand. In addition, they were asked that, through their position as hand pump attendant, they should try to influence the hygenic standards around the pump, and to explain the importance of these standards to the users.

It appears from the initial reactions of the communities involved, that this aspect of health education was one of the significant achievements of the project.

8.5 Socio Economic Effects.

Although the planned post evaluation survey of the area was not conducted, nevertheless the general effects of the programme were observed with interest.

It was noticed that within the areas, which were drilled first, in marked contrast to previous years, many more families remained within the settled areas during the dry season, with the result that cultivated areas were enlarged and crops were planted immediately after the first early rains, thus obtaining a larger first crop, and making a second crop in the season possible.

Other benefits included the increased usage of domestic water during the dry season, and the considerably reduced walking distances.

There was a greater degree of re-settlement in the Dinka areas during this period, mainly due to pressures from cattle raids on the eastern-most settlements,

by the Murles, who were thought to be taking advantage of the general unsettled situation. It was interesting to note that re-settlement was taking place most noticeably in the areas close to hand pump installations.

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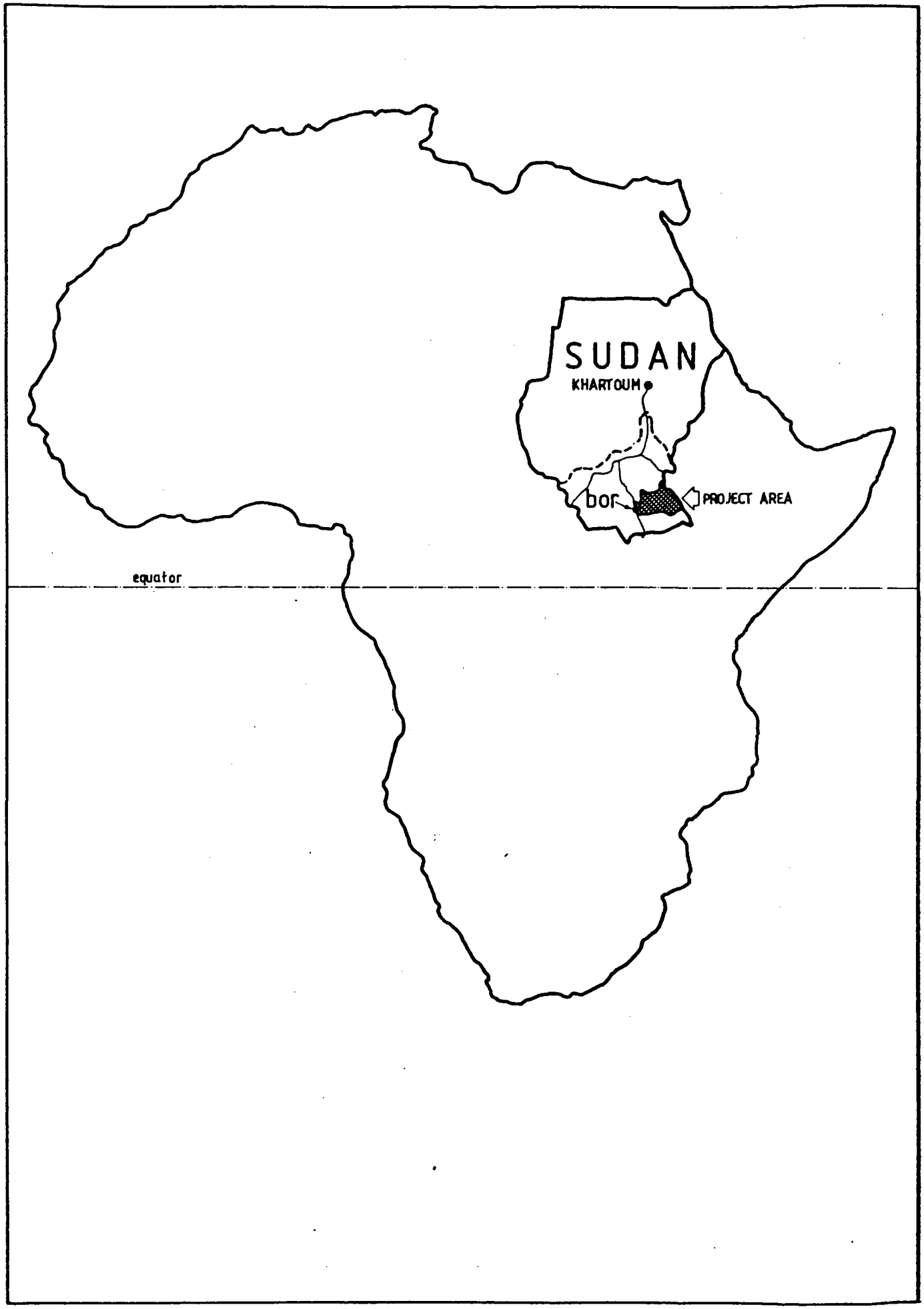
9. MAIN CONCLUSIONS AND RECOMMENDATIONS.

