ASSESSMENT OF TECHNICAL ASPECTS OF PROGRAMME IMPLEMENTATION AND THE FEASIBILITY OF A REPAIR AND CONSTRUCTION WORKSHOP TO SUPPORT TECHNICAL DEVELOPMENT AND MAINTENANCE IN THE INTEGRATED AREA BASED PROGRAMME: UUKWALUDDI

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1. INTRODUCTION

1.1 The UNICEF, Council of Churches Namibia, and Government of Namibia supported Integrated Area Based Programme (IABP), in Uukwaluudi has engaged in a number of community based development initiatives comprising community health, water and sanitation and income generating projects.

1.2 The following report constitutes a technical assessment of the various components of the programme with suggestions related to the technical development and needs of each aspect of the programme.

1.3 The report also makes an evaluation of the possibilities of establishing, operating and maintaining a viable artisan workshop, both in direct support of the community through possible sales of manufactured or repaired goods and indirectly, through the support of the IABP in its general development interaction with the community.

2. BACKGROUND

Uukwaluudi forms a constituency of Omusati, a newly formed region within former Owamboland.

2.1 The Oshana system.

2.1.1 Because of the unusual nature and its effect on the life and overall potential development of the district an understanding of the topography and physical characteristics of the district is essential.

2.1.2 The entire region is a part of an extensive sandy plain reaching some several hundred kilometres into Angola and stretching down to the vast Etosha Pan area. This is an internally draining basin without the clearly defined river system more typical of a land drainage system. There are no small, catchment waterways leading from a watershed to larger rivers with a distant, external discharge. Here the terrain is table flat, with wide and extensive waterways called Oshanas, the edges of which are not discernible by eye, meandering slowly from a generally north to south direction.

2.1.3 Oshanas form a network of very shallow waterways and pans with an extremely low gradient. In a season of good rain, especially following prolonged falls in Angola, water moves slowly, no more than some 0,5 metres per second, throughout the system, towards the Etosha Pan. In seasons of poor rainfall water is far less extensive in the system and only accumulates in parts of the oshanas, evaporating and draining into the underlying sand layers. Such water is in evidence for some two to four months following cessation of the rains and is thus available for some eight to ten months of the year.

2.1.4 Such a system has far reaching effects on any development initiative. Being in general extremely shallow waterways with very slow moving water there is no effective flush of water. The waterways, which are used extensively as sources of domestic water remain throughout the season, polluted with household rubbish, animal faeces and carcasses.

2.1.5 With no clearly defined water courses there are no possibilities for conserving water in typical dams which impound water behind an embankment. Dams in the oshana must be excavated pans or tank dams taken down to an impervious calcrete layer, which makes them both difficult and expensive to construct.

2.1.6 Much of the medium level water is saline and because of this and the exceptionally fine Kalahari sands, both at the surface and deeper underlying levels, boreholes offer very little potential for water development in this area. Sands slowly penetrate even the latest synthetic textiles, permeating the boreholes, destroying the pumps and clogging the boreholes with silt.

2.1.7 Soils, which have an average consistency of 95% sand, are infertile with very low nitrogen contents. Organic matter on higher land is often as low as 1% and only some 5% within the oshanas. Although the pH is usually neutral the soils are generally deficient in the three major plant nutrients, Nitrogen, Phosphate and Potash, as well as many of the important trace elements. Soils thus require considerable improvement to sustain any intensive or semi intensive cropping.

2.1.8 Although the water table generally lies fairly close to the surface throughout the year, abstraction rates of fresh water must, of necessity, be at an absolute minimum. To compound further an already difficult water development potential, the underlying sand levels are highly salt ladened. Being an inland basin terminating in the Etosha Pan which has no outflow, there has, over the milleniums, been a massive build up of salts. Salinity, with a subsequent souring of land, is continually increasing within the area, due to this influx of salts ladened water. As the water only slowly passes through, or evaporates from the system, a precipitation of salts remains which works its way into underlying sand layers.

2.1.9 In many localities there are underlying pockets of impervious calcrete which retain the salt deposits in a proximity close to the soil surface and within the plant root zone.

2.1.10 Natural salt removal is very limited, being either wind blown from the surface in very small amounts, or in years of high rainfall within the catchment area, through the creation of a washing effect with a downward movement of dissolved salts into the underlying sands. With a low infiltration rate into the system or an over-abstraction of water, the process is reversed and salts come closer to the surface.

2.2. Food Security.

2.2.1. Dry-land cropping.

Crops grown are sorghum in the lower lying oshana areas with millet (mahangu), on the slightly higher more arid land beyond the oshana. Over the years available draught power for tillage and cropping has diminished. Opportunities to develop tools and appropriate tillage equipment may well exist.

2.2.2. Food Storage & Processing.

The design and use of materials in traditional grain stores is always the most appropriate and acceptable method of staple food storage. The Owambo grain stores are large baskets holding anything from 300 to a massive 1500 kilograms. Construction is of small diameter mopane sticks, which are bound into a continuous plait, one coil being sewn to the next. Finally a clay lining is applied to the inside of the basket. The baskets sit in a similar, substantial ring supported on short mopane poles to keep the construction off the ground. Access to the basket is by way of a removable thatch roof. Depending on the affluence of a family and the area of mahangu cultivated, baskets may be from three to ten or more in number.

2.2.3 Weevils do not attack the very small grains of the traditional millet varieties. The newly introduced Okashana No1 and other millet varieties with larger grains may however not be as immune to weevil attack and may require an adaptation to existing systems.

2.3. Traditional Skills and Tools.

2.3.1 The construction of a traditional home is an art, developed over generations using suitable and available materials. Two types of roof construction were observed with neither requiring anything but a basic tool. In fact all that is required in the entire construction of a traditional village is an axe to cut, and cut to length, structural poles, invariably mopane (omusati). The actual fixing is by lashing with mopane bark and makes a most neat and sound structure. As a result, because there is no heritage of traditional tools, there is only a limited knowledge of such and no methods of tool making have evolved, consequently there is no potential market for such tools.

2.3.2 As with both household roofs and walls, the basic construction principle of traditional grain stores is one of binding. Such methods and skills are developed and adapted over time to suit prevailing conditions. Unfortunately, through the rapidly changing circumstances of wildly growing populations, environmental degradation and global pollution, many passive, once sustainable, traditional systems, have been unable to keep pace or adapt quickly enough and have now become inappropriate. A rural workshop may well have a role to play in improving or correcting such situations.

2.3.3 Traditional craft work is restricted to household needs, such as grain and meal handling baskets, all of which are made within the home by women. There are no local sales of baskets or other fibre craft work and thus nothing which could be supported or developed within a workshop. Surprisingly, since palm trees grow extensively throughout the area, little use is made of palm leaves or fibre. There is a tradition of clay pot manufacture, but this also within the home and thus little opportunity for significant sales. Again, there is no traditional skill associated with seating since typically, it is provided by felled logs or palm tree stumps rather than on crafted stools or benches. A local market expected to have goods necessary to the greater community was, of traditional wares, selling only pestles and mortars for grain processing, and these of poor quality from Angola.

2.3.4 Of significance to any technical intervention is the division of labour. Being an essentially pastoral area the livestock become the chief responsibility of men. This responsibility extends to plowing but it is then the responsibility of women to plant and cultivate crops. Harvesting has a peak labour requirement so the entire family is then involved but it again becomes the responsibility of women to thresh, winnow and store grain. However work is sometimes undertaken collectively through "ondjambi", when a number of families come together to work in rotation on each families land. Within the household, men are responsible for obtaining building materials, essentially mopane, and for general building construction. However, of the two building designs, one construction is virtually a male prerogative and the other a female. Women are then responsible for building and grain store maintenance and for providing baskets, pots and jars. This on top of the routine work of drawing water, gathering and fetching firewood and preparing and cooking meals.

2.3.5 It should be noted that in many parts of Owamboland increased demands for wood suitable for construction, as well as for fuel is leading to some areas becoming severely de-forested. However there are mixed understandings with regard to this, some considering that the traditional methods of high timber use, lead to increased environmental degradation, through the cutting of such small wood and particularly, through the stripping of bark which kills the tree. Others however feel that there are still extensive areas of mopane and that such practices in fact encourage mopane growth by clearing out young scrub and assisting the young growth to mature. Some consider that coppicing, harvesting the main stem so that several strong side stems grow out, is a desirable and sustainable method of tree husbandry but others still encourage the felling of mature trees in forest areas, considering it better to clear land for natural regeneration. Whatever the persuasion, it must be acknowledged that mopane forests are over used and deteriorating and that some management control is necessary.

2.3.6 The tools observed, whether at a household or commercial level were extremely well cared for. Two pangas for instance, each had a leather cover shrunk onto the handle, thus extending the life of the tool and making it considerably more comfortable to use.

2.3.7 Although I found literature and old pictures of blacksmithing in Owamboland, as well as receiving oral confirmation, no evidence was found to support the present existence of this traditional skill. This, in spite of ostensibly good prospects for the trade, with so much scrap steel available from vehicle bodies, chassis and springs. As well as an apparent overall dearth of traditional tools two other possible clues to the apparent loss of this art are, the widespread availability and subsequent preference for commercially available hand tools and a lack of good wood of a shape suitable for typical, traditional methods of fixing handles to tools.

3. IABP INVOLVEMENT

The foregoing has far reaching effects on every development initiative and thus the support technologies which can be utilised. The following components of the programme each require some form of service, maintenance and repair facility.

3.1 Community Health, Water & Sanitation.

3.1.1. Potable Water.

Surface water is generally polluted. Adequate, appropriate and cheap systems to ensure sufficient and effective supplies of potable water are therefore of prime importance. The adaptation of local traditional technologies, such as shallow wells, developed and promoted through a rural, artisan workshop may well increase both acceptability and sustainability.

3.1.2. Pit Latrines.

The sand soils are so unstable that pits are liable to collapse. The water table itself is high, occasionally so high that extensive slow-moving bodies of water are included and become contaminated through the pits. An artisan workshop set up with appropriate tools and equipment and cognisant of the need for adequate care and planning may well be of assistance in excreta disposal systems which will prevent the ingress of contaminates into the fresh groundwater table.

3.2. Food Security

3.2.1 Irrigated Gardens.

Particularly in areas bordering on an oshana or canal, gardens are a possible intervention with considerable implication for a rural workshop. Tools, small scale equipment and basic pumps each have distinct possibilities for manufacture and repair. However in view of the prevailing water and soil conditions, meticulous care and monitoring must accompany any involvement with irrigated gardens.

