RURAL INDUSTRIES PROMOTIONS
(BOTSWANA)
A NON-PROFIT ASSOCIATION

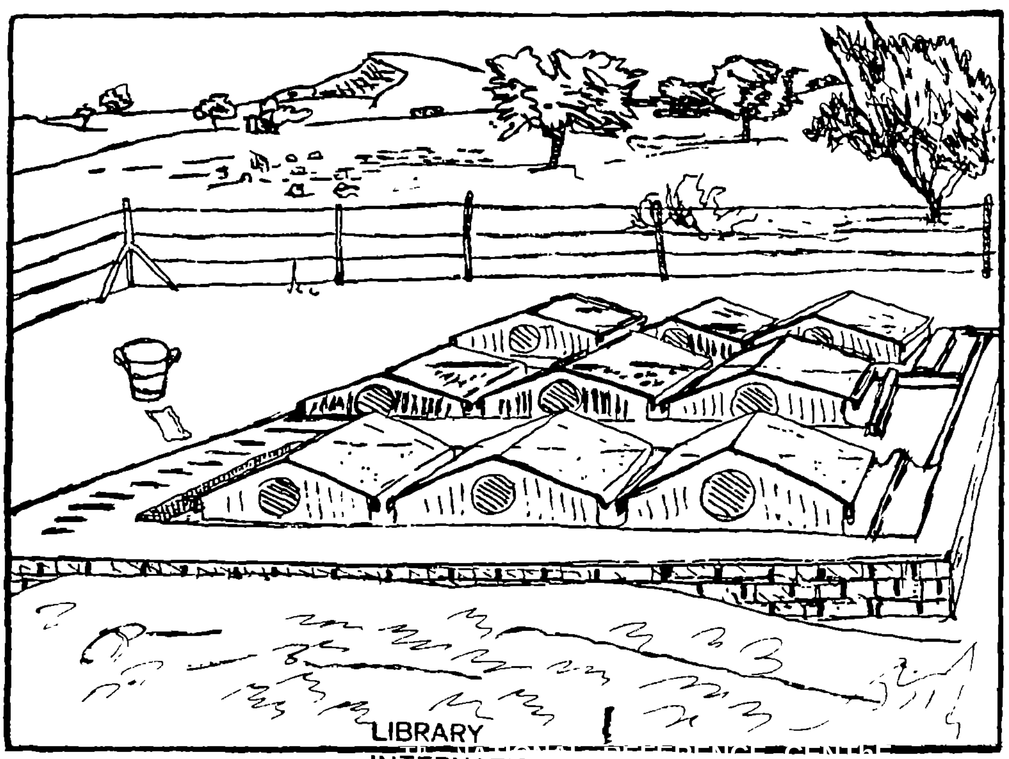
RURAL INDUSTRIES
INNOVATION CENTRE

PRIVATE BAG 11
PHONE 393, 392, 448 & 449
KANYE BOTSWANA

The Experience with Small-Scale Desalinators for Remote Area Dwellers of the Kalahari Botswana

by

T. Woto



SOLAR ENERGY

REGISTERED OFFICE: TSHOLETSA HOUSE - P O BOX 2088 - PHONE 52441 - TELEX 2435 BD
GABORONE BOTSWANA

A C K N O W L E D G E M E N T S

I would like to thank the following for their invaluable assistance.

The greatest thanks must go to the residents of the numerous Remote Area Settlements who cheerfully welcomed the research team and are still maintaining cordial working relationships. May their patience and co-operation be rewarded by timely and constructive government action to alleviate their water problems.

Special thanks must go to the Humanistic Institute for co-operation with Developing Countries (Hivos - Holland) for their finance which made it possible to carry out this programme under such harsh conditions. We owe special thanks to Menuala Montario and Ian Cherrett who managed to actually visit us and made a field trip to some of the settlements we were working with.

The RIIC Small Scale Desalination team needs congragulation for the work they have done in the field. These people - R. Yates, J. Tlhage, M. Moetse, P. Cooper,and maybe myself, have dedicated a lot of effort in making this project a success. Not to forget the RIP/RIIC Management for tolerance and patience. Indeed the project has been time - demanding on their part. We are also grateful to our RIIC Research and Development colleagues for their valuable contributions and recommendations.

We are very grateful to the various district authorities especially Kgalagadi district for their cooperation. In Kgalagadi district, we are very grateful to Mr. J. D. Nyatanga who has stood by us, represented us in council and has always met us on the question of appropriate recommendations.

I would also like to thank Mrs. S. Gontse for typying the report and D. Phetlhu for designing the cover.

T. Woto
SOCIOLOGIST

/sbg

12.02.1987.

C O N T E N T S

INTRODUCTION

This paper is the last report on the desalination project in the Kalahari for Basarwa to the Humanistic Institute for Co-operation with Developing Countries (IVOS - Holland). The project, set up Mid - 1984, had the major objectives of providing simple prototype desalinators as an emergency measure for Remote Area Dwellers (RADs) whose only water supply is salty. A lot of progress in so far as implementing the project has since been achieved and after two and half years we are able to analyse and evaluate the project.

Rural Insustries Innovation Centre, which has been the implementing Organazation, identified desalination as early as 1977 as a Potential Technology which could be utilized in Botswana. While some basic research work was initiated since then, it was not until 1983 that efforts were intensified due to the impeding and prolonged drought which has engulfed the country for the past five years. With the drought, the historical life pattern of the RADs was disrupted - their traditional water sources dissapeared forcing them to converge on boreholes most of which are salty.

Over the two and half years, there were also some major changes and alterations on the project objectives. Of importance among these was a shift from emergency implementation to community self-sufficiency. Because of the well-coordinated drought relief programme, the urgency of providing basic drinking water was alleviated leaving us in a situation of competition between desalination and council trucked-in water. It thus became necessary to promote desalination as a viable water supply system which could effectively compete with other systems, especially trucking water to settlements.

Also of importance to note is the fact that the original target group changed from Mobile Hunter - gatherers to permanently settled communities. Such a change was in line with coping with the general developments in the desert which have over a period of time forstered a transition from the traditional life pattern to the present settled RAD. Changes have mainly been due to the drought, Government Policy, Mining, and borehole drilling programme.

It is our hope at RIIC that the pool of information that we have compiled over the past two and half years will be of help in moulding Government Policy towards Remote Areas Dwellers and that dessemination activities be expanded so that more people can become aware of the value of this technology.

Photo 1. The present-day Mosarwa or Remote Area Dweller is not the commonly reported person wearing traditional regalia. This picture was taken from Ukwi in August 1984 and it shows typical present day young women. (Pic. by R. Yates).

CHAPTER 1

THE CALL FOR WATER IN THE KALAHARI DESERT

1.0 From experience, it is clear that the provision of water supplies is more essential for the survival and development of Remote Area Dwellers (RADs) in the desert than in other less remote areas of the country. In the desert very low and erratic rainfall is exprienced (300 mm per annum). In general, the lower the rainfall average in a given area, the higher the degree of variation or unpredictability.

1.1 THE WATER NEED

While a situation of the nature described above is normal under usual circumstances, things have been much more severe over the past 4-5 years with some areas registering nil rainfall over a 12 months period. Years of drought have actually made the Kalahari a more forbidding place than ever. In the past soil retained sufficient moisture after the infrequent rains to support sip wells, reservoirs from which the Basarwa could suck water using long straws. Also, RADs had access to wild roots and in some cases melons.

The response to the dissapearing water sources has been permanent settlement in village communities around reliable sources of water and game-settlements where they have access to governments services. Now they get their drinking water when the district council water truck rumbles into the settlement once or twice a month. And when this supply is exhausted, they must travel to another village for water.

1.2 AFFECTED GROUPS - REMOTE AREA DWELLERS

Initially, it was proposed that the project would serve the following groups of people:-

i) Mobile hunter-gatherers.

ii) RADs in process of being settled; seasonally mobile to a decreasing extent.

iii) Settled RADs who remain year-round in one place.

With the actual implementation of the project, it became quite clear that most Batswana RADs are no more nomadic. The few identified groups were those settled at Ukwi, Zutshwa, Ncaang, Monong, Make, Lokgware, Kokotsha and Khawa - all in Kgalagadi District. Another site was Mathathane in Southern District.