1. The organization structure and methods of using mobile maintenance crews to maintain the exisiting boreholes in the area, was found to be inappropriate for this sparcely populated rural area.

2. The transfer of ownership and the responsibility for maintenance and repair of the hand pumps to the local communities, offered the best prospects for maintaining the pumps in working condition.

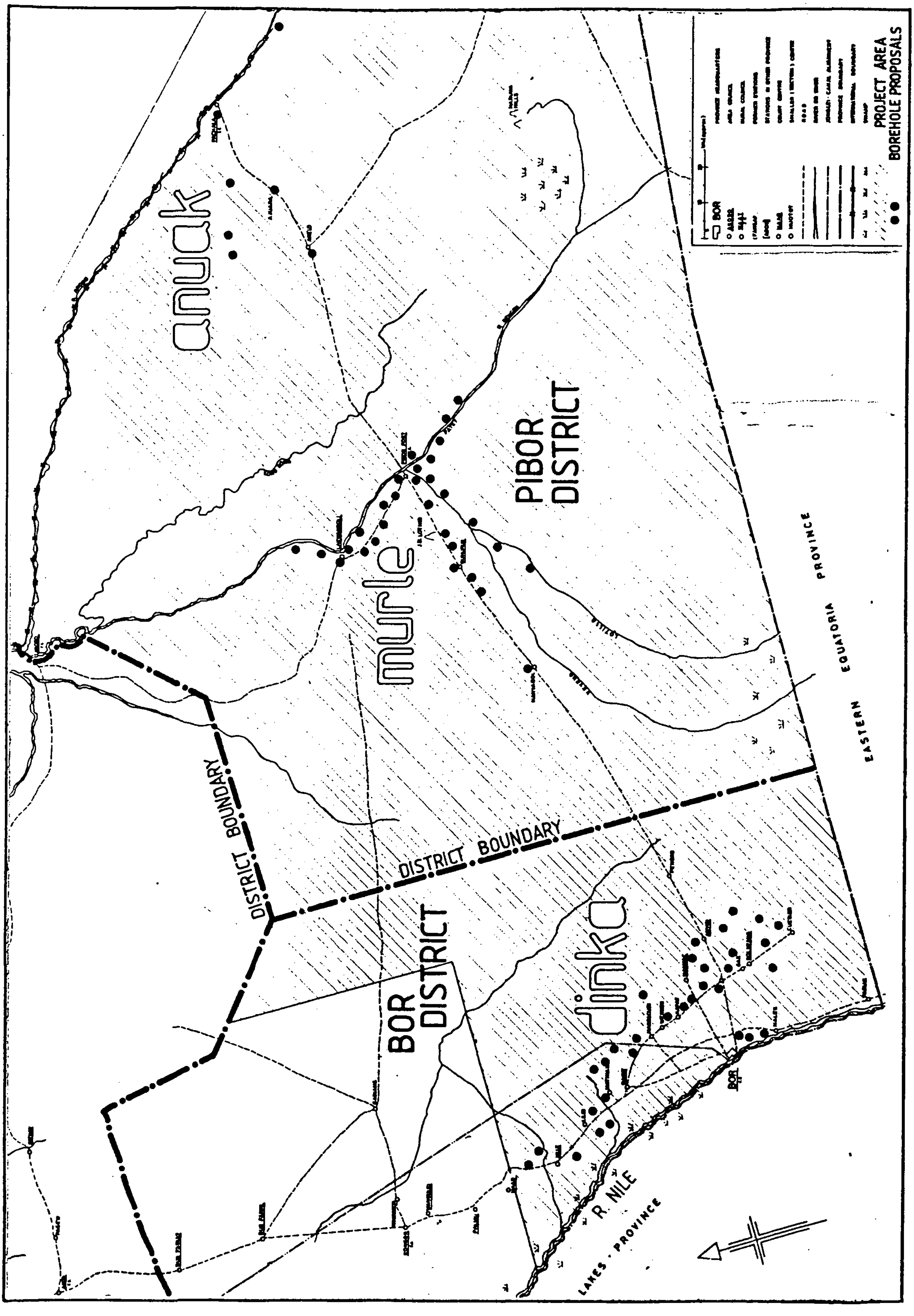
3. All the people who attended the pump maintenance school exhibited an enthusiasm to learn, and they quickly assimilated the necessary skills and knowledge to maintain and repair the hand pumps.