3.3 Income Generating Projects

3.3.1 Brick making,
3.3.2 Fence wire manufacture,
3.3.3 Bread baking.
3.3.4 Grinding mills.
3.3.5 Irrigated gardening.

The above are each undertaken within the IABP and are reported on in the following section. Each could well gain support from a rural based artisan workshop programme.

4. REPORT ON TECHNICAL ASPECTS OF IABP ACTIVITIES.

4.1 Water and Sanitation Programme.

Presently the IABP programme consists of:-

1. Water Harvesting.
2. Shallow Wells,
3. Sand Filters.
4. Pit Latrines.

4.1.1 Roof Water Harvesting.

This aspect of the programme is primarily one of roof water collection from corrugated iron (zinc) roofs, where the water is stored in ferrocement tanks. This initiative is presently, primarily, an emergency programme, constructing one-off tanks on suitably roofed buildings such as schools, clinics and churches. In this severe drought several of the tanks have been regularly filled for communities by mobile water tankers. However, with a view to operating a household water supply programme, although most traditional village homes are comprised of small, thatched roofed buildings some 70% of villages also had at least one zinc roofed building suitable for equipping with a roof water catchment system.

4.1.1.1 The existing ferrocement tank construction involves the use of re-usable frame moulds of angle iron and corrugated iron, with 200x200mm aperture x 5,00mm diameter wire reinforcing mesh, in the base, wall and top. The wall and top also uses 13 mm chicken wire netting for both strength and initial ease of plastering. Unfortunately available sands are very fine, which does not make for strong plaster and necessitates a lot of cement. At the tank seen under construction the walls were being raised above the mould and there was insufficient watering of the surface of the initial plaster layer before the second layer was applied, both of which further weaken the final tank wall.

4.1.1.2 Construction consists of a base layer of concrete (1 cement : 3 sand : 4 gravel), cement is widely available and locally available sand is used but the 19mm gravel has to be trucked in 100 kilometres from Ruacana. Reinforcing mesh with

two layers of cement plaster (1 cement : 3 sand) is applied over the reinforcing mesh and netting. After removal of the forms an internal layer of plaster is applied and a final plaster (1 cement : 1 sand) is applied to the inner surface giving an ideal wall thickness of some 50 to 60mm. Flat, pre-cast slabs have been used on the tanks as covers, however, recently a new method of fully sealing the tank with an integral domed cover has been introduced. This self supporting cover is cast over removable moulds supported on temporary timber props.

4.1.1.3 Two sizes of tank are in use, both stand 1,80 metres high, one stated to be of 5,00 cubic metre and one of 10,00 cubic metre capacity. One tank measured however, with walls of 100mm thickness only gave an effective storage capacity of 3,6 cubic metres. At 800 to 900 Rands estimated by the Programme Water Consultant, for the "5,00" cubic metre tank, this is very expensive water.

4.1.1.4 Suggestions.

4.1.1.4.1 The IABP should establish the degree of community interest in this aspect of its water development programme and clarify its position accordingly. The programme must establish whether or not tanks are to become a part of a household water security programme or remain as community water supplies, based at schools and clinics.

4.1.1.4.2 Although a standard size, standard price tank, may have advantages at a household level there should be better awareness and correlation of tank size or number to roof size and rainfall. See appendix 4. This is particularly important if roof tanks are to be accepted as a method of improving the access of households to potable water.

4.1.1.4.3 If roof water harvesting becomes an integral part of the programme, a viable, sustainable system of both tank construction and gutter fabrication and erection must be established.

4.1.1.4.4 Alternate methods of construction should be considered to reduce the installation costs. These could include, alternate methods of reinforcing for the moulds presently used, see appendix 4, other methods of ferrocement construction and the use of corrugated iron tanks.

4.1.1.4.5 Brass taps are not only easily left turned on, but are prone to leaks and are an expensive way of closing

water. A length of flexible hose reaching to the top of the tank would be a significant reduction over the cost of the bibcock and the brick built sump into which it leads.

4.1.2 Surface Water Harvesting.

4.1.2.1 An experimental 5 x 5 metre surface catchment area covered with a polythene sheet draining to a five cubic metre sub-surface polythene sheet lined tank has been tried, estimated cost 300 Rands. The surface sheet was in a good condition and may well have a useful life of three years or so, it did however, contain pockets of sand in the depressions and is a potential rubbish trap, all of which would ultimately work their way into the tank. Further, the unstable surface sand surrounding the top of the tank had slumped to the bottom of the hole, making the top unsafe and also reducing the capacity of the tank.

4.1.2.2 Several designs of sub-surface ferrocement tanks have been successful in similar situations, however, initial reactions to this method of water harvesting has not been good. Many local people equate an excavation in their home yards to an impending death and are thus reluctant to install such a system. Although the system could be sited in arable lands this would require further fencing and protection and still not overcome the initially outlined problems.

4.1.2.3 Suggestions.
This water harvesting initiative has been a useful experiment but when considering the amount of dubiously potable water and the associated difficulties and reservations attached to the system, it is, I consider, no longer worth experimentation.

4.1.3 Traditional Shallow Wells.

4.1.3.1 This is a well established and highly accepted traditional practice, conforming to culturally acceptable parameters of individual rather than community responsibility for water. When traditional values, management systems and usage methods are applied the system offers, in suitable areas, a most sound and feasible method of potable water supply.

4.1.3.2 The system gains access to two limited, fresh-water supplies. To "omifima", temporary, seasonal sub-surface micro catchments of fresh water perched on the underlying impervious calcrete layer or to the fresh water "lens" which form on the underlying saline water-table. These vary each season in their depth, depending on local and upper catchment area precipitation. The first are more general away from the main oshana system, the second, depending on the locality, more within the oshana system.

4.1.3.3 Traditionally, households dug and managed their own wells, constructing a fairly large cistern and "lining" the upper parts with chunks of calcrete built on substantial timber cross-members. These wells, depending wether they are omufima or water-lens, range in depth from only a couple of metres to some, almost twenty metres. Three wells were measured, one 8,5 metres deep and two six metres deep, each had some 500 to 550mm of standing water.

4.1.3.4 To line such wells, the Rural Development Centre (RDC) among others, constructs heavy pre-cast concrete well rings. The RDC rings are cast at their workshop at Ongwediva, eight fit in a truck for transport to a well site and are lowered into place by truck mounted crane. Moulds are of heavy 5,00 mm plate and in three sections bolted together, the outer has a diameter of 1,30 metres and the inner 1,10 metres, both are 0,60 metres high. Mixture is 2 cement : 5 sand : 3 aggregate, the sand being local and the aggregate from Tsumeb. Bolts are inserted into the moulds at casting for permeability, a reinforcing ring at the top of the ring acts both as a handle for moving and as foot holds when in the well. Rings sit one on top of the other, surface to surface without notched lips. The IABP programme has cast in-situ the concrete lining for one well dug at Elondo.

4.1.3.5 The possibility of using soil augers (notably the Vonder Rig), is an automatic first response, however, experience has shown that they do not readily penetrate either the solonetz (sandstone and clay), or calcareous layers above the water bodies, but only create a muddy paste in them. Hand digging, with pick and shovel however, can reach the water bearing layers and although laborious, is a method which local communities can carry out unaided. Further, through innate knowledge of vegetation types, ant hills etc., the identification of possible fresh water areas is certainly something best left to local people.

4.1.3.6 RDC uses a tractor mounted soil auger, which can reach 32 metres, this however operates best in areas away from the main oshanas where they are looking for at least 2,00 metres of standing water and where hand pumps, notably the "Bush Pump" can be installed.

4.1.3.7 In these shallow wells which are generally between six and twelve metres deep, salinity is a particular problem. Wells which are deeper than this reach saline water and abstraction rates must be minimal, over abstraction of fresh water also introduces saline water into a well. It is the perched water table on the calcrete which must be reached, without breaking into the underlying water levels. Because of the ingress of saline water such wells may only yield fresh water for some eight to ten months. Nevertheless these wells probably offer the best solution for potable water, particularly when used in conjunction with a roof rainwater harvesting tank.

4.1.3.8 Seven traditional unlinined well sites were visited north of Tsandi. Although each was flooded from the nearby oshana, it was apparent from observation and from interview that each site contained anything from two to twelve bodies of water. However, as all were flooded they were usable. The lining, backfilling and equipping with handpumps of these wells would improve considerably the available potable water for the community, ensure a cleaner and more regular supply of water and make considerably easier the drawing of water by women. See appendices 5 and 6.

4.1.3.9 Possibilities exist within the IABP area for developing wells, particularly in conjunction with an artisan workshop.

4.1.3.9.1 Moulds for pre-casting concrete well rings and shuttering for casting in-situ well linings can be fabricated.

4.1.3.9.2 The fabrication and subsequent service and maintenance of simple low lift, low volume, inexpensive handpumps can be undertaken. One appropriate pump, the "Simbi" pump is already on demonstration at the Tsandi office as is the "bucket pump". A variation of the bucket "pump", which was really designed for borehole use would be the most appropriate solution to abstracting water from a shallow water body. Assistance can be obtained from RDC

which fabricates bush pump, pump heads and bucket pumps in its workshop.

4.1.3.10 Suggestions.

4.1.3.10.1 In view of the limited options for potable household water, the general low cost and the overall acceptability of such water source development, this intervention should become a more focal point of the programme and, should be persisted with even when some diggings prove to be either dry or of extremely low yield. The repair of tools, sharpening of picks etc. may be undertaken by the most basic of blacksmith equipment.

4.1.3.10.2 The casting of well rings and subsequent lining of both existing and new wells should be given more attention within the programme. Concrete well rings can be easily made by the existing brick making groups. See appendix 5.

4.1.3.10.3 Simple bucket pumps should be made by local artisans for sale to the programme and to individuals. See appendix 6.

4.1.4 Sand Filters.

4.1.4.1 Both the potable water initiatives (roof water tanks and wells), pursued by the programme can only provide limited quantities of water. Since, in general, clean water supplies are insufficient, potable water supplies will be augmented by water from any available source, from the extensive canal and water pipeline system and from open oshana water. Because of the nature of the oshana system it is to be expected that this source of water is infested with E.coli and contains high levels of organic matter and very fine silt in suspension.

4.1.4.2 Because of this situation and particularly because the programme is attempting to increase the quantities of clean water available to households, it is imperative that efforts be made to develop effective, reliable systems to make such water drinkable. Particularly, for instance, when the programme promotes the use of "aqua rollers", which makes it easier to transport more water, much of which will be from open, polluted oshanas.