The RAD population was found to be a Cross-Section of numerous ethnic groups and not just confined to the Basarwa. This included Bakgalagadi, Basarwa, Batlharo, Bakgothu (Hottentots) coloreds etc. Such a composition meant different socio-political problems in different communities we have been working with during project implementation e.g. variance in technology acceptance rate and preference of the end-users.

Also of importance is a good understanding of the term/phrase Remote Area Dweller (RAD). This was clearly defined in the report on The Remote Area Development Programme: An Evaluation which states that;

"In order to counter allegations of 'Separate development' and ethnic bias by those who deprecate any form of special assistance for narrowly defined groups of the poor, the name of the Basarwa Development Programme was changed to Remote Area Development Programme in 1978 and its target group has been described since 1978 as all people living outside organised village settlements." (B. ENGER P2).

1.3 Government Policy Towards RADs

The last twelve years have experienced a major strengthening of government development efforts in remote areas. It has the following as its objectives;

(a) Social Services: Extension of basic services (education health, drinking water, vulnerable group feeding programmes) to remote areas.

(b) Economic:

Access to land, water rights, income earning opportunities for RADs.

(c) Political:

Legal self-reliance, reducing dependency, social intergration, awareness of rights.

Thus, small - scale desalination was closely related to the RAP Policy in so far as it aimed at enhancing the social services objective by way of providing potable/drinking water. The idea was also to promote self-reliance since this water technology or supply system is community based. In the case of council trucked-in water, a situation of complete dependence on the expensive and unreliable system by the RADs is created.

While RIIC is aware of the limitations of the council/government water supply system i.e. economic costs, reliability etc, it appeared that there is enough money for now to support the system. In addition to this, the district council - Kgalagadi appear to be having enough internal problems discouraging the risk of attempting something new.

1.4 The Drought Relief Programme

Central Government, together with the other implementing Organizations such as district councils have over the past four years strengthened the above programme to the extent that because of effective management and coordination there has been marked increase in funding for the programme. The result is more trucks for water purposes and extended services to almost all the known settlements. The major implication of all these developments was that the emergency need for water was eliminated hence a change from emergency implementation to promotion of self-sufficiency.

It is yet not clear what will happen after the drought i.e. whether council will still have enough funds to maintain the present water supply system. But then, the RADs cannot be expected to go back to their traditional way of life based on desert plants and moisture after exposure to the easier way of life.

Photo 2. Khawa residents at a meeting to discuss water-related matters.

CHAPTER 2

THE TECHNOLOGY

1.0 Desalination is commonly known as the process of purifying saline water for laboratory purposes. The above process is usually based on the basic distillation principles. It involves a simple distillation process to separate contaminants from the water and ultimately remain with distilled water.

The project had the ultimate goal of assessing the potential role of small-scale desalinators as suppliers of pure drinking water for family groups or small users. Thus we had a good chance of assessing its full potential in Botswana and the following are some of its obvious benefits and limitations.

Benefits

(a) Desalination can expand areas of Settlement - Areas like those presently occupied by the Kalahari RADs which could not have otherwise been seen as potential settlements can be used for above purposes.

(b) Desalination can modify the present effects of deteriorating water supplies in the desert. This technology can effectively be used to combat the adverse results of the already vanished traditional water sources of the Kalahari RADs.

(c) Desalination has the potential of improving health standards. Distilled water is chemically and organically pure. The removing of contaminants from questionable water supplies generally benefits the intended end-user's health. A good example is Khawa where the use of the borehole water causes serious stomach complications - diarrhoea. Severe cases (fatality) have been experienced before which have since been alleviated by the introduction of this technology to such areas.

(d) The community (ies) using the technology easily becomes self-reliant in its water needs since the water supply system is community based and controlled. Some degree of independence from the council trucked-in water has so far been realized especially in Zutshwa.

Limitations

The experience with our field application of the technology has shown that there are a few limitation always to be considered.

a) Capital Cost

The technology tends to be capital intensive. The capital investment necessay to build the equipment for distilling water by solar energy is high but less so than other distillation methods when small volumes are needed as is the case in RAD Settlements in Botswana. A solar still unit supplying pure water to a poor RAD family tends to be more expensive than the hut in which they live in.

b) The desalination technology definately required changes in traditional life-styles. For best social acceptance and use, domestic water produced by desalinators requires new patterns relating to water-use, work, settlement and responsibility with the community. From our experience, it should be clear to the user that his daily life pattern to which he is accustomed must change in order to adapt and use the technology, that the water may taste different, that it must be conserved and stored, and that work patterns must change in order to produce water. Social constraints have varied from one community to the other i.e Zutshwa, Khawa etc.

c) Basically, the technology is not able to produce enough water for people and livestock despite the fact many Batswana RADs highly depend on their animals especially donkeys.

1.1 OPTIONS

As already cited the project had as one of its initial objectives, supplying the best available desalinators to small mobile, semi-mobile and permanantly settled RAD groups in the desert. Research attempts at that time were centered around wood-burning and solar stills. These devices were supposed to be potable and easy to carry around since they were meant mainly for mobile hunting and gathering bands.

It was quite obvious then that the drought was continuing to be severe in the desert. Thus the traditional water sources such as sip-wells and under-ground moisture plants were fast disappearing. In response to the above situation the RADs quickly abandoned the already fast disappearing traditional mobile hunting and gathering way of life and converged around much more permanent water sources. Most of these water sources turned out to be salty because of the monopoly of potable water by cattle owners who were not prepared to share their water resources with the poor RADs. The readily available salty/brackish boreholes or pans were thus suitable for the new comer since this water could surfice for Animal/Livestock purposes. Unfortunately, at the time of initiating this project, all these developments were not well pronounced hence the centering of project objectives around the mobile and semi mobile bands.

1.2 PROPOSED SOLUTIONS AND RESULTS

Major attempts had already been made to adopt the desert survival still - "Poverello" to local conditions. This design comprised of a flat-bottomed hole in the ground 1 - 1.2 m square, 35 -40 cm deep with inclined surface on the northern side. Dried grass or other thermal insulator on bottom. The hole is lined with polythene sheet and then covered with black cloth and anchored at the mouth of the hole with sand. A distillate collector i.e. small bucket is then placed centrally at the bottom of the hole and weighed so that it doesn't float away. Salt water is then poured into the hole to a depth of 3 - 5 cm and then the hole is covered with PVF sheet anchored at sides with sand. A small stone is then used to depress the PVF sheet to form a shallow cone. PVF is a clear ultra violet resistant plastic.

Field testing of this still in a number of sites i.e. Ncaang, Zutshwa found that it could produce on average 1 - 1.2 litres per day, depending on season and insolation. Field dessemination was later discontinued because the unit was found to be completely unacceptable by the intended users.

Notable Limitations

i) The yield was too low.

ii) There were no mobile bands requiring such potable low-yielding units.

iii) The unit was susceptable to easy damage by dogs, children, goats etc.

iv) The yield critically depended on correct assembly of the still.

WOOD-BURNING STILLS

i) NIGHT-SKY RADIANT STILL

The radiant still used a traditional three legged pot to boil saline water and a copper pipe coiled above and around it.

Photo 3. The Night-Sky Radiant Still - tried and found to be unacceptable.

The coiled NSR still proved unsuccessful as the coil was overheated by the fire and as such there was not enough condensation. The coil was then redesigned into a 3-4 metre long straight pipe for a condensor.

Out-puts then improved to about 750 mℓ per hour. Like the POVERELLO, this design failed to gain acceptance among the RAD communities mainly due to low yields and was later superceeded by the Ghanzi still.

LIMITATIONS

i) Yield was too low.

ii) Coil was difficult to transport/look after in settlements and was easily damaged.

iii) High cost per unit.