4. The potential benefits of the project in terms of health, were increased perhaps many times, by including a health education component within the pump maintenance school.

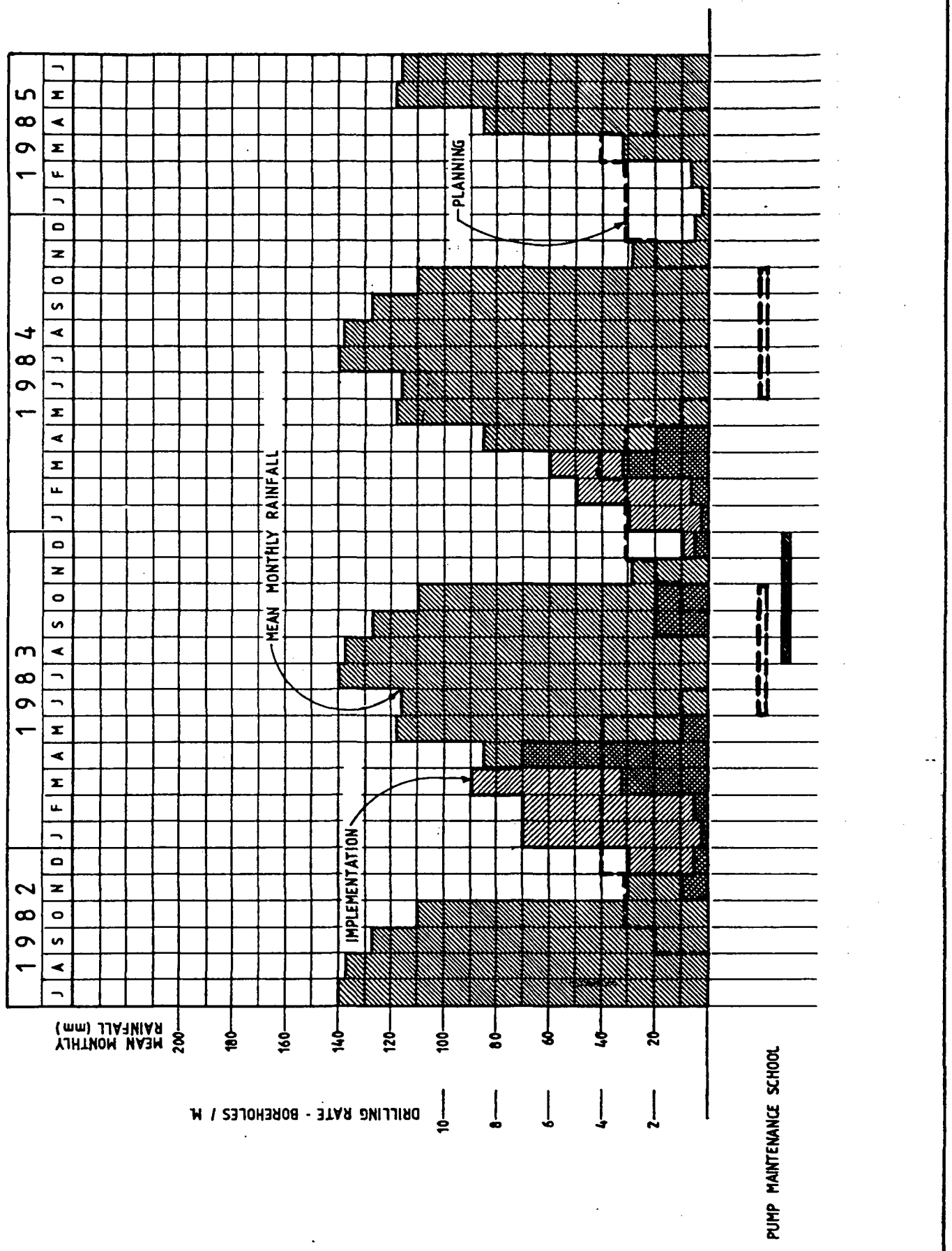


PROJECT LOCATION

FIG. 1

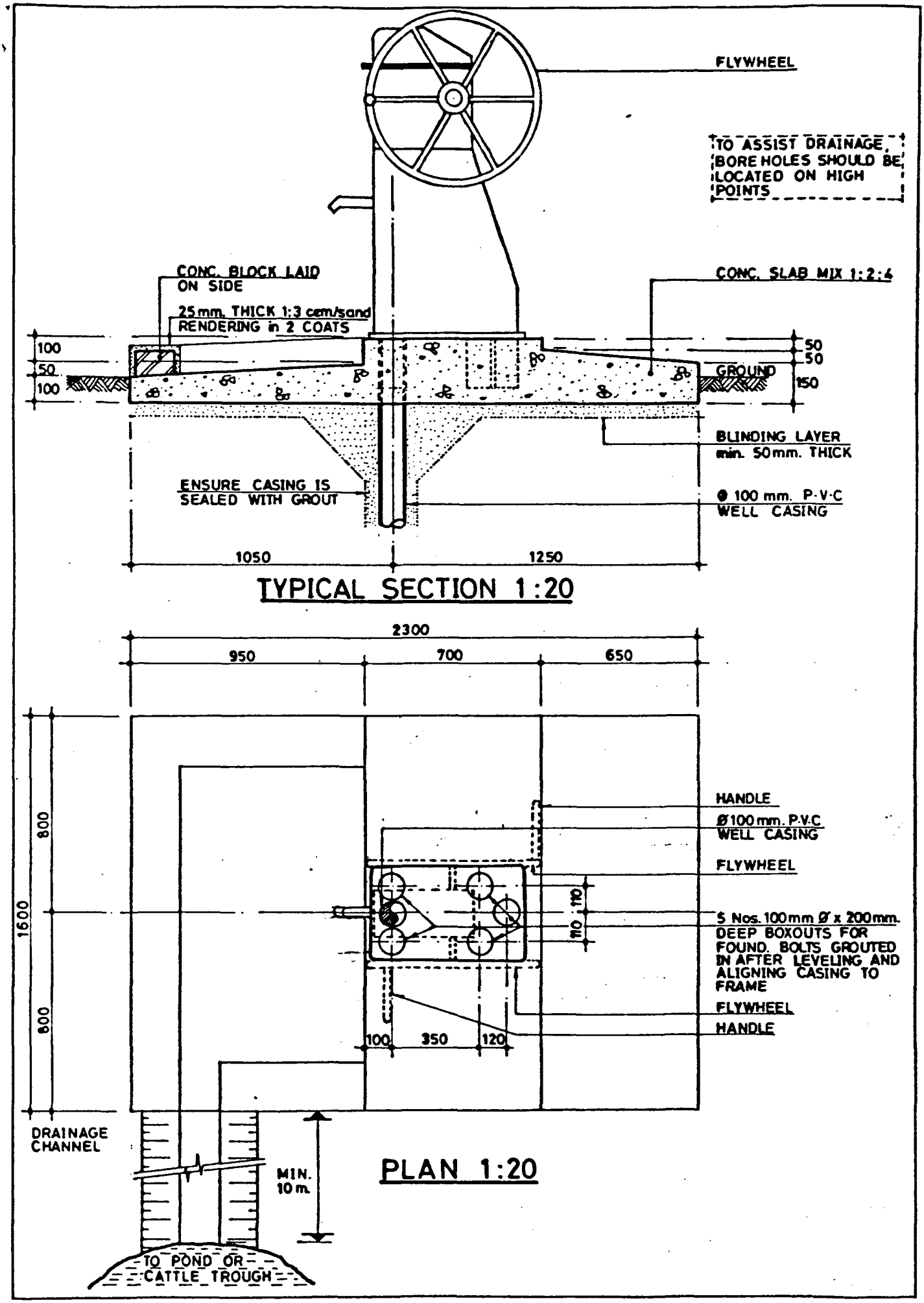


PROPOSED BOREHOLE PROGRAMME FIG. 2



PROJECT PROGRAMME & INSTALLATION SCHEDULE

FIG. 3