4.1.4.3 Some basic attempts have been made to filter water. Experiments have comprised varying layers of sand and gravel, with and without charcoal, placed in 200 litre steel drums. Results have so far not been good and consequently the technology has been largely ignored by all who are even aware of it. A particular problem is one of smell, which the water picks up during filtration. Also, people do not expect to wait whilst a trickle of filtered water fills a cup, and thus will simply draw a quantity of contaminated water for drinking.

4.1.4.4 Suggestions.

A lot more serious effort has to be given to developing a satisfactory and acceptable filter.

4.1.4.4.1 There should be considerably more awareness building amongst the community by staff, on potable water and the need for water filtration.

4.1.4.4.2 A ferrocement container, of which there are many designs, would be a better filter receptacle than a steel vessel.

4.1.4.4.3 Because of the high concentrations of organic matter and fine silt in suspension, high levels of regular but basic maintenance will be necessitated with any system.

4.1.4.4.4 A system comprising a floculation tank, with or without a slow sand roughing filter, may be necessitated at a community level. Water which is very silt laden might have to be first passed through such a community filter system and then through a saturated, slow sand household filter. With the particular peculiarities of this water such a system may be necessary in spite of the considerably more sophisticated level of technology.

4.1.4.4.5 Whilst it has to be accepted that this is most difficult water to deal with, there has been a virtual science of slow sand filter systems developed with organisations such as ITDG. and WEDC in the U.K. VITA in the U.S.A. IRCWD in Switzerland and the CSIR in South Africa. Each has a wealth of specific information and experience and each, from personal knowledge, I can recommend. IRCWD are particular experts in sand filtration systems. (See appendix 2 for complete names and addresses of organisations with expertise in water filtration). Mr. Chandra Badloe has details on a CSIR operated computer

programme system "Water Lit". If followed up this may well prove to be of general assistance, with any of the other above listed organisations able to assist on more specific problems, such as that of smell.

4.1.5 Excavated Pans (Dams, or Tank Dams).

Whilst the roof water catchment and shallow wells offer the best general possibilities within this particular oshana system for potable water, the overall supply of water must also be improved. Adequate water is necessary for both livestock watering and for irrigated gardening to improve the local nutritional capacity and to increase cash incomes.

4.1.5.1 Evaporation within the oshana system is some 2,5 to 3,00 metres annually. Approximately 83% of surface water evaporates with 17% infiltrating into the ground. Any shallow water within the oshanas is thus quickly lost. By excavating 2,00, 3,00 or better 4,00 metres into impervious calcareous layers, water storage times may be considerably increased.

4.1.5.2 Because of the low speed of water movement, particularly where dams are well sited, siltation rates within the excavations are generally minimal.

4.1.5.3 As heights to any possible garden site or livestock watering point will be of only a few metres at most, simple, low lift, relatively high volume pumps, which could well be made in a rural workshop have a distinct possibility and advantage. A simple, foot operated "treadle pump", developed in Bangladesh, using local materials and further developed and used in Zimbabwe, has particular merit. See appendix 3.

4.1.5.4 Unlike more usual dams where the dam wall impounds a body of water many times larger than its own volume, the volume of water stored in a dam in an Oshana, is only the volume of the excavation. To be worthwhile, excavations need to be some 7000 to 15000 cubic metres. (A 10000 cubic metre dam could be 4,00 metres deep and 50x50 metre in extent). Although new excavations of this size are impracticable for community hand labour, desilting existing dams by hand is a possibility.

4.1.5.5 Suggestions.

4.1.5.5.1 A community programme be developed to desilt some of the older pan dams.

4.1.5.5.2 Some two or three new dams should be constructed in the project area and monitored on an experimental basis. RDC undertakes such work in its own water development programme and operates for this purpose two large scrapers of the type used on road construction work. Possible assistance might thus be forthcoming from RDC. Alternatively, there are several Windhoek based contractors able to undertake such work.

4.1.5.5.3 The operation of such machines is well beyond the scope, capacity and even vision of the IABP. If however, such water source development proved to be popular and successful, further contracted work could continue. Alternatively, on a much smaller scale, a farm dam construction unit, comprising a farm tractor, sub-soiler and dam scoop should be tried. If successful, the operation of such equipment would fit within the programme and prove to be a sustainable component. Initially, to gain experience, the work should be undertaken by a contractor but eventually would probably be better undertaken through the acquisition of the programmes own tractor and equipment.

4.1.6 General Water Supply Comments.

4.1.6.1 Within Owambo, where such an intricate, delicate and awkward balance of nature exists, no one water supply system is either suitable nor adequate in itself. Thus, as many systems as possible, which are successful within their various limitations, must be developed. These include, roof water catchment systems, protected shallow wells, filtration systems and to ensure sufficient water, even the considerably larger intervention of dams.

4.1.6.2 Partly because of limited water supplies and partly because of the poor water quality of the area, where available, there is an over-dependence on both the extensive canal and piped water scheme. There is, throughout the region, a network of canals and pipelines in excess of 1000 kilometres. The canals are in fact only another open water source and, as the oshanas themselves, easily polluted. The pipeline system is already

severely over-stretched and frequently suffers periods of insufficient or no water.

4.1.6.3 Of far greater significance however, is that almost the entire supply of water for this system comes not from Namibia but from within Angola. Reliance on this source is thus rather tenuous. With a political change within Angola this water might well, as a reprisal for Namibian support of the present Government, be terminated. Of even greater concern is that when peace finally comes to Angola, with whatever government, this water will be diverted sooner or later to development of southern Angola rather than northern Namibia. The establishment of adequate, sustainable, water supplies thus needs to be worked on now.

4.1.7 Pit Latrines.

4.1.7.1 The Ventilated Improved Pit (VIP) and the "Ombili Plat" (Peace Platform) latrines are both used in the programme. In ideal conditions a pit depth of 5,00 metres is sufficient to ensure a satisfactory latrine with no elaborate superstructure. With such a latrine fly entry is already minimised as is odour release. Further, the average family takes many years to fill a pit of some 10 to 20 cubic metres. The IABP however, is not a locality ideal for pit latrine construction.

4.1.7.2 Blair Research Laboratory, Harare, Zimbabwe, where the VIP latrine was developed, has research experience with a family of seven people, (two adults and five children). With little extraneous matter added to the pit, a 1,20 metre diameter by 3,00 metre deep pit has, to date, lasted fifteen years. Blair recommends a 3,00 metre deep pit, brick lined to full depth.

4.1.7.3 In many situations the VIP is well established as the "standard" for pit latrines. By virtue of its design, when correctly built and well maintained, "ventilated" latrines constitute a positive step towards improving community health. Because of the ventilation pipe which is sealed with fly gauze, odour is minimal and flies which do come into contact with excreta are unable to escape the latrine and are thus unable to spread disease. In order to achieve this however, the inside of the superstructure must be darkened. This poses its own problems

and further, makes particularly children, reluctant to use such latrines. Costs are high through the need to provide a covering roof and a solid wall. In general, within this programme, the VIP has proven to be too expensive for householders to purchase and is now usually only constructed at schools.

4.1.7.4 The Ombili Plat is a local adaptation of a Malawian design of pit latrine. Whilst not as refined as the VIP, this design does not require ventilation and the superstructure need not be as solid as a VIP latrine. A removable concrete insert fits into the main concrete slab, this seals the drop hole to the pit and thus reduces odour and excludes flies. When correctly managed, it conforms to general criteria and offers an adequate alternative. The concept has proven to be both acceptable and significantly cheaper. Some 30 Ombili Plat slabs have been made at the development centre and await sale.

4.1.7.5 The above ground latrine superstructure appears to be satisfactorily developed, the overriding problem is one of sandy soils which collapse at the surface into the pit. Several latrine slabs and cabins were seen to have sunk into the underlying pit. This phenomena is by no means peculiar to Uukwaluudi, but, because of the particularly unstable, sandy soil, it constitutes a frequent and persistent problem.

4.1.7.6 Pit latrines in sandy areas require lining to prevent subsidence. If the region was still well covered with indigenous timber, an ideal pit lining could be achieved with mature mopane poles, such as those used around rural homes, braced internally in a manner allied to traditional construction methods. However since the area is no longer well timbered this form of structure should only be encouraged in outlying areas.

4.1.7.7 Since the household hygiene programme is unsubsidised, if the cost of conventional lining with concrete rings were added to construction costs, latrines would be given a low priority by families. However, discussion within a live hygiene extension programme could bring about an appreciation of the value of a toilet which was stable for several years, particularly if the difficulty of initial payment costs could be overcome.

4.1.7.8 There are still many problems to be overcome before pit

latrines are more widely accepted. Particularly with widespread de-forestation the advantage of privacy afforded by a latrine should be inculcated during any discussions. The security of the structures needs to be ensured and a community involvement programme devised to establish the general principles of health and hygiene, especially around sanitation and water. Particularly with the local difficulties associated with the latrines, affordable ways must be devised to ensure that the system is developed to an acceptable stage.

4.1.7.9 Suggestions; primarily to prevent subsidence of the pit:-

4.1.7.9.1 Attention should be paid, where possible, to good siting. Although proximity to, and direction from a home is important, building near ant hills or mature trees, which help bind soil, should be considered. In order to reduce soil subsidence, pits should be dug round, rather than square.

4.1.7.9.2 To prevent edges of the pit from falling in the weight of the slab should be spread beyond the edge of the pit. In some localities mopane-logs could be suitable but better would be reinforced concrete beams, cast as bearers as a part of the pit cover slab. Two beams, either parallel or at right angles to each other should extend some 1,5 metres beyond the edge of the slab. In particularly unstable sites, where it is known that surface soil will fall into the pit, this practice should be employed to prevent the superstructure itself from falling into the pit and for safety of users.

4.1.7.9.3 An alternative method to prevent the loss of latrine superstructure into a pit is to place the slab and cabin on solid ground in front of a pit. The slab requires two load bearing beams which may be cast as an integral part of the slab to span the pit. The pit itself should be dug with reclining sides to extend under the drop hole of the slab. This method, although ensuring security of the superstructure, will require a sound covering to the pit, either with a further concrete slab or stout mopane poles covered with some 300 mm of soil.

4.1.7.9.4 Particularly where unstable soils continue to a depth of many metres relatively shallow pits, only to some 2,00 metres depth should be excavated. A further advantage of shallow pits is a reduction in ground water contamination at times when the water table is high. When the pit becomes full the slab and cabin can be picked up and used again by being

placed over another pit. The original pit should then be filled in and hopefully, cropped with a tree. This process is advocated by RDC with moderate success, they do at least have a limited market for a slab and cabin at 350 Rands.

4.1.7.9.5 The natural reclining angle of soil is 45 degrees. Whilst this is impracticable for a pit, the sides, through unstable sands, should be inclined, rather than sheer. Where calcareous or solonetz layers are encountered, pit sides may then be vertical.