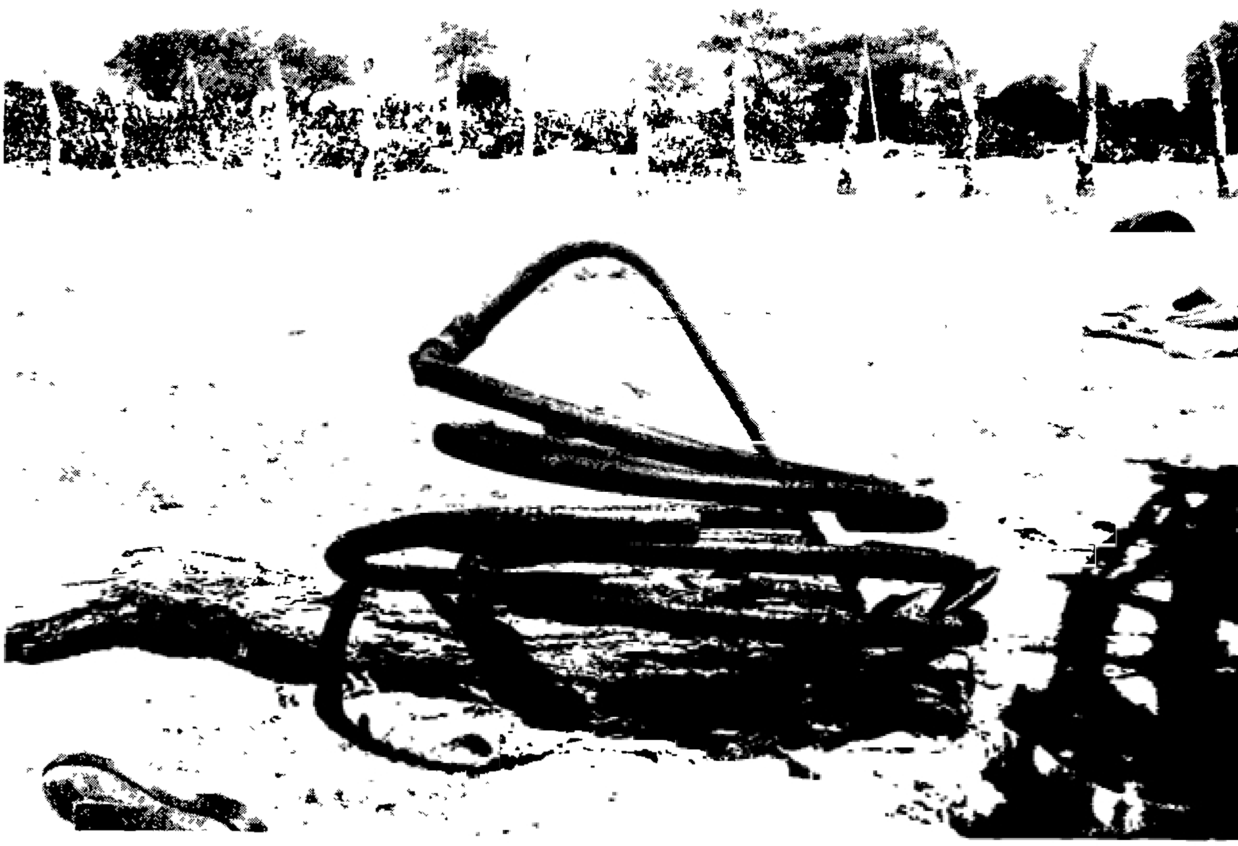
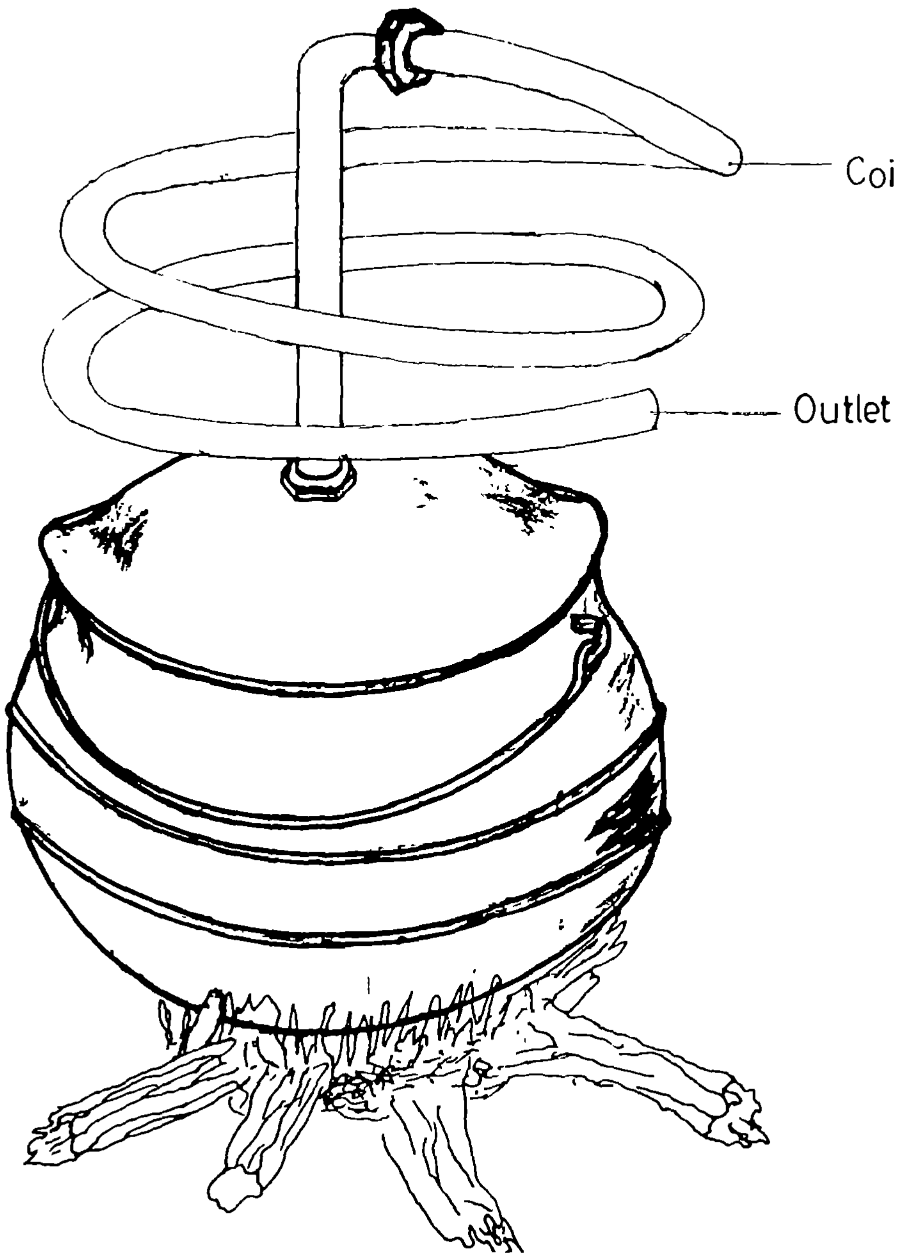


Photo 4. Picture of a destroyed Copper Coil at Mathathane.

WOOD BURNING STILL



Of the six NSR stills delivered at Mathathane, four were later returned by the users. Also, all the forteen NSR stills distributed at Ncaang were later returned because of lack of interest by the end-users. The conclusion then was that the options we were proposing were not the answer to the problem. The technology in that state could not effectively compete with any other method of acquiring water accessible to the RADs.

1.3 MODIFIED SOLUTIONS AND RESULTS

From efforts in Kanye on site Research, we had designed and developed two types of stills. These were the Ghanzi still (wood-burning) and the Mexican still (solar). Field application and dissemination proved these to be much more successful than the Proverello and NSR stills. This can mainly be accounted by the fact that their efficiency was much higher. One common character with these two units is the fact that they are big non portable units meant for the permanently settled RADs we found ourselves dealing with.

THE GHANZI STILL

The unit is made out of two metal drums, a joining length of galvanized pipe or hose, a coil of copper pipe and two tripods for the two drums. One 100 litre drum is used to boil the salty water while the other 200 litre drum with the copper coil emmersed in cold water is used to condense the steam into a distillate. The distillate is then collected by a small container. This unit can produce up to 17 litres of distillate per hour.