TYPICAL HAND PUMP INSTALLATION WITH DUBA TROPIC TYPE II HANDPUMP

FIG. 4

TRAINING COURSE CERTIFICATE FIG. 5

BOR RURAL WATER SUPPLY PROGRAMME

This is to certify that

_____

on the_____ day of_____

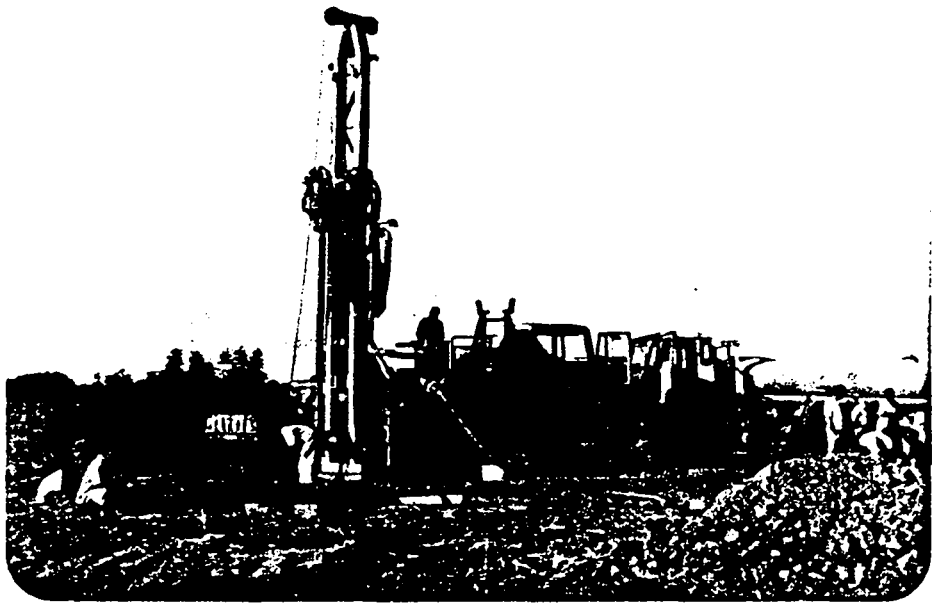
successfully completed a training course

for hand pump maintenance

DEMOCRATIC REPUBLIC OF SUDAN
PUMP MAINTENANCE CERTIFICATE
ILACO SUDAN
KINGDOM OF THE NETHERLANDS