4.1.7.9.6 In spite of the associate costs, some experimentation with pit lining must be undertaken, to establish effectiveness, acceptability and actual costs. Linings to try, should be brick, since these are already made by local groups; concrete rings since this technology has already been employed on shallow wells and, where suitable, a more traditional approach using mopane stakes should be tried.

4.1.7.9.7 In the worst of situations a system development of present practices may have more advantage than that of a "long drop" pit latrine. Shallow conical pits, little more than an excavation dug with a hoe to say, only 1,50 metres, will be considerably more stable than a deep pit. Because excreta is now close to the surface and thus a potential source of contamination, sand should be thrown into the "pit" after each use.

4.1.7.9.8 Useful cladding for the cabin roof or sides can be obtained by flattening discarded drink cans. This will also ensure that the cabins are lightweight and suitable for translocating.

4.1.7.9.9 If the simplest and cheapest, open and unventilated, latrine technologies are to be continued, a tight seal between the main slab and the insert is vital to exclude flies and contain bad odour.

4.2 **Income Generating Projects.**

4.2.1 Brick Making.

4.2.1.1 Two group projects were observed, one at the IABP development centre and one at Okahao, run in conjunction the Lunganda Grinding Mill Project.

4.2.1.2 At the Development Centre a group of six women and two men were making two sizes of solid concrete bricks; 70x105x220mm and 100x100x220mm. A larger 230x230x440mm block was said to be no longer made since it used too much material and was thus uneconomical and not popular. Beside the moulds being used there was another range of moulds on site which could produce either four 120x100x220m or 75x130x220mm solid bricks. The group was using 19mm granite stone from Ruacana with locally available sand. Mixing was carried out in a petrol engined concrete mixer and although of a fair consistency, was in danger of becoming too wet. The consolidation of the mixture in the three section brick mould, whilst somewhat inaccurate in quantity, was adequate.

4.2.1.3 The group at Okahao was using broken, scrap glass as aggregate instead of granite chips which seems an excellent, appropriate recycling resource.

4.2.1.4 No production system was applied by the development centre group. Although the materials were generally well placed in relation to the production floor, no attempt was made to clear a section of the floor and to produce bricks systematically, adjacent to a cleared area. The 10 x 20 metre work floor, shaded with a medium density shade cloth, was completely full. The brick mould was operated in one corner of the work area and the fresh bricks carried and stacked outside in the full sun. A realisation that bricks should be cured was apparent as questioning revealed that the bricks would be 'irrigated'. However there appeared to be little evidence to support this claim which in any event runs contrary to a production system in conjunction with a shaded area.

4.2.1.5 Although the selling price of bricks at 38 cents for the smaller and 47 cents for the larger was known, the cost price of the bricks and how the selling price was arrived at, was not.

4.2.1.6 Suggestions:

4.2.1.6.1 Awareness building in material and labour costs, budgeting and pricing would considerably assist sustainability of the project.

4.2.1.6.2 Productivity could be increased, giving more time for other ventures. The strength of the bricks could similarly be increased and breakages reduced by the

introduction of a production system.

4.2.1.6.3 Since costs are a major consideration, an experiment into the acceptability of 110mm and 150mm hollow concrete blocks which use the same concrete mixture and of which the group appeared to know nothing, would be worthwhile.

4.2.1.6.4 The project-made bricks and possible, future made blocks, would be ideal as an alternative to the somewhat awkward and cumbersome system of corrugated sheet metal moulds presently used for the roof water tanks. See appendices 4 and 5.

4.2.2 Fence Wire Making.

4.2.2.1 Wooden frames for the weaving of pig wire netting were seen at the IABP Development Centre and at the project group at Okahao, although neither were then in use.

4.2.2.2 Although these frames when used with light gauge wires are both effective and economical, the wire with which the Development Centre frame was set up was far too heavy for such a system. Using wire for which the frame is not best suited is time consuming, inappropriate and unsuited, especially for the operators; fatigue and painful hands are bound to ensue. An already slow process is further slowed and an undue strain is placed on the frame. A further problem associated with this particular method of making pig wire, is that of undue wear on the operators clothes as they lean over the wooden frames.

4.2.2.3 A roll of galvanised, 1,6 mm mild steel wire costs some 240 Rands, finished fencing presently sells at R 3,51 per metre for that 0,90 metre high and R 4,74 for that 1,20 metre high. Revenue from sales of fencing to the IABP and to the Ministry of Health have been sufficient for the group have more than purchased the fence making frames. However, local sales have not been great, some 20 to 30 rolls at most as communal arable lands are not fenced. Although there is frequently an intricate system of fencing within a village, wire fencing is presently not deemed appropriate for this use.

4.2.2.4 Suggestions.

4.2.2.4.1 A lighter gauge wire (1,60 or 1,25mm, or for particularly light work, 0,90mm) be obtained for the frames already in use.

4.2.2.4.2 Other equipment utilising other systems of fence manufacture be acquired for heavier fencing (2,00; 2,24 or 2,50mm). Two systems are available, diamond mesh (security) fencing which can be produced on hand operated machines and square mesh (sometimes called sheep netting) utilising another, less exacting, form of lacing (2,00 or 1,80mm gauge).

4.2.3 Bakery.

4.2.3.1 Although shown a building and two bread ovens, neither had been used for some time. The ovens were quite adequate, although the brickwork of one in particular had not been allowed sufficient time to cure before being fired, and thus was cracked and had much of the outer plaster falling off. Design of the ovens was a typical 200 litre drum design, which, particularly where baking is infrequent and old drums are readily available, makes for as sound a system as any.

4.2.3.2 Surface water in the proximity of the ovens was given as the reason for non-use of the bakery but in fact contributed only a minor, insignificant part of the general ineffectiveness of the venture. A more likely explanation and one which was agreed to, is the frequent difficulty of obtaining firewood to fuel an oven. If bakeries, which can have a tremendous appeal, offering fresh, local bread, vetkoeks etc., are to be taken as serious development initiatives, sustainable sources of energy must be planned. In Uukwaluudi, in fact, King Taapopi, says that no tree should be cut. Since, timber is still the main source of fuel in the district it is imperative that some community discussion be held on this and perhaps family, or community wood-lots be established. It is most likely that such an initiative would be fully supported by the King and Queen who are both extremely active within their area and wish to develop conservation measures.

4.2.3.3 A further, typical problem associated with a bakery is that of the expense or difficulty in obtaining wheat flour. In

any event it would be worthwhile baking some experimental mixtures of wheat flour, millet and /or sorghum. The use of either grain, as well as making for a cheaper, more sustainable loaf, will make it considerably more nutritious. The "development" of such a loaf could well form a part of the existing food processing programme which mills these small grains and could also be incorporated into the forthcoming work with Mahanene Research Station and ICRASAT. Through these links the possibility of improving household food security by processing, packing and offering for sale, locally grown mahangu will be assessed. The acceptance of blends of flour may well further interest in dehulling equipment.

4.2.3.5 Suggestions.

4.2.3.5.1 Smaller ovens, for smaller batches of baking which require less fuel should be constructed either from old truck rims or truck bodies. Small quantities of scones, cakes etc., may also be baked in simple ovens over braziers each of which can be made in an artisan workshop, see appendix 3. RIIC has several oven designs. A traditional three legged pot can also be suitable for baking.

4.2.3.5.2 Experimental baking with blends of wheat and mahangu flour should be undertaken.

4.2.3.5.3 Conservation measures should be introduced to establish better management of timber resources. and thus to ensure a continuance of sufficient fuel wood. Mopane is used primarily as a fuel wood, but also extensively for building and fencing, discussions should centre on a better utilisation of this valuable resources. Possibilities are for forestry, fencing off or setting aside areas essentially to allow natural regeneration of mopane into mature trees or for organised rotational coppicing of the timber and possibly for the establishment of woodlots.

4.2.4 Food Processing - Grain Milling.

4.2.4.1 A visit was made to the mill unit of the Lunganda Project at Okahao, close to the Uukwaluudi IABP. The small, portable Drotsky mills used here are the same as those within the project area and appear to be most appropriate for the amount of grain brought from the locality for processing.

4.2.4.2 The mill operates fairly consistently, five days a week. Fifteen kilograms (one latha), of dehulled millet can be processed in 10 to 20 minutes depending on the condition of the mill tips. This allowed, on the day of the visit, a fairly continuous operation without the formation of a queue of people, with eight latha of grain being processed in the two hours of the visit.

4.2.4.3 By using such a compact and light-weight mill it is possible to take the mill to the people and thus reach those presently unable to get to the mill on a regular basis. A regular schedule of visits could be developed, transporting the mill unit either by "bakkie" or donkey cart.

4.2.4.4 Present milling costs are at 4,00 Rands per 15kg of grain, of which production costs are approximately Rand 2,50 depending on throughput of grain.

4.2.4.5 In order to check the mill a service technician from Tsandi accompanied the visit. There is apparently an on-going problem with belts working off the pulleys. The technician adjusted the pulley alignment and was paid 10,00 Rands for his ministrations and everyone was satisfied, a thoroughly satisfactory arrangement. The units are small, relatively low cost and easily operated and maintained by the present operators, all of whom are women. The units do not require a purpose built building nor a heavy steel base, they were in fact carried outside where there was no dust, no noise nor vibration and plenty of ventilation for cooling.

4.2.4.6 Regular maintenance of all programme mills is provided by the service technician, who, although only semi-skilled, carries out a competent service. It is most encouraging to see such a service being effected as the regular maintenance of the engines and mills is vital to the on going success of the programme. Regular oil changes, belt replacement, tightening of screws and bolts etc., each adds to prolong the working life of the units. If insufficient maintenance is given, for instance to the mills, hammers become badly worn and the milling process takes longer than 20 minutes. Consequently, not only do costs escalate but quality deteriorates as heat generates within the mill. This leads to a partial 'cooking' of the meal, which in turn makes it increasingly bitter.

4.2.4.7 Grain which has not been dehulled is milled for fermentation and beer making. Grain for staple food consumption is invariably dehulled by women, by hand.

4.2.4.8 Many people are apparently interested in knowing more about mechanical dehulling equipment which could be placed at the mills. Dehullers could in fact fit well with the existing milling equipment and consequently save women considerable time and energy from processing staple food. Presently however, the acquisition of such equipment is considered to be unviable as the overall price of processing would then exceed 4,00 Rands per latha, which has been shown to be the maximum cost people are prepared to pay.