This unit was widely disseminated all over the desert to Kokotsha, Mathathane, Zutshwa, Monong, Make, and Ncaang. After a period of continued use - especially Zutshwa, we discovered a serious effect on firewood resources. Because this still uses a lot of firewood, it meant that its daily use seriously depleted firewood resources around the settlements. This was brought to our attention by the RADs themselves. The result then was a shift of emphasis from the still as a solution to the water problem to its use as a back-up system to the council trucked-in water. That is to say, in case the truck delays in bringing water and the settlement runs out of water people can than temporarily use the Ghanzi still to produce water. In Zutshwa these stills were used even if council water was available to produce water for donkeys going out for hunting. We found this to be a fairly normal exercise given the circumstances in that particular settlement.

POINTS TO NOTE

i) The still has got a very good yield - up to 17 litres/hour.

ii) It uses a lot of energy - firewood.

iii) It's very good as a back-up system.

iv) It's not expensive - about P300.

THE MEXICAN STILL

The Mexican still looks like a miniature green house. Each still covers an area of about 1.6m² comprising of two panes of glass, a supporting cross-piece, a fibre glass body with an insulated basin, and outlet pipes. The shallow black basin is filled with saline water, which solar radiation heats to as much as 75°c in the desert sun. The hotter the water, the faster the rate of evaporation. The water vaporizes leaving the salt behind in the basin. When the water-vapour comes into contact with the cooler glass, it condenses as a thin film of distilled water which then slides down the glass into the troughs through pipes to a central collection vessel located outside the mould. Tests indicate that the Mexican stills are performing well, with their efficiency ranging from 44 to 52 percent. This compares favourably with ratings of other basin stills elsewhere in the world. Before any field dissemination could be done, we concluded that the Mexican still would be much more suitable for use in the form of communal installations. Thus a whole batch of these would be systematically installed all feeding a centrally located tank submerged to ground level. Also, we thought this would be a system which could potentially compete with the other system of council trucked-in water which we found to be more expensive, unreliable, and creating a state of RAD dependency on a system they have no control over.

POINTS TO NOTE

i) Mexican solar still produces about 4 - 8 litres of distillate per day per 1.6 m^2 depending on season variation.

ii) This unit is best utilized on communal basis.

iii) The unit is strictly non-portable hence is for permanently settled communities.

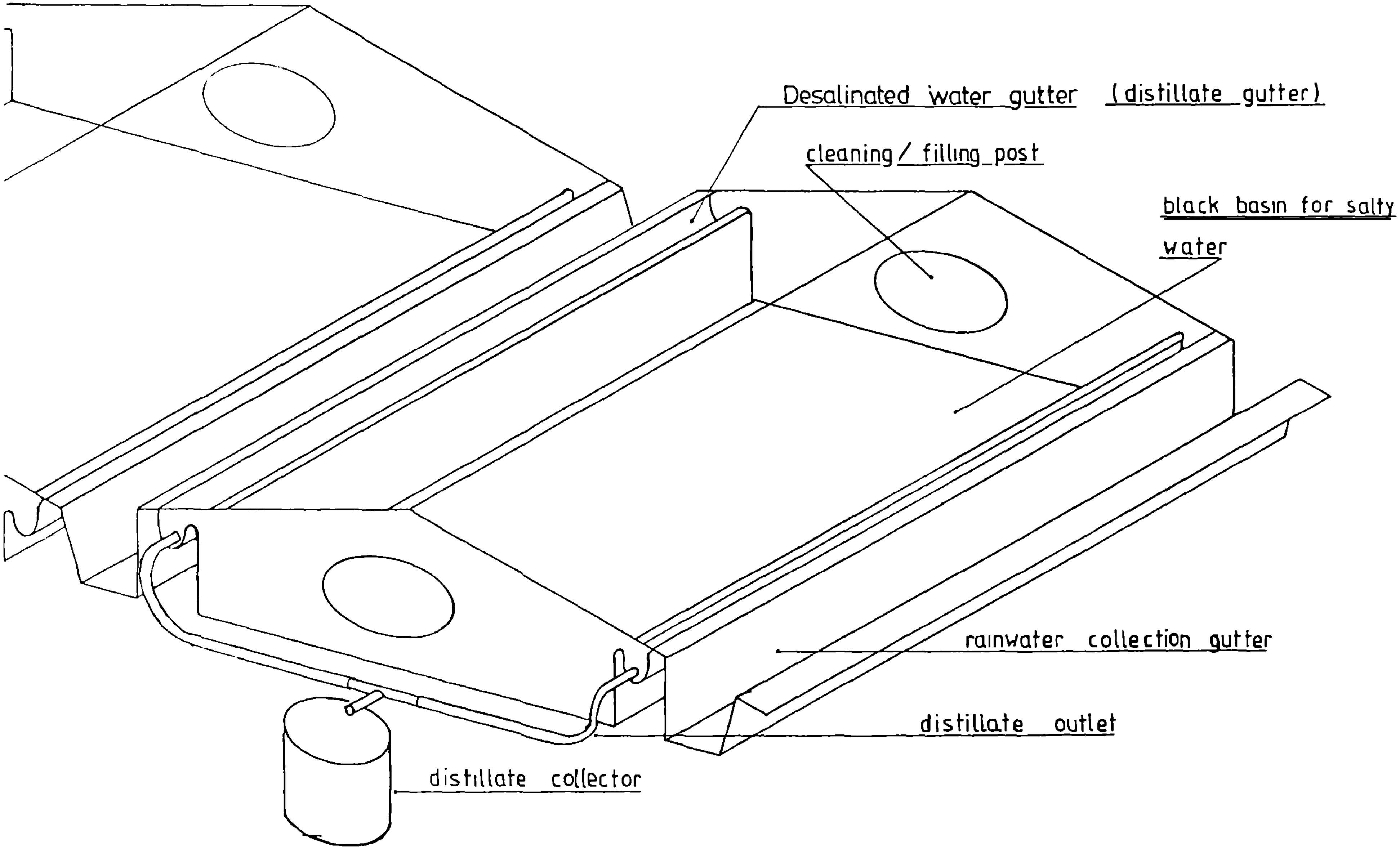
iv) Presently it's the best available desalinator developed at RIIC.

v) The stills and their base can be used for rainwater catchment.

vi) The stills are made in Botswana.

vii) Installation of the stills can be carried out by mainly unskilled labour.

THE MEXICAN STILL



CHAPTER 3

TECHNOLOGY DISSEMINATION AND PROMOTION STRATEGY

1.0 The project was initially planned for a two years duration but ultimately took two and half years from beginning up to the end. During this period of time much was learnt from our field experience culminating in a slight shift in project goals. This shift also resulted in a re-allocation of the project budget.

1.1 PROJECT PLANNING

The initial plan as outlined in the project proposal was to enable the Kgalagadi RADs to get access to clean drinking water. This was to be accomplished by way of working with affected Basarwa population of 10 - 15 communities in the three desert districts viz Kgalagadi, Southern and Ghanzi districts. Having indentified the sites, it was planned that five desalinator models would then be disseminated among the communities.

In order to eliminate the exteriority of the technology, that is to say desalinators not being viewed as an outside technology, it was planned that the necessary sociological, extension and training work among the target group would be carried out. This, it was thought, would foster the assimilation of the technology into the lives of the Remote Area Dwellers hence adapt it to their changing circumstances. Demonstration and training were to be a role to be carried out by the technical team in collaboration with RIIC's Extension Team. This would involve technics such as group - discussions, popular theatre and demonstration experiements all focusing on teaching the basic principles of desalination, maintenance and repairation of desalinators.

All the initial planning was centred around the provision of the best available desalinator proto-types as an emergency measure to the most needy RADs.

Hence the whole programme came to be reffered to as "Emergency Implementation".

1.2 INFORMATION GATHERING

The commencement of the project was high-lighted by a fact-finding trip during which all the proposed settlements in Southern, Ghanzi and Kgalagadi districts were visited. A series of Kgotla meetings were addressed in the settlements and also with the district authorities. From this trip it become quite evident that most of the settlements which appeared on the list as needing desalination did not in fact have any reliable salty water source. A thing which is a basic necessity for desalination to be considered. Also, it became apparently clear that the project would be dealing with permanently settled communities and not mobile and semi-mobile hunter-gatherers as initially thought.