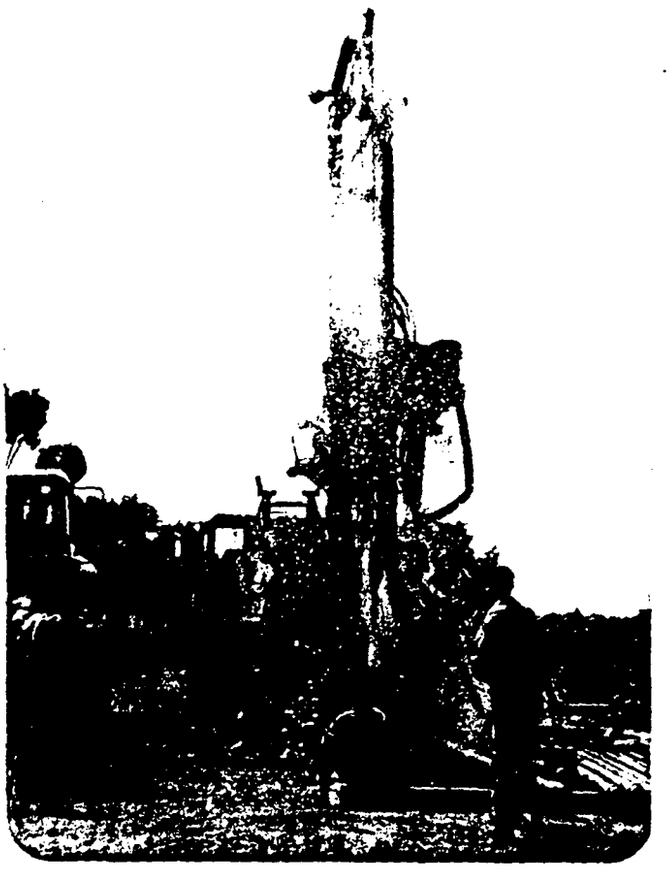
_____
CHIEF ENGINEER

_____
B.A.D.A. REPRESENTATIVE



A. PREPARING TO COMMENCE DRILLING

B. DRILLING AT KOLYNANG VIEWED ACROSS DRIED OUT HAFFIR



C. DEVELOPING BOREHOLE

D. COMPLETED INSTALLATION, ILLUSTRATING LIFTING POLE AND MODIFIED SPOUT ARRANGEMENT

PUMP MAINTENANCE SCHOOL IN PROGRESS

F. "PASSING OUT PARADE" FOR KOLYNANG COURT CENTRE STUDENTS