4.2.4.9 Because of the time and tremendous effort expended by women in the dehulling and preparation of millet, and the interest presently expressed in commercial dehulling systems, closer ties should be established with Musese Research Station, Rundu, which is involved in millet dehulling trials. ENDA-Zimbabwe has also been instrumental in installing three large grinding-mill units around Rundu and one further unit in the Caprivi. These units are Hippo hammer mills and dehulling units of a type which were initially developed by Rural Industries Innovation Centre (RIIC), Kanye, Botswana, and are powered by Lister TS 3 engines. Following these initial trials, ENDA-Namibia now intends, fairly quickly, to install some twenty units throughout Caprivi and Okavango. Following the installation of these units they will be looking for further possible mill, dehuller locations, as well as service/maintenance facilities throughout Owambo.

4.2.4.10 Suggestions.

4.2.4.10.1 A service and maintenance operation such as this one in support of small mill and pump units could well form a useful and viable component of any artisan workshop.

4.2.4.19.2 The existing mill power unit, a small 9HP petrol engine, could, especially where under-utilised, be further extended with the addition to the unit of a small generator, making it not only a portable grinding unit, but also a welding and power-tool unit.

4.2.4.10.3 If sufficient interest and viability were to be shown, dehulling units manufactured either by

RIIC, Kanye, Botswana; or De Freitas Engineering, Harare, Zimbabwe, could well be experimentally introduced to the programme. These units would fit well with the existing Drotsky mills. Several other engineering firms in Zimbabwe are presently showing interest in the commercial manufacture of dehulling units. Alternatively, the ENDA-Namibia programme will be selling processing units at cost price to interested parties and local business people. Mr. Tom Kroll who introduced the original mill units has a variety of facts and figures as well as a good appreciation of the issues of such an intervention.

4.2.4.10.4 Although the units are generally appropriate for the task, there are apparent weakness in design which should be furthered with the manufacturer. However the following may be of some assistance,

1. To adequately transfer approximately 6 Kw to the mill, the pulleys and vee belt should be changed to a larger 13mm section.
2. Adjusting bolts which would allow accurate adjustment of engine / belt alignment settings and would retain those settings could well be advantageous in preventing drive belt loss.
3. Engine mounting bolt holes could be elongated to allow the engine movement through a horizontal plane allowing an easier adjustment of pulley alignment, though this may well not be necessary if 2 above is undertaken.

4.2.5 Gardens.

4.2.5.1 Several visits were made to the Iilya Katossi Garden at Tsandi. A 1,2 hectare garden has been adequately fenced with programme-made pig wire netting. Inside this netting fence attempts have been made to establish several species of bush and tree as live fencing. A number of species have virtually disappeared in the drought, there are, however, several specimens of Kigeria Africana, commonly known as the Sausage Tree. The most successful species has been Parkinsonia, commonly called Jerusalem Thorn, a thorny stemmed tree which with suitable management should make an adequate goat proof fence to protect the garden as the original fence posts either rot or are removed, and as the netting is damaged or taken to be used elsewhere.

4.2.5.2 Within the garden there is an 1600 metre square experimental section under shade cloth and a further 0,25 hectare section laid out for alley gardening. Leucaena in 4.5 metre rows has established very well.

4.2.5.3 Garden water comes from the Ruacana to Oshakati canal, the main water supply system of the entire region which is heavily drawn upon. Water supply is by way of a portable petrol engined pump, taken by wheel barrow twice a week, 150 metres to the canal, from here it is pumped an approximate 3,5 metre delivery head to the supply tank at the garden. In an effort not to over water and thus not to increase salinity, water application to the garden beds is by hand. However, watering by hand is slow and tedious, requiring more labour than many of the group had anticipated.

4.2.5.4 The build up of salts within the soil of any irrigated garden is always to be expected and must be constantly monitored. This garden which is also a training garden, is sited on land close to a water distribution canal and is as high as is possible above the natural water levels of the locality. It is possible that the garden will be viable for three seasons, before increasing salinity will necessitate moving the garden to a fresh site. By judicious watering and 'shifting' after such a relatively short period of operation, the build up of salts should only be minimal and the land should quickly and naturally re-grass. It is unlikely that the irrigated garden would return to this site, the Leucaena trees will then be cropped for livestock fodder or fuel wood and will also offer an improved rain-fed arable land for millet cropping on the alley farming system.

4.2.5.5 Efforts have been made to improve soil fertility. Silt from hand-dug wells is collected on a regular basis and is spread some 20 to 30mm deep over vegetable beds, as is manure which is collected from deserted cattle kraals. Both these measures improve the soil and its water holding capacity, but manure unfortunately lasts no appreciable time as it decomposes too quickly in the prevailing conditions.

4.2.5.6 An interesting vegetable bed experiment which will not only prevent levels of soil salinity increasing to excess, but also requires minimal quantities of water, is being accessed. The system consists of a normal, approximately 0,90 x 10,00 metre

bed dug out to 0,40 to 0,60 metres deep and lined sides and bottom with 2,5 micron black polythene sheet. A mixture of the natural sandy soil, clay silt, kraal manure and any compost available, which is already a vast improvement on the surrounding soil, is placed in the polythene lined trench. A line of perforations in the polythene, some 200 mm below the surface prevents the trench from flooding. Such a system of gardening, if continued to be assessed, may well have considerable impact on the success of small irrigated nutrition gardens.

4.2.5.7 Fruit trees are growing particularly well, either in this garden or other locations in the immediate locality:-

Guava trees are probably best, once established, they draw their own water and require no further irrigation.

Granadilla vines are growing prolifically.

Paw paw is establishing well requiring minimal supplementary watering.

Mangoes have surprisingly not established well as there has been a high loss of plants.

Citrus, apparently, do not do well in this locality. being perhaps, effected by salinity, high temperatures and low humidity.

Rough lemons are however, sometimes grown.

4.2.5.8 Exotic vegetable crops presently growing and which have done well during the winter months are:-

Tomatoes,

Carrots,

Chilli,

Spinach, to some degree but brassica is however not an important crop in Ovamboland.

Onions have not formed sufficiently large bulbs.

4.2.5.9 The establishment of possibly more appropriate, less exotic crops has so far been encouraging, both in growth and acceptability:-

Amaranth, as a leaf crop has been accepted as a local spinach and responded well to winter irrigation.

Sugar cane is growing well.

'Bushman Bean', a local cow pea/ovambo bean, is growing particularly well.

Sweet potatoes.

Water Melons.

4.2.5.10 The garden is managed by a 'strong' group of women who enjoy the support of the Queen of the district. The garden was initially established to broaden the nutritional base of the community with the intention to first supply vegetables to the participants and then to sell surplus production, probably to the school or local hospital. However, once the economic potential of the garden was realised, cash production quickly became an incentive. Such labour intensive, limited income gardens are frequently an exclusive preserve of women. Whilst of necessity the wider community development process must include men, sustainable, low key interventions such as this garden project have a better chance of success because of the absence of men who would wish to dominate and impose their own methods and ideas on the group and the operation.

4.2.5.11 This has been a particularly testing season for this training garden with crops subjected to drought, followed by flood and army worm. The women have however stuck to it and some both experimental and useful crops have been produced.

4.2.5.12 The "project" garden opposite the IABP training garden was visited with three members. Water is carried from the canal 157 metres distance with a rise of 1,00 metre by the women. Manure from abandoned cattle kraals, by way of the main garden, has been worked into the soil. Maize and "Bushman Beans" are doing well with tomatoes, struggling. However, plants, probably partly due to several dying, are extremely widely spaced, wider in fact than can be seen in rain fed millet (omahangu) lands. This makes for very poor utilisation of water and difficulty in improving soil. In total there are thirteen "project" gardens.

4.2.5.13 Suggestions.

4.2.5.13.1 That the programme continues to encourage and develop such nutrition gardens, which can become vital sources of nutrition and income.

4.2.5.13.2 That work continues, to develop and thus perfect the polythene lined, "sealed" beds.

4.2.5.13.3 That the programme keep abreast of research and developments in methods of growing plants in areas where there is high salinity or minimal water, such as at the Scottish Agricultural College, Strathclyde University, Scotland.

4.2.5.13.4 Although the shade cloth area at the main training garden is essentially only experimental, other methods, such as palm leaf covers, should be utilised for shade.

4.2.5.13.5 That the traditional methods of food preservation through drying be experimented with on non-traditional crops to improve selection, widen the general nutritional base and to extend vegetable use into the dry season.

4.2.5.13.6 The possibility of establishing such gardens at schools be considered.

4.2.5.13.7 Programme support should be maintained at the main garden in order to continue training and the establishment of small independent gardens with a possible water supply from oshana dams and the canal. Any workshop activity should be fully aware of the importance of such gardens and the role workshops can play in supporting gardens and thus the viability of workshops themselves.

5. REQUIREMENTS OF A RURAL TECHNICAL SUPPORT INFRASTRUCTURE.

5.1 Community Involvement.

5.1.1 It is for the community to identify its needs and priorities. Priorities must be established for education, health, water, food production or income generation. Having established this, people with resource and experience may assist in the development of a programme to support the particular technical needs of each priority. A live programme to identify major areas of concern is vital. From this base an appropriate infrastructure can be developed, which should meet the technical requirements of the community.

5.1.2 An appreciation of local social structures and of the community leaders, both supportive and unsupportive is imperative. Within any society there are cliques, vested interests and power struggles. To be caught within any such local conflict would pose a most serious and potentially devastating situation for any technical development initiative. Whilst it is beyond the scope of this consultancy to make such an assessment of a community, it is encouraging that the IABP

enjoys the support of both King and Queen Taapopi who are resident in Tsandi and held in some esteem by the people of Uukwaluudi.

5.1.3 Any technical intervention or infrastructure should have the support and confidence of the entire community and offer far reaching advantages. It should be:-

5.1.3.1 Operated in an economically viable manner,.

5.1.3.2 Provide a service to the surrounding community by maintaining, repairing and manufacturing a wide range of tools, agriculture equipment and articles generally required by the community.

5.1.3.3 It should be able to offer a professional service of community support through a technical, hands-on advisory service, particularly in response to food security, water and sanitation programmes.

5.1.3.4 Provide employment to a number of local artisans.

5.2 Market.

5.2.1 For any technical development programme to succeed there must be a strong local market. Not only must such an intervention be able to repair and manufacture articles required by the community it must be able to sell the products in a viable and profitable manner.

5.2.2 Through observation and discussion with local people in the IABP, it can probably be assumed that a local market would not be strong and there might in fact be some resistance to local products.

5.2.3. There are existing, well established wholesale and retail suppliers of such items as basic hand tools and agricultural equipment. These stores are already well stocked with many of the products which could be made locally. Three local hardware suppliers were visited, each was well serviced with competitively priced goods. Appendix 7 gives an outline of product and material availability as well as prices of some of the goods sold in these stores with which articles made in an artisan workshop would be competing.