Apart from field trips, a working group and co-ordinating committee had already been set up consisting of RIIC representation and any other institutions, councils, government departments and individuals involved directly or indirectly with desalination. This committee - Joint Advisory Group on Desalination for Remote Areas (JAGDRA) has since been in operation - meeting quarterly, and has effectively contributed in terms of information sharing and coordination. So far it is presently proposed that its leadership be changed to comprise of high-ranking government officials in an attempt to gain some influence on government policy towards Desalination. We are hoping that government will in the near future seriously consider capital investment in desalination and accept it as another viable option of small Village Water Supply system.

SURVEYS

In the case of all the selected settlements i.e. those settlements we were seriously working in. We carried out some structured mini-fact-finding social surveys. These surveys, carried out in Ncaang, Lokgware, Khawa, and Zutshwa, tended to be much more demographic inclined. Much of the stress in the questionnaire was to find out population size of the settlement, number of children, migratory patterns if any, sources of household income e.g. livestock, hunting, crafts, arable agriculture, etc. These surveys came to play a very important role in so far as information gathering was concerned.

In addition to the above, regular meetings between the project staff and the affected communities, and also the district council staff were held. These were meant to keep all the affected groups informed of the situation hence ignite possible council take-over of the project in the near future.

1.3 FIELD IMPLEMENTATION AND EXPERIENCES

As already earlier mentioned, initial stages of project implementation were much more inclined towards emergency implementation. The main objective here was to combat the emergency cases in as many sites as possible hence the project was implemented in the following sites with different success rates:-

1. Ncaang	-	Kgalagadi district
2. Make	-	" "
3. Monong	-	" "
4. Zutshwa	-	" "
5. Lokgware	-	" "
6. Mathathane	-	Southern district
7. Kwee	-	Central district

In most of the above settlements we tried the PROVERELLO, NSR still and the Ghanzi still and found the Ghanzi to be the most commonly accepted design. As a result of these trials, the Ghanzi still came to domminate and infact did superceed the former two designs.

Thus, from our experience, we can say that the emergency need was effectively combated with relative success. Other reasons for our success, apart from the success rate of the Ghanzi still, were the general developments in the desert. Of importance among these was the ever improving and strengthening of the drought relief policy. The water trucks increased from one to a few in the Kgalagadi district alone over a period of 2 years. This meant that the trucking of water to RAD Settlements soon became on a much more regular basis. With water also came food - drought relief rations were issued to all the recognized RAD settlements on monthly basis (each person with RAD status was entitled to 12.5 kg mealie meal, some beans and cooking oil per month).

Given this situation, the Ghanzi still came to play a prominent role as an emergency back-up system to be used in the case when the council for one reason or another failed to deliver water. Other developments included a highly pronounced borehole drilling exercise, and aid from humanitarian institutions such as Botswana Christian Council etc. Efforts to further expand this programme were not successful. Such efforts culminated in a long trip covering Kweneng, Ghanzi central Kgalahari Game Reserve) and Central districts. The aim here was to identify more sites urgently in need of desalination but none were identified except Kwee in Central district. But still work could not commence immediately there because it was just a proposed settlement.

The original planning and structuring of the project had some major reprecussions on the actual implementation of it. Of importance was the fact that the project was planned to cover settlements all over the desert - 3 districts, while the man-power resources were put at five people comprised of two project leaders (Technical and Sociologist), a field Officer, an Extension Officer, and a driver. The team was then provided with one 4 x 4 vehicle to do the job. This should have been apparent from the on-set that the above resources were not enough to meet the expected goals.

The fact that, we were working in numerous settlements all of which were hundreds of kilometres apart meant that our work was thinly spread. The result was that councils, especially southern and Kgalagadi districts, could not feel our presence. In fact, of more importance was the fact that our visits to the RAD communities were sporadic. Follow-up visits to these settlements were not continuous since we had so many settlements to visit and hence so much distance to drive before we could come back. Also, money allocated to transport did not warrant continued field trips, meaning that there was not enough money on kilometrage. Travelling in the desert turned out to be a strenuous exercise on the team and this is mainly due to the bad roads (an average expected normal speed is 60 km per hour on desert roads).

Photo 5. Bad roads are a major limitation when working in the desert. The above picture shows the main Sekoma-Ghanzi road.

1.4 TRAINING

As one of the its major objectives, the project had the responsibility of teaching RAD communities the basic principles of desalination, and the general daily operation and maintenance of the desalinators. But we found from experience that there was very little to teach when using wood-burnings stills. The training that proved to be a necessity was with the communally installed Mexican stills which were later installed at Zutshwa (and also Khawa and Lokgware under the IDRC field research programme).

Basically we found that by merely establishing a good communication system between ourselves and the RADs a lot could thereafter be achieved by merely explanining to individuals, and through group discussions and community/RIIC meetings. Throughout this we attempted to get as much involvement from the Remote Area Development Programme Office as possible. We found that the RADs had no problem in grasping the technology since they are exposed to much more complicated technologies in their daily lives than simple desalination e.g. fire-arms, diesel lister engines, hand-pumps to cite a few examples.

Training workshops were held in all those sites where communal solar stills were being installed and these places were Khawa, Lokgware and Zutshwa. The workshops involved all the key members of the community and those representing individual households (all the households had to be represented), RIIC staff, and council staff. Much of what was done during these workshops was through group discussions, recording and re-playing these discussions, popular theatre and ordinary lectures all these focusing mainly on project management, and on operation and maintenance of the desalinators.

Still we encountered some main set-backs in this exercise. Among these was the fact that the RAD population in the different sites formed a heterogineous population. This meant that each one of these communities spoke a different language or dialect from the others. Thus we were dealing with languages ranging from Sekgalagadi, Setswana to Afrikaans. Another limitation was the fact that the literacy rate in all these communities is very low. Thus, a combination of the above two factors was prohibitive in so far a developing appropriate pedagogical methods.

1.5 THE INEVITABLE CHANGE

Following the successful complexion of the emergency related activities, some major proposals were made by RIIC to HIVOS in the November 1985 six monthly report. These proposals were to be discussed and ultimately finalized in correspondence that followed. The proposal followed our fieldwork experience which reinforces the opinions stated earlier that realistic long term desalination could only be carried out on a scale which could provide water for every member of the community. Also that the stills could only be effectively maintained and used if there is a regular supply of water to feed them. From experience, stills that are left unattended deteriorates very rapidly under the harsh desert condition.

In view of the above factors, it was proposed that the then unexpended money from the HIVOS budget be supplemented with a portion of the IDRC budget to make one suitable site self-sufficient. This, we thought, did correspond with both the long and short term project objectives, i.e. to enable the RADs to have access to clean drinking water and to improve the position of the RAD population in Botswana. We also thought that such a site would be exemplary to local and central governments that the desalination technology is a potential option for providing drinking water for remote small communities. The proposal was approved by HIVOS and Zutshwa (in Kgalagadi District), was selected as the suitable site to implement the programme.

Photo 6. Kgalagadi sand dunes. Much of the areas of the Khalahari are fast becoming severely desertated.

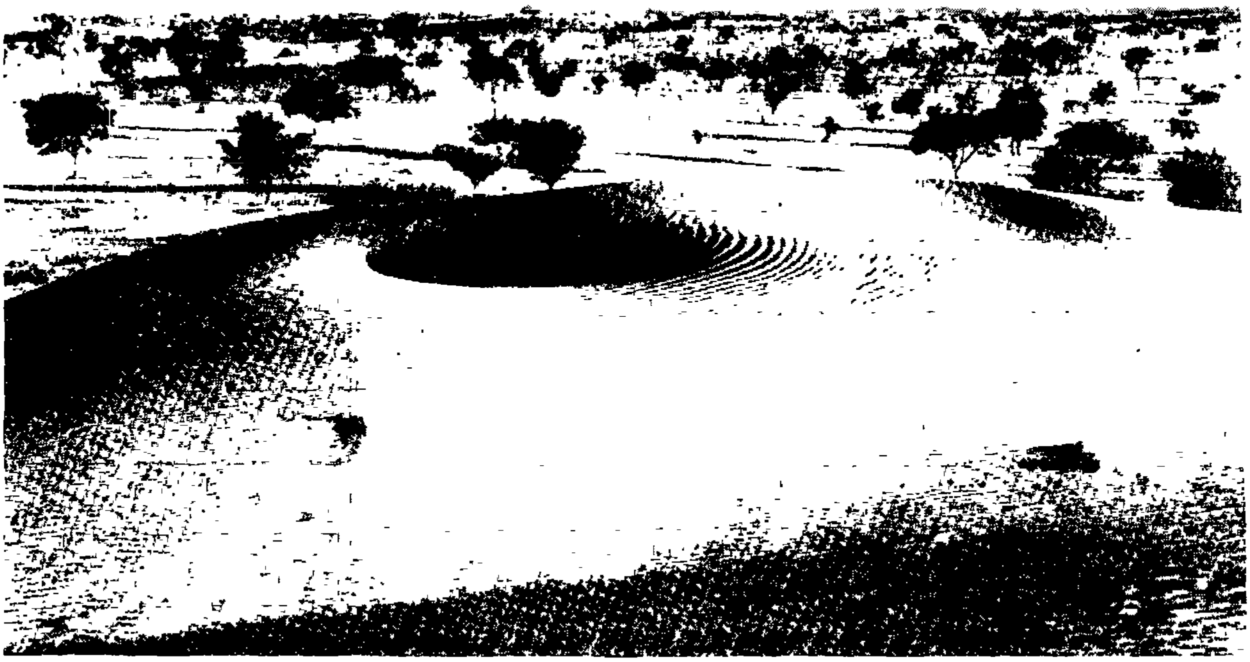


Photo 7. The picture shows sand-dunes and vegatation around Khawa where RIIC has installed 37 Solar stills and an Animal Drawn Pump (ADP) to pump water from the borehole. (about 72 metres deep)

CHAPTER 4

CASE-STUDY: ZUTSHWA

Zutshwa is located about 65 km South-West of Hukuntsi which is the nearest village. The settlement is comprised of a mixture of Bakgalagadi and Basarwa population even though the latter group is predominant. It has 19 household units totaling to about 122 people (including absent school children). From observation, Zutshwa is comparatively speaking the most organised and easiest to work with. The people there are a non agricultural community practicing no crop production nor livestock save a few goats and donkeys kept mainly for hunting. Although there are a few goats in the settlement, only 20 percent of the households own these and infact they are not an important part of the village economy. Hunting and drought relief programmes form a bulk of their present means of survival although the latter - hunting is slowly being strangulated by wild-life hunting laws which are slowly being made applicable to RADs. Also, a substantial amount of their cash income is generated from migrant labour.

The water situation in Zutshwa is much more severe than in most of the other similar RAD settlements. Two shallow boreholes were drilled there sometimes in March 1986 producing ample water of 200000 mg/ℓ of NaCl. One of the boreholes was fitted with a hand-pump by Mr. K. Irvine of the African Evangelical Fellowship, a missionary who has been working with the people there since 1982.

Mr. Irvine had previously constructed five stills at Zutshwa and trained an operator to fill these using water carried from a well in the pan 1½ km away. Two types of RIIC stills were later introduced there and were readily accepted. Major work was held back for sometime due to pending government drilling plans for this site but when this finally took place, saline water was discovered.

Thus we then started seriously thinking of working there and this culminated in the RIIC - HIVOS budget re-allocation.

Once salt water was available in sufficient quantity it was agreed that RIIC could work there, though the logistical problems were enormous. Work began in April 1986 on an installation of 32 solar stills. A total of 8 truck loads of potable water had to be brought from Hukuntsi for the installation, an amount far more than was strictly necessary as much was used by the residents since council was not delivering water at that time. Bricks and concrete also had to be trucked to the site.

Photo 8. The community has to be effectively participate in order to ensure a future sense of responsibility and acceptance of the technology.

Community participation in the work was excellent, and workers were employed at the drought relief wage of P2.00 per day. Unfortunately none of the residents had any building skills as has been the experience elsewhere i.e. Khawa. Community participation in this project is seen as a major determining tool in the overall acceptance of the technology. By promoting this, we have always found that it is a very effective method of teaching the community possibly all they can learn about the technology. Also, this exercise tend to restrict any possible existence of feelings of exteriority of the project. The community comes to associate quite closely with the project.

The site attendant, Kunu, had already been trained by Mr. K. Irvine on the operation and maintenance of stills. Given his experience, he was chosen as the site attendant. He is reputable, diligent and enthusiatic at his job. So far he is paid by Kgalagadi district council for the job he is doing. Originally, RIIC had hoped that a member of the community would voluntarily take the responsibility of looking after the stills at his spare time, but this was was found to be impossible due to the fact that the work-load turned out to be more than initially thought. Also, the stills require daily attendance which would be impossible in the case of voluntary labour since the volunteer could easily be absent from the settlement doing other private chores such as hunting. During follow-up visits the stills have always been found clean and filled.

Photo 9. Kunu, the Zutshwa site attendant as usual busy.

People in Zutshwa are usually keen on working together whether they are paid a renumeration or not. Through this kind of group participation in the desalination project they were exposed to different skills ranging from cement work through piping to glass work.

Photo 10. Zutshwa RADs working on distillate piping.

In this respect, the benefit is not only in terms of getting access to clean drinking water but exposure to new working tools, their function, skills hence a definite indicator of social intergration into the outside world.

Photo 11. Kunu teaching a fellow RAD how to use a silicone gun.

With such salty water there was an obvious potential for salt production. The salt has been tested and found to be almost pure NaCl. The main problems are transporting and marketing the salt. With Mr. Irvine's help, several shops began to stock the salt but it was never without a certain amount of wind blown sand. At present negotiations are underway to sell large quantities of salt to the Livestock Advisory Centre as cattle lick feed. Over 300 kg of salt is always found stock-piled at a time. The money from sale of salt used to provide an income for the site attendant, but now that he has a salary, it will be administered by the Village Development Committee (VDC).

So far it has been reported that the yield of the shallow borehole is gradually dropping (presently at 200ℓ per hour). Thus plans are underway to seek funds to deepen the borehole and equip it with a diesel engine in place of the hand-pump. This is being initiated through JAGDRA. The need is quite well pronounced since the existing 32 Solar Stills are not able to provide water for everybody. Given the possible improvement of the water situation, plans are pending to increase the number of stills by another

16 fibre-glass solar stills to make of total of 48 the number of stills in Zutshwa.

Fibre-glass stills will be used for the above proposed expansion as they require less water to be brought in, need less skilled labour, and do not require river sand for cement. River sand is necessary to give a water proof cement but is not available at the site. It has already been found there that the salty water eats away cement very quickly hence we cannot consider brick stills.

Photo 12. The Extension Officer (RIIC) Mr. M. Mooka and Field Officer - Mr. J. Tlhage addressing a group of participants during the Zutshwa Workshop.

C H A P T E R 5

LESSONS FROM THIS EXPERIENCE

Some broader lessons about the factors affecting the design, adoption, and use of appropriate technologies in general can be learnt from the Botswana (RIIC) Small-Scale desalinator programme. These lessons concern the relationship between technology choice for remote area water supply systems and delivery systems as they interact with social, economic, institutional, and policy factors.

In this case, the choice of the technology was mainly based on laboratory experiments or rather engineering principles. But, anyhow, this choice was a direct response to a need in the Remote Area Settlements resulting in a request to RIIC from Kgalagadi district Council for us to come up with possible technical solutions to the need. Initial work showed that no traditional technologies related to desalination existed which could be used as a starting point. Consequently, we had to resort to adopting distillation devices developed elswhere in the world or develop new devices altogether based on the already existing known distillation principles.

Despite the fact that the need to start this programme was ignited by the local authorities viz Kgalagadi District Council, our experience over the period of project implementation has shown that it is very difficult to coordinate and incorporate the programme with the general council water policy. While we managed to attain satisfactory participation from the Remote Area Development Programme Office, imput from the rest of council has been minimal. Infact the minimal participation has been heavily imbued with reluctance mainly related to the fact that the technology is not satisfactory. The putting up of numerous installations which meet whole community water needs could possibly give credit to the technology and possible acceptance by the authorities - local and central government.

32/...