5.2.4 There are in fact a number of existing repair and maintenance facilities, both at the conglomeration of Oshikati and Ongwediva and within Uukwaluudi. Each has their own speciality and established market, but given the resource and assistance, almost any of them

could be expanded into a more comprehensive community support workshop.

5.2.4.1 Okahao has a large service station and a well equipped and well run general workshop; Onekuni Garage. Within the workshop there were two arc welding machines and an oxy-acetylene welder, tools and spares were well laid out. Apart from a storelady there were two mechanics and six boys or young men, all appeared quite competent and were working at a variety of activities including vehicle repairs (including panel beating), fridge repairs, welding burglar bars to new window frames and making donkey carts. The carts were to a very good standard and were selling at 1200 to 1300 Rands each. In spite of so many derelict vehicles, it was said that it was difficult to procure sufficient, reliable axles and hubs, but if these could be obtained, significantly more carts could be made and sold. It was also stated that window frames could be made, but it was not always easy to obtain the steel sections However, it may prove difficult even for this workshop to compete with the commercial suppliers. A further problem was expressed by the owner, in that all suppliers required cash when he made purchases, but he found it difficult to make cash sales.

5.2.4.2 Six workshops were found at Tsandi, ranging from a few car bodies and an oxy-acetylene welding / cutting set to a small, but well equipped garage / workshop.

5.2.4.3 Two young men in Tsandi were selling petrol and carrying out vehicle repairs, both had been trained in Windhoek by the Rossing Foundation, 1988 - 89 and 1990 -91. Again the workshop was neat and tidy with a good selection of tools and spares, well laid out. Carts were also made at this workshop and they too experienced difficulty with wheel axles and hubs. The welding of one of the young men was of a particularly high standard. In short this was a well run rural workshop operating at Tsandi.

5.2.4.4 A further Tsandi workshop was also equipped for vehicle repairs and maintenance, including spray painting. This workshop however was also able to carry out some sheet metal work, although there was only a very limited demand for this.

5.2.4.5 Cart manufacture was the main enterprise of a third Tsandi workshop. Here a number of carts were in for repair and

a further three were under construction. There were no specific orders and construction was markedly slow. A small number of axles, hubs and wheel rims had been acquired and stock piled for future use.

5.2.4.6 The remaining three workshops were each, to some degree, involved in vehicle repairs and breaking. Used spares were sold and welding and cutting undertaken.

5.2.5 A commercial market has been firmly established for almost all requisites, consequently dependence on commercially available goods is strong. Several people interviewed expressed a preference for such goods and some a reservation to try locally made articles. Fears were expressed on anticipated poor quality, poor presentation or a concern that cutting tools would buckle or at best, not retain a sharp edge.

5.2.6 There is no established traditional market selling bits and bobs of recycled material, tins to mugs, candle holders and paraffin lamps etc. Local markets seen in Oshikati and Ombalantu had row upon row of second hand clothes and inferior cuts of meat but no traditional wares, herbs, roots, local delicacies, nor any goods essential to rural households. Almost all requirements are either obtained commercially or made by the family. There is considerable resource and self reliance at a family level and consequently no market.

5.2.7 As there is no established local market to build on there is little opportunity to develop goods for a rural market. Further there is little chance to develop a rural market infrastructure since so much is carried out at a household level. Almost all village construction and repairs are undertaken by householders, as is the making of domestic equipment such as pots and jars, threshing, winnowing and meal baskets. The essential pestle and mortar for dehulling and pounding mahangu grain to meal is also chiefly made in the home. That which cannot easily be made locally is purchased from commercial suppliers.

5.2.8 Nowhere was the sharpening of basic hand tools such as picks, axes, hoes etc. which could be accomplished through some very basic blacksmith work, being undertaken.

5.3 **Skills.**

5.3.1 Although it is quite apparent that the traditional skill level is high and that the young artisans seen in the various workshops visited have been quick to grasp the essentials of their trade there is not a wide local skills base. Within the area there are a number of welders and budding mechanics but no blacksmiths nor sheet metal workers. Almost all construction work is of timber, but there are no carpenters. Apart from pestles and mortars there is no hewing of wood to shape, nor any traditional tools with which to do this and from which new tools and skills can be developed.

5.3.2 Apart from the existing workshops, within Uukwaluudi there was no facility for training which could assist with the development of basic technical skills training. However, some initial training or work experience has been offered through the RDC workshop at Ongwediva. Further, it is apparent from the two young men operating Tsandi Garage that appropriate training in some skills is available through the Rossing Foundation in Windhoek.

5.3.3 Some skills building can be obtained from work experience and in-service training with the existing development organisation in their workshops and general programmes. Further training will probably best be acquired either from specific, short term, contract trainers or by temporary secondment to technical development organisations, outside Namibia.

5.4 **Materials.**

5.4.1 As in any situation there is a mixed selection of materials generally available for community needs and further development work. However although supplies of commercially available materials are presently good, Uukwaluudi is far from the source of most supplies.

5.4.2 General Building Supplies.
Because of the nature of the area, although sand is exceedingly plentiful, it is very fine. This is generally suitable for plaster work but not for concrete work as it lacks the "sharp" sand necessary to mix with aggregate. There is in fact no aggregate in the immediate area, it has to be trucked in from upwards of 100 kilometres. Cement is presently widely available and is a product of Namibia.

5.4.3 Timber.

Throughout time, mopane has provided all the timber that has been required; for homes, both as poles and fixing material, for fencing, for tools and for household equipment. Almost above all else, mopane has provided fuel. In some areas this timber is now over cropped. Within commercial centres, treated gumpoles and pine boards are quite plentiful, but both are imported.

5.4.4 Steel.

Steel section, wire and galvanised roofing material are all available. There is however a great resource in many of the derelict vehicles in the area. There is useful sheet metal in old car and truck bodies which makes quite adequate containers and water buckets. It is also a possible source for roofing, roof guttering and small water tanks. Truck chassis are recyclable into gutter brackets, hoes and for general repair work. Truck springs and half shafts can be made into a variety of tools: axes, chisels, tongs, pliers, hammers etc. and aluminium can be melted down and recast.

5.4.5 Fuel.

Sufficient fuel will be an ever increasing problem. In rural areas, presently mopane is used but at least in the areas of high population density this is now supplemented with both cow dung and paraffin; the latter particularly in urban centres. There is an extensive rural electrification network, but this is largely inappropriate for the average household. Should an enterprise such as blacksmithing be taken up, fuel would be a problem, wood itself does not give a hot enough fire so either charcoal would have to be made, or brought in from somewhere like Tsumeb.

5.5 Work which could be undertaken in a rural workshop.

5.5.1 Blacksmithing and Forge Work.

With so much suitable steel available from scrap car and truck bodies and new sections of steel available from commercial suppliers, blacksmithing is an obvious choice. Items which are essentially forge work and in continual demand are, in mild steel, hoes, plough parts and cooking pot stands and those in spring steel, pangas, axes and knives. Products which could be developed and made for sale to the community are tools such as hammers, pliers, fence wire strainers, chisels and boring tools. Other articles which can be blacksmith made

are a variety of arable and gardening tools, trek chains, steel fence posts and droppers, gates and braziers.

5.5.2 General Fabrication Work; Arc and Gas welding.
Again, utilising similar sources of steel many of the foregoing articles can be made in a welding shop. A typical product line in a welding shop is a donkey cart, but it is also possible to make and repair other high demand items such as window frames, burglar bars, wheel barrows and bicycles. A market may well be established for such things as hand carts or for lightweight, wheeled hand hoes. Possibilities certainly exist for developing tillage equipment beyond that of the basic ring hoe, also for equipment to assist at harvest time.

5.5.3 Tinsmithing.
Considering the potential and material resource there is a surprising lack of tinsmithing undertaken. Although fired clay jars and pots are readily available and there is a general proliferation of plastic buckets, sheet metal buckets and containers have much to offer, if only that they are durable and easily repairable. Other sheet metal products are larger water storage vessels, possibly water filters, guttering and gutter brackets, gardening equipment and cooking utensils, pots, basins, spoons and ladles.

5.5.4. Plumbing.
Within the growing population centres such as Tsandi and Okahao limited possibilities exist for some pipe installation work. Branch lines continue to extend from the main pipeline, hence stand-pipes and small domestic reticulation lines are required. Pipes and faucets are required for roof water catchment tanks and even with the limited possibilities, water tanks and supply lines for irrigation. Since potable groundwater supplies are both minimal and shallow, a simple pump technology can be utilised so that appropriate pumps could be made and repaired in a rural workshop. Further, where volumes of water are particularly limited, such as in the small omufima, the most suitable pump is probably the bucket pump. This entire pump, from bucket to windlass, is easily made in a small artisan workshop, much of it from material which can be recycled.

5.5.5 Water Development.
An integrated water development programme could well be established at a rural workshop. An equipped rural service facility would be able to undertake any hand pump maintenance and fabricate corrugated

galvanised tanks and make and erect roof guttering. The fabrication of forms for ferrocement tanks and tank domes is also well within the capacity of a local workshop. The transport of water is always a difficult and arduous task, equipment to carry water by donkey cart, panniers on donkeys, hand carts and wheel barrows, as well as the present "aqua rollers" would have distinct advantages for rural women. Much of such equipment could again be made from recycled materials, purchased sheet metal, or, for these particular articles, a small fibre-glass industry might well be established. It is of significance to note that in the recent drought, in some localities, delivered water was selling from two to as much as four Rands per twenty litre bucket.

5.5.6 Fencing.

There is already an established group making pig wire netting. Within a workshop this could be developed to include, on the same frames, lighter gauge poultry wire netting. On new frames, sheep netting, more suitable for garden fencing could be made and on different machines again, diamond mesh security fencing. There appears to be a relatively good sale in the growing population centres for security fencing, for both wire and fence posts and standards. Further this diamond mesh could be used as reinforcing on the existing ferrocement tank moulds. See appendix 4.

5.5.7 Mechanics.

It must be acknowledged that there are already a good number of garages and service stations, many of which are carrying out puncture repairs, engine servicing and general maintenance and repair work, panel beating and spray-painting. However, especially since the programme is already involved with engine powered grain mills and a water pump, there are limited possibilities.

5.5.8 Carpentry.

Although there is presently very little carpentry work in the District, there would be some limited opportunity for basic household furniture, such as tables, chairs and cupboards. "Kitchen" type furniture of a steel frame and legs with a wooden top is always popular. However competition in both price and quality would be stiff here. It is further, quite likely that there would be a small demand for assembled timber roof trusses.