In fact, the idea of having the desert RADs as the target group was as far as we are now concerned a set back. This is so because their acceptance or non-acceptance of the technology has no effect what so ever on the general government water supply policy. Government has an overall responsibility of supplying drinking water to everybody in the rural areas. Thus it is up to the authorities to decide on acceptable water supply system given the resources at their disposal. The acceptance of the desalination technology as an alternative option of supplying drinking water to the desert RADs as opposed to trucking water still remains in the hands of Central and Local government. Basically, the above situation applies to all RIIC water related technologies especially windmills and Animal Drawn Pumps.

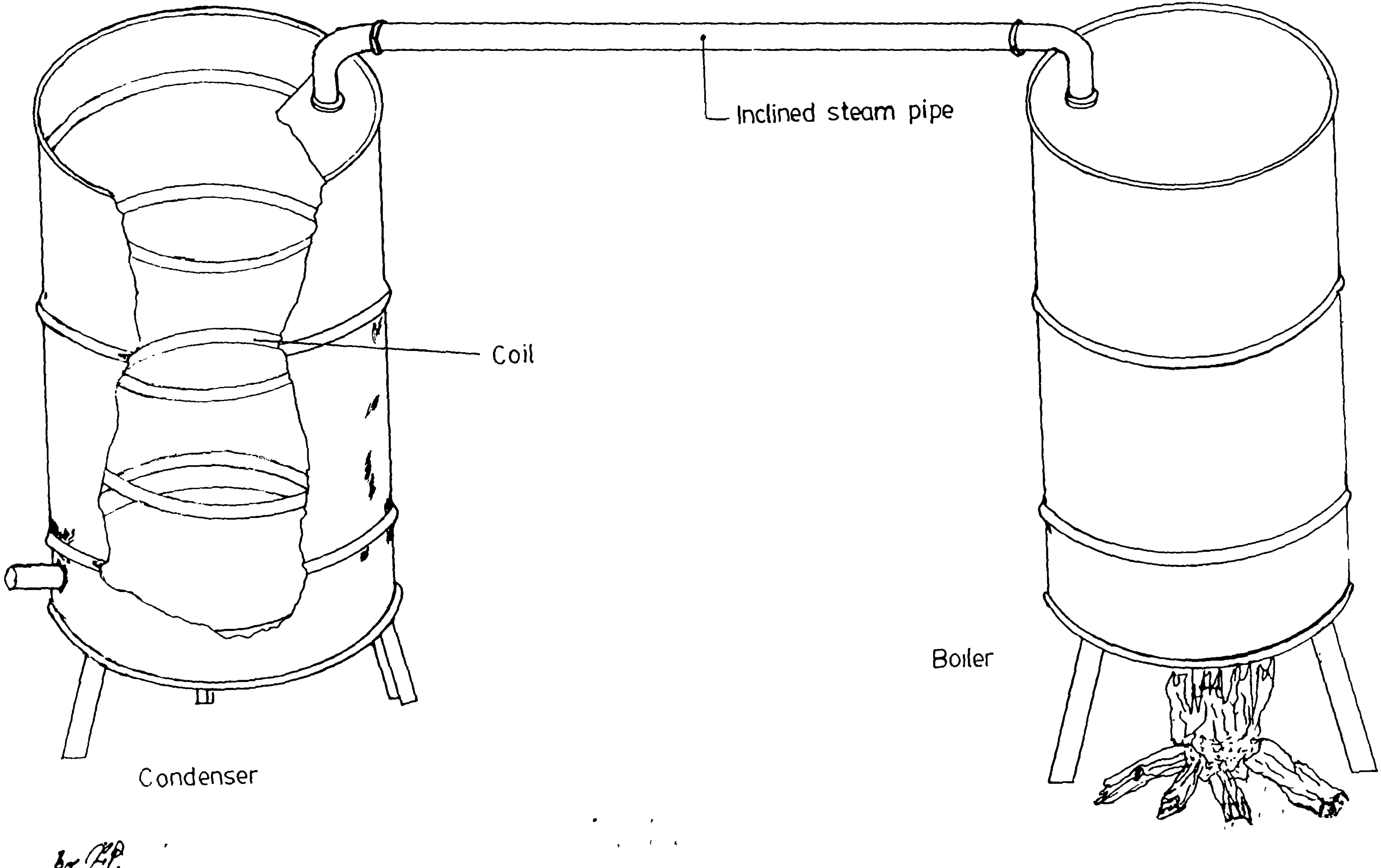
While the desalinators (solar) are expected to last for a maximum period of 8 - 10 years. We are now aware of the fact that their life expectancy can be considerably reduced to 2 - 4 years due to fragility. These designs require considerable care and maintenance on a daily basis. It is very important that they be kept in a working order continuously. Failure to do so has always resulted in considerable drop in yield mainly due to material deterioration e.g. over-heated glass.

Despite the intensity of work done in the settlements, the Kalahari RADs still lack a complete understanding of the desalination technology. This is mainly due to the fact that it is not their responsibility to assert their own water supply systems. Government has the overall responsibility of meeting the above need, hence, ought to have been the primary target group. This is so because it is government, local and central, responsibility to consider the various options available and ultimately finance the most suitable one. It still remain RIIC's responsibility to convince government that desalination is a potential technology worth considering.

While the Emergency Programme can now be said to have come to an end, the field research programme (IDRC funded) will continue for a considerable period of time - up to October 1987. Hopefully we will, during this remaining period, learn more on some other aspects of the technology especially the technology transfer aspects. Much of the work will now be concentrated in Lokgware, Zutshwa and Khawa - all in Kgalagadi district.

&&&&&&&&&&&&&&&&&&&&&&&&&&&

THE GHANZI STILL



COST OF GHANZI STILL:

Materials per Still

1	x	Used 200l drum	P.15
1	x	New 100l drum	P.38
3m	x	galvanised pipe (15mm)	P. 3
1	x	15mm socket	P. 1
1	x	15mm union	P. 2
4m	x	angle iron for task stans	P.11
2	x	20mm elbow	P. 2
1	x	copper coil (second hand)	P.18
			P.90
Labour			P.60
			P.150

Cost of Mexican Still Installation at Zutshwa

Materials

Number	Stills	Unit Cost	Total Cost
32	fibreglass basins	205	6560.00
70m^2	glass	28.26	1978.20
8	6m lenghts 20mm galvanised pipe	8.55	68.40
37	silicone sheet	9.55	305.60
6	rolls weatherstrip	13.00	78.00
			8990.00

Foundation

74 bags	vermiculite	10	740.00
2000	bricks	.20	400.00
65 bags	cement (average price)	6.50	422.50
75 lenghts	asbestos gutter	8.25	618.75
2 kg	epoxy	19.00	38.00
			2219.25

Piping

22 lengths	20 mm galvanised pipe	8.55	187.00
64	nipple	0.25	16.00
64	tee joint	1.17	74.88
10	eblow joint	0.83	8.30
8	union	2.05	16.40
2	2 m^3	450	900.00
			1202.58

Fencing

30 x 30 m	bolts and fastenings	-	50.00
2	gates	60.00	120.00
6	corner poles	28.50	170.00
8	supporters	10.00	80.00
4 rolls	mesh wire	47.00	188.00
56	poles	9.50	532.00
1 roll	barbed wire	70.00	70.00
2 rolls	8 guage wire	73.00	146.00
			1356.00

Total cost of materials	13,768.03
Cost of Labour employed @ P2.00 per day	508.00
Cost of RIIC labour @ P10 per day	P1,140.00

TSABONG COUNCIL WORKSHOP - 24TH OCTOBER, 1986

DESALINATION (SMALL SCALE)

(a) TECHNICAL DETAILS

1. Use of the technology - areas of application
   - Salty water sources
   - Reliable long - term supply
   - Reasonably small settlements i.e. Khawa
   - Strictly for people not animals

2 Construction materials

(i) Fibre - glass solar stills (mexican)
   - Fibre - glass mould
   - Galvanised pipes, joints and connections
   - Silicon sealant
   - Vermiculite Cement
   - Ordinary Cement
   - Bricks (prefferably stock bricks)
   - Glass

(ii) Brick stills (none as yet installed in the field)
   - Bricks
   - Cement (ordinary)
   - Vermiculite Cement
   - Fibre - glass guttering
   - Silicon sealant
   - Glass
   - Strong water - proof paint
   - Hatch hole covers (plank or insulated fibre - glass block)

(iii) Wood -burning stills (GHANZI STILL)
   - 1 x 200 l litre drum
   - 1 x 100 litre drum
   - Copper coil
   - Galvanised pipe and joints
   - drum stands (Tripod)
   - Distillate collecting containers

3. Material Suppliers

- Fibre - glass solar stills and gutters - S and J (Pty) ltd Gaborone
- Galvanized pipes, fittings and joints - any other known suppliers
- Silicon Sealant Gaborone Hadware, B.M.B. or any other known suppliers
- Vermiculite Cement - Mondaval S.A.
- Ordinary Cement - Any known supplier
- Bricks - Any known supplier or Drought relief
- Glass - Any known supplier (i.e. Plate Glass Botswana)
- Paint - Delux suppliers
- Drums - Any supplier
- Copper pipes - Any Dealer/supplier

4. TOOLS

- Silicone Guns
- Building and painting tools
- Glass Cutters
- Plumbing tools

5. CONSTRUCTION METHODS

(i) Mexican stills
- laying of concrete slab and bricks
- preparation of insulation
- Installation of still
- Distillate piping
- Cleaning of still
- Glazzing

(ii) Brick Stills
- Brick foundation
- Building of walls and plustering
- Preparation of insulation
- Final plustering of base

NB: Leave for about 2 weeks for cement warte to properly cure/dry
- Painting
- Glazzing

(b) MANPOWER NEEDS

- Coordinator (knowledgeable enough with the technology)
- Supporting staff i.e. RADs to help with extension and routine maintenance work
- Site attendant (paid by council) depending on the number of stills

(c) YIELD OF STILLS

Mexican stills: 4 - 8 litres distilled water per day per still
Brick still (9 m^2)

Dilluion proportions to depend on salinity of the borehole/well and end - users faste

NOTE: Two Mexicans stills will be installed to give the serminer attendants a practical idea of what the technology is all about.

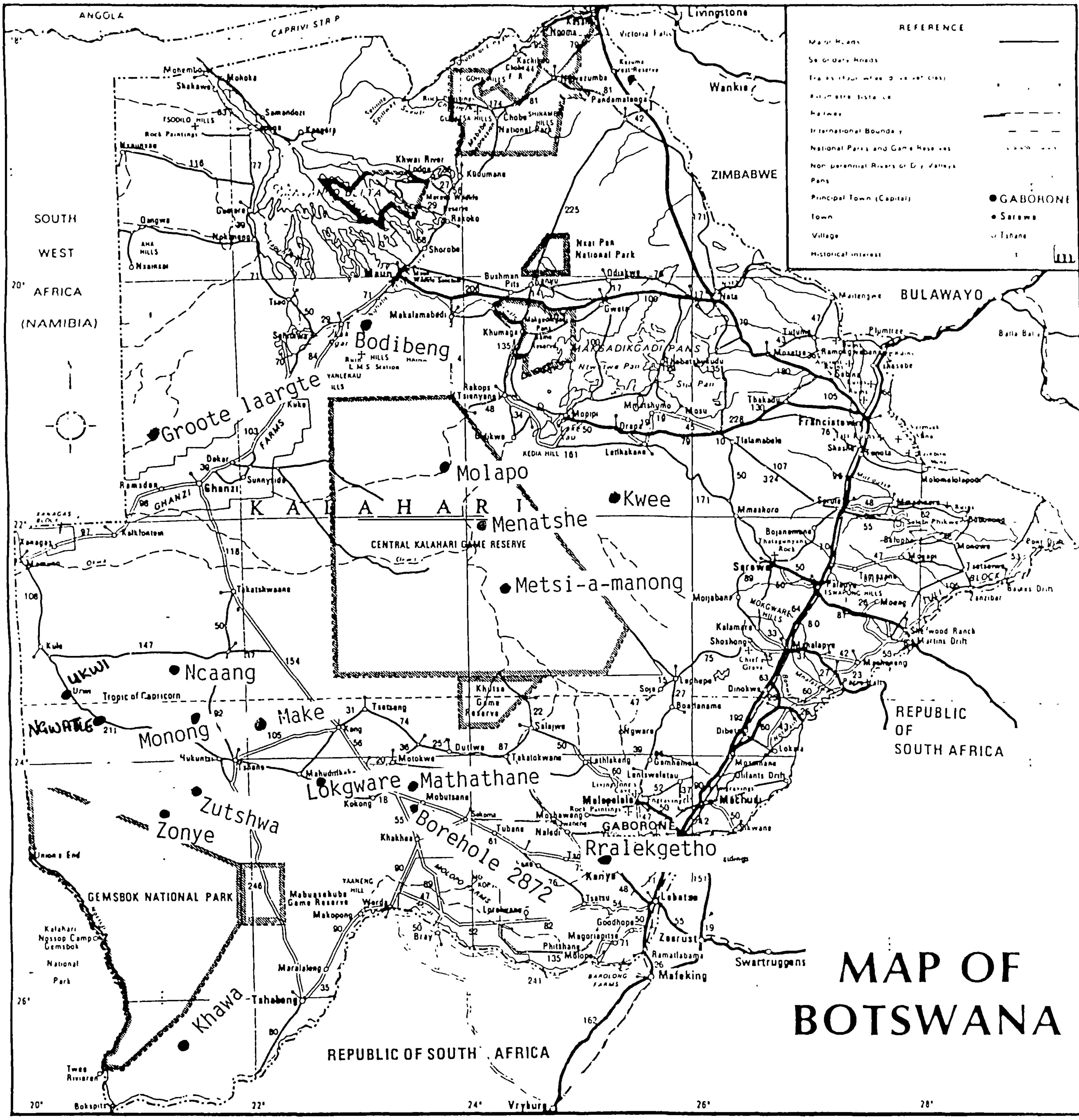
HIVOS FINANCIAL REPORT

	Total Reallocated Budget	This period allocation	Expenditure to date	Balance c.f.	Ecpenditure this period	Balance at end of project
A. CAPITAL COSTS						
1. Desalinators: Materials	13726	2500				
Manufacture	5536	1500	18861	400	5194	(4794)
Total Capital Costs	19261	4000	18861	400	5194	(4794)
B. RECURRENT COSTS						
1. Salaries: Field Officer	6664	1250	5414	1250	1250	-
Extension Officer	6287	-	6287	-	-	-
Driver/Assistant	3396	500	2896	500	500	-
2. Repairs & Maintenance	1744	580	669	1075	-	1075
3. Insurance	1200	-	600	600	600	-
4. Travel Allowances	5026	2000	3513	1513	480	1033
5. Site Installation	0	-	-	-	-	-
6. Kilometrage	14914	4000	13391	1523	1867	(344)
7. Training	4111	1500	1211	2900	-	2900
8. Administration overheads	5650	700	4950	700	700	-
9. Desalinator Maintenance	20	-	20	-	-	-
10. Contingencies	5	-	-	5	-	5
Total Recurrent Costs	49017	10530	38951	10066	5397	4669
TOTAL A + B	68278	14530	57812	10466	10591	(125)

HIVOS -

SUMMARY OF PAYMENTS AND EXPENDITURE

DATE	AMOUNT	EXPENDITURE	BALANCE IN U RIP
6/84 - 11/84		9030	
3/85	29794		
3/85	10803		
3/85			31567
12/84 - 5/85		9095	
5/85			22472
6/85 - 11/85		19573	
11/85			2899
11/85	10063		
12/85			12962
12/85 - 5/86		20113	
5/86			(7151)
7/86	17618		10467
6/86 - 11/86		10591	(124)
	68278	68402	



Proposed Sites

1. Zutshwa
2. Monong
3. Make
4. Ncaang
5. Ngwatle
6. Ukwi
7. Zonye
8. Khawa
9. Mathathane
10. Borehole 2872
11. Bodibeng
12. Groote laargte
13. Metsi-a-manong
14. Menatshe
15. Molapo
16. Kwee
17. Lokgware
18. Kokotsha
19. Rralekgetho

RIIC Minimal Involvement

1. Manong
2. Make
3. Ncaang
4. Metsi-a-manong
5. Kwee
6. Mathathane
7. Kokotsha
8. Rralekgetho

RIIC Major Involvement

1. Khawa
2. Zutshwa
3. Lokgware

* Shows site distribution