5.5.9 Leatherwork.
Possibilities will also exist for the manufacture and particularly for the repair of shoes, sandals and leather goods. Not only leather, but old vehicle tyres hold good possibilities and can be recycled into presentable, durable sandals, or cut into strips to make useful donkey harness.

5.5.10 Technology Resource.
A further option of a rural workshop is as a resource centre to which villagers may come for advice and where local, experienced people may sell or trade ideas. Technical advice on, for instance pit latrine construction, water source development or developments in food security options all have possibilities.

5.6 Community needs for a technical resource centre.

5.6.1 The IABP is already involved in practical programme work through health and sanitation, water development, food security and income generating projects. Technical support for this project work could be drawn together and increased through an artisan workshop.

5.6.2 Presently mechanical applications at a household level are few and almost all needs are met either directly from local resources or from commercial outlets. Some manufacture and repair of basic equipment could however, be carried out and there is certainly opportunity to develop, new labour saving equipment. Particularly in the light sandy soils a range of tillage equipment from hand hoes, digging and cultivating, to ploughs and light-weight wheeled cultivators could each be more efficient than present methods. When necessary wheel barrows or hand carts are useful in the transportation of water and staple foods.

5.6.3 A number of workshops and garages are already operating successfully within the IABP. Although each of the initiatives is in support of a particular venture and has established successful and viable lines of work, several of the workshops could be assisted to offer further technical support to the surrounding community.

6. RECOMMENDATIONS TO DEVELOP LOCAL TECHNICAL CAPACITY.

6.1 Local Assessment.

6.1.1 Although a technical overview has been provided through this assessment a more detailed understanding of local resources, materials, skills, requirements and household possessions, such as tools, tillage equipment, hoes, ploughs etc. must be made. Ideally a study should also be made of chore time; of water collection, the source and time taken to fetch water, of fuel collection and requirements, of food storage and processing. From an accurate understanding of these processes community requirements can be established and a realistic technical support programme developed.

6.1.2 A survey must establish the needs and requirements of the community as well as the resources. Since any workshop or service must be viable and sustainable, it is particularly important to establish what services people, in fact want and will pay for.

6.1.3 Specific surveys can highlight particular needs. A survey initially amongst local farmers could establish the need for draught animal transport or hand carts, or for ploughs, and tillage or cultivation equipment. A further survey amongst existing workshops should establish the resources and capacity to manufacture this equipment. Possibilities may then exist for one workshop to manufacture for instance, the axles, wheel hubs and rims for others to make into carts. Appendix 3 lists some organisations which undertake this type of support either through training courses, during which the essential equipment is made and then used, or through commercial sales.

6.1.4 As a possible example appendix 8 is four survey questionnaires which have recently been developed by team members of the Water Workshop programme of Dabane Trust. The first questionnaire is a general survey of a ward which equates to the ten divisions of Uukwaluudi; Ilyateko, Oshituda, Okathitu, Otshilemba, Tsandi, Elondo, Eemwandi, Onangalo, Okashidi and Othithiya. This is completed by the District, Government Agricultural Extension Officer. The second questionnaire is completed by the local councillor, the third by randomly selected community members and the fourth, more specifically by people who would like to, or who are already involved in a workshop.

6.1.5 Although a comprehensive survey is vital for background information necessary in the establishment of a technical support programme and of which an artisan workshop might be a part, from the assessment already undertaken a number of factors are apparent.

6.1.5.1 Presently, it appears that there would be little interest or support in developing the local technical infrastructure. There is a strong capacity at household level to meet most daily requirements and there is an apparent preference for products commercially made. Considerable skills upgrading would be required for many of the possible artisans before they could either expand or engage in new lines of work.

6.1.5.2 Although considerable material for products and repairs exists, both recyclable and new, it appears that it would be difficult to offer products of sufficient quality which would equal or undercut the existing commercial trade. It is further likely that only a very limited market would exist for such goods.

6.2 Recommendations for Programme Development

6.2.1 At this stage of the IABP development it is doubtful if an artisan workshop programme would gain sufficient local interest or support. The presently limited skills base and poor market potential, the existing mechanical workshops and well established commercial trade, the general lack of need or appreciation of household "improvements" or labour saving equipment, each constitute to a weak foundation on which to develop such an involvement. Before such an interaction could be implemented there would need to be considerably more discussion and awareness building on the scope, potential and advantages of a rural based fabrication, maintenance and repair facility.

6.2.2 Although at this stage of programme implementation expansion of the IABP into a sustainable artisan workshop programme is not justified there are already many interventions with the greater community of Uukwaluudi which could be better supported through an increased or better co-ordinated practical and technical support programme.

6.2.3 The essential concern of the greater community is sufficiency in food and water. By facilitating stronger local technical support for existing projects and concentrating on the important issues of water and food security, the overall programme should be considerably enhanced.

6.2.4. Water And Sanitation Programme Support.

6.2.4.1 Roof Water Catchment Tanks.

A better package must be offered to the community for the value of this system to be appreciated. A survey should be carried out to establish the numbers of homes with zinc roofs suitable for guttering and water tanks. Thatched roofs are not appropriate being generally too small for useful catchment. It is difficult and expensive to attach gutters to thatched roofs, being uneven in both planes. Further, although water is potable, thatch discolours water to the extent that many people are reluctant to use it.

6.2.4.1.1 A correlation of roof size to tank size must be made so that water is not wasted nor are excessively large expensive tanks constructed. See appendix 4.

6.2.4.1.2 Costs must be considerably reduced.

6.2.4.1.2.1 Householders must be able to do more for themselves, probably under the direction of one skilled tank builder / gutter erector.

6.2.4.1.2.2 Less costly tank construction methods must be devised:-

1. A tank fabrication method which does not require the use of the corrugated iron moulds presently in use has been devised by the emergency drought relief programme. This particular construction method, using temporarily attached polypropylene sheeting outside the weldmesh and wire netting also means that tanks can be tailor made to size. Re-usable and adjustable, temporary supports for the domes, are easily devised.See appendix 4
2. An alternate method requiring less skill in erection and construction and perhaps more acceptable to somewhat conservative builders is to place reinforcing mesh inside a brick wall which is then plastered. See appendix 4.
3. A further method, which continues to utilise the existing moulds and can also provide employment to the fence-

wire group, is to dispense with the presently used weldmesh and wire netting as reinforcing and use instead 2,50 mm gauge, 50 mm x 50mm aperture diamond mesh security fencing which can be made by the fence making group. See also appendix 4.

4. A corrugated iron tank can be assembled from galvanised sheet metal which has been rolled into a circle. RDC has the equipment to do this and has offered the use of it to the IABP. A 2250 litre tank is fabricated from three corrugated and two flat sheets of zinc and is presently sold for R 350,00 but will soon increase to R 400,00.

6.2.4.1.2.3 Guttering costs must similarly be reduced if water harvesting is to appeal to rural communities.

1. Gutter brackets have been purchased by UNICEF at R 2,84 each (November 1992) which would be difficult to undercut using new materials. However brackets are frequently the weak point in a roof water collection system. It is at least as satisfactory to strap or wire guttering directly to the end of zinc roof sheets. Gutter bracket material can be obtained from discarded vehicle bodies and straps or brackets made by the home owner or purchased from local artisans.
2. Fabricated guttering (November 1992 price), costs R 27,64 per square metre. A 0,915 x 1,83 metre sheet of 0,45 mm galvanised sheet metal cost R 36,08 (inclusive of tax), (actually R 33,30 on special offer), therefore R 21,60 per square metre. Local artisans should at least match the price of R 9,04 per metre length of guttering. However, guttering is budgeted at R 11,90 per metre, (February 1993, UNICEF assisted emergency water programme), but is considerably cheaper at Cash Build, Oshikati, at R 6,54 per metre length, (March 1993 price). Large quantities of sheet metal purchased from a wholesaler by the programme would lower unit costs and smaller gutter sections could be made for smaller roofs to further reduce costs. Also to reduce costs, particularly for smaller buildings, scrap sheet metal from old car bodies, can be readily formed into guttering.

6.2.4.2 Shallow wells.

This aspect of the programme should be considerably strengthened and supported by local artisans.

6.2.4.2.1 A mould to produce pre-cast concrete well rings should be made. The well rings should be of a size and mass which are easily transported and manageable on site. A concrete ring of 900 mm internal diameter with 75 mm wall thickness, 200 mm high will weigh 110 kg. This weight and dimension is easily moved by three or four people. Moulds should be of 5 or 6 mm plate to prevent buckling or denting. Well rings could be made by the existing brick making groups who are already accustomed to concrete work. Rings would be best made at the group sites where water and materials are already delivered. People will find their own transport to fetch the rings and will then be able to place them themselves, making for a much sounder community based water programme.

6.2.4.2.2 Alternatively, well rings can be constructed of bricks or made at the well site, using similar moulds, or cast in-situ in the well.

6.2.4.2.3 Since many of the existing wells which could be lined are already extensive excavations, use should be made of these diggings to develop underground cisterns. By accessing a larger volume of water considerably more water can be abstracted than from a regular well , further, through this method, a relatively narrow bore well ring of a manageable size and weight can be used. See appendix 5 for explanation and design.

6.2.4.2.4 Artisans should produce an adaptation of the bucket pump for sale to individuals and communities. This is an inexpensive pump of a simple design, most suitable because of the shallow standing water, see appendix 6. Much of the material for this pump, the windlass and the bucket, can be obtained from scrap material such as old vehicle bodies or chassis.

6.2.4.3 Tank Dams.

6.2.4.3.1 Should tank dam building with a tractor and dam scoop prove to be feasible, a workshop would provide a suitable base for such an expanded programme. A suitably equipped building for the storage of spares and equipment and for the necessary routine service and maintenance of machinery would lend considerable support to the work.

6.2.4.4 Pit Latrines.

6.2.4.4.1 Apart from the recommendations to continue and experiment with a number of differing pits and latrine slabs, the workshop could profitably gather, flatten and piece together discarded drink cans to sell as cladding for the latrine cabins.

6.2.5 Food Security Programme Support.

6.2.5.1 Support for this aspect of the programme is already being undertaken through the servicing of the mahangu grinding mills. A workshop would provide a more comprehensive base for the local repair person and would similarly serve other artisans should the programme expand. Many back-up services, tools and basic repair facilities, storage, equipment, spares etc., could be adequately provided from a rural service workshop. It should, however be noted that there is an engineering infrastructure, capable of welding, making modifications to mill units and carrying out engine repairs, already existing in the community

6.2.5.3 Although ploughs are repaired with parts obtained from commercial suppliers, the possibility of making parts and undertaking repairs at a community level will be greatly increased through a local workshop. Similarly the possibility of making and extending the range of hoes available will be considerably increased.

6.2.5.3 Through the foregoing a base will be laid to develop the local technical capacity and support services and from this, in time, more efficient tools and equipment will be forthcoming.

6.2.6 Income Generating Project Support.

6.2.6.1 Gardens.

6.2.6.1.1 The manufacture of some of the equipment presently bought for the gardens would fit well with the foregoing, particularly items such as buckets and watering cans. Fencing is already being made and should new equipment be obtained for the manufacture of different types of wire, the service / repair of the equipment can be provided from a local workshop.

6.2.6.1.2 In the vicinity of a canal water is presently available for gardening. Should water from tank dams become available for further gardens or for a livestock development programme, there will be an increased need for simple pumps. The treadle pump, which is suitable for both the pump static and friction heads likely to be involved, is an ideal pump to be made in a local workshop.

6.2.6.2 Bakery.

6.2.6.2.1 Particularly when only small quantities of baking are to be done, the firing of a large oven is most wasteful. Designs for small, simple ovens suitable for local manufacture made from recycled materials such as old car bodies, are available from development organisations. See appendices 2 and 3.

6.3 Establishment of a Rural Artisan Workshop.

6.3.1 A discussion process will need to be instigated with the community to raise awareness of the service and vocational possibilities of a local workshop and to demonstrate the support a workshop can provide to the existing programme work.

6.3.2 Much of the foregoing has purposely been linked to sheet metal work. Within the scope of this survey it has been seen that there is a potential and a need for such work. A localised support service can be provided for the main initiative of the programme which no enterprise is presently engaged in and there is a good possibility of utilising existing scrap material.

6.3.3 To assist an artisanal development process a multi-purpose building should be erected. A suitable building will act as a focal point for the programme and provides a safe and secure place from which to work. It will in fact give further permanence to IABP. Possibilities are either a duplication of the existing development centre storeroom / lecture room building, which would make a most adequate small scale workshop, or an open work area and storeroom building, as the building plan appendix 10, for which structural plans are available if required.

6.3.4 As many of proposed items for manufacture will be used by the programme the workshop building should be erected at the IABP

Development Centre. If the potential of a workshop is appreciated and the concept is taken up other independent workshops may be started. However in order to get the programme started the initial workshop should be at the expense of and be the property of the IABP. The facilities, tools and equipment should be leased to artisans and products purchased from them, such as fencing for instance, is presently purchased from the IGP fencing group.

6.3.5 A contract stating the terms and conditions governing the building and equipment, should be drawn up. Such an agreement should also clarify the provision or non-provision of specific tools, equipment and materials. Similarly a contract for goods should be entered into each time a product run is required, this should contain clauses relating to delivery schedules and quality of goods.

6.3.6 The existing programme has a need for specific equipment which can be made within the community. Through this production local artisanal skills will be improved and the self reliance and overall community development capacity enhanced. In order to establish an independent, community motivated technical programme in support of daily rural life, initial infrastructure and some market support should be provided. This new interaction will start with products which are initially required by the programme but which as the programme develops will be required independently by the community.

6.3.7 Appendix 7 constitutes a list of tools and equipment in support of the work outlined.

6.4 Implementation of a technical development programme.

6.4.1 The facilities of the Ongwediva workshop and hands-on training sessions have been offered to the IABP by the RDC. Through this, practical skill experience may be obtained in such work as general sheet metalwork, marking out, cutting, bending and soldering; bucket pump manufacture and the casting of concrete well rings, also some further or comparative experience in pit latrines.

6.4.2 Particularly for the development of skills, such as blacksmithing or of specific equipment such as wheel rims. hubs and axles. or treadle pumps, training can be provided by consultants, or some of the technical development organisations such as ITDG or ApT, as listed in appendix 3. Several organisations offer the possibility of either

trainees attending courses at institutions or of trainers setting up training sessions in the field.

7. EXECUTIVE SUMMARY.

7.1 Individual households have a great capacity for undertaking their own requirements and achieving regular needs through generally traditional methods.

7.2 There is insufficient need, interest or local artisan skills level to presently sustain a broad based workshop or technical development programme.

7.2 An artisan workshop would assist to support and develop existing programme work. It would strengthen the self reliance and community participation aspects within the programmes:-

1. Water & sanitation
2. Food security
3. Income generating projects, such as gardens

7.3 Work which could be undertaken through a programme support workshop which would have considerable benefit for the district.

Reinforcing for ferrocement roof water tanks.

Sheet metal work - gutters, down pipes, water containers, tanks, tank moulds, shuttering etc.

Manufacture of simple well pumps, notably the Bucket Pump

Manufacture of simple irrigation pumps, notably the treadle pump.

Technical support and maintenance in the casting of well rings.

Fabrication of frames and cladding for pit latrine cabins.

7.4 A workshop should be built and equipped at the IABP development centre. Tools and equipment should be leased to artisans and products made bought as necessary by the programme and by the community.

7.5 Training of artisans to use the workshop should be undertaken at the RDC workshop.

APPENDIX 1.

PEOPLE, GROUPS AND TRADERS INTERVIEWED OR VISITED.

UNICEF Windhoek office staff.

1	Frances Chinemana	IABP Project Consultant
2	Chandra Badloe	Asst Project Officer IABP/WES

IABP - Tsandi based staff.

3	Simone Shileka	Project Co-ordinator
4	Francis Sibea	Asst Project Officer / North
5	Alina Ithamalo	Community Liaison Officer
6	Mary Joseph	Community Mobilisation Officer
7	Yambila Mhone	Water & Sanitation Consultant
8	Kapolo	Programme Driver & Local Farmer
9	Tom Kroll	Food Security Programme Consultant
10	Naftali Kanandjembo	Assistant Gardening

Non-programme people.

11	Cristof Brock	Directorate of Co-ops, Windhoek
12	Viv Stuart-Wilson	Hydrologist, Windhoek
13	Peter Van Wyk	ENDA-Namibia, Windhoek
14	Mr. Van der Leest	Water Affairs, Windhoek
15	Jim Ingram	Manager RDC. Ongwediva
16	David Rimmer	Water Development Manager, RDC
17	Hanno Pelkonen	Water Specialist, Finnida
18	Arto Suominen	Project Co-ordinator, Finnida
19	Desmond Tshikesho	Project Manager, Ohangwena Water Pro.
20	T. Goetze	Water Affairs, Oshakati
21	Willie Haugk	Workshop Manager, Phoenix Motors,
22	Rihan Sneymann	Civil Engineer, Oshakati
23	Pastor Peter Pauly	LWF Pastor, Oshikuku
24	Gunnar Bendelin	Asst. Forestry Officer, Ongewdiva
25	Hafeni Mtuleni	RDC/GoN Forestry Officer,
26	W. R Lechner	Mahanene Research Station
27	Mr. Von Lansberg	Etandia Irrigation Scheme
28		Councillor, Omusati
29	King and Queen Taapopi	Tsandi
31	Pastor David Angula	Chairperson IABP Water & Sanitation
32	Ephraim Kapolo	Elondo farmer

33	Ms. Kapolo	Farmer, member of Elondo garden group
34	Ms. Tuliki Shilumba	Chairlady, Lunganda Project Okahao
35	Ms. Laimi Amulunga	Mill operator, Lunganda Project
36	Simion Hoseo	Mill service technician. Tsandi
37	Johanne Iniko	Onekuni Garage, Okahao
38	Angula Nekwayo	Tsandi Garage
39	Vino Amukwa	Tsandi cart manufacturer
40	Mr. Malumbu	Auas Motors, Tsandi
41	Garden Group	Tsandi
42	IABP Development Centre Brick Making Group.	
43	Roof water tank making team; Okashidi	
44	Restaurant Group	Tsandi
45	Benz Hardware Supplies	Oshakati
46	FNDC Hardware	Oshakati
47	Cash Build	Oshakati
48	Local Market	Oshakati

Visits undertaken.

1.	RDC and Finnida workshops	Ongwendeva
2	IABP IGP groups	Uukwaluudi
3	Wholesale & retail supplies	Oshikati
4	Local market	Oshikati
5	Roof water project	Oshikedi
6	Shallow wells & rural household	Elondo
7	Garages & workshops	Okahao & Tsandi
8	Mahanene Research Station	Mahanene
9	Etandia Irrigation Scheme	Ruacana

Background material

1	Oshanas	ISBN 99916- 709 - 0 - 4
2	Millet in Namibia - Engine For Growth	NRI / ODA
3	Social Economy of Livestock Production in the Ovambo Region	Chris Tapscott, NISER Discussion Paper No.4.
4	Northwestern Owambo Irrigation Project.	Planning Consultants FNDC
5	Forestry in Namibia 1850 - 1990	Silva Carelica
6	Rainwater Catchment Possibilities for Botswana	J. E Gould, Botswana Technology Centre.

APPENDIX 2

ORGANISATIONS INVOLVED IN SLOW SAND FILTRATION SYSTEMS.

1. ITDG.
   INTERMEDIATE TECHNOLOGY DEVELOPMENT GROUP
   Myson House
   Railway Terrace
   Rugby CV21 3HT
   UK Fax +44 788 540 270

2. WEDC
   WATER, ENGINEERING & DEVELOPMENT CENTRE
   Loughborough University of Technology
   Leicestershire LE11 3TU
   U.K. Fax + 44 509 211 079

3. GATE
   GERMAN APPROPRIATE TECHNOLOGY EXCHANGE
   GTZ
   Postbox 51 80
   D-6236 Eschborn 1
   Germany Fax +49 6196 79-11 15

4. IRCWD
   INTERNATIONAL REFERENCE CENTRE for WASTE DISPOSAL
   Attn Martin Weglin
   Ueberlandstrasse 133
   8600 Dubendorf
   Switzerland Fax +41 1 823 50 28

5 IRC
   INTERNATIONAL REFERENCE CENTRE for COMMUNITY WATER SUPPLY & SANITATION
   P.O. Box 93190
   2509 AD The Hague
   The Netherlands

6 VITA
VOLUNTEERS IN TECHNICAL ASSISTANCE
P.O. Box 12438
Arlington
Virginia 22209-8438
USA Fax +1 703 243-1865

7 AWWA
AMERICAN WATER WORKS ASSOCIATION
6666 West Quincey Avenue
Denver
Colorado 80235
USA

COMMERCIAL COMPANIES
Commercial possibilities. - None with which I have any personal experience, but information from one or two may have some use. Some, particularly the early ones are well established in potable water systems.

1 SULZER BROS. - (Advice & Systems of filtration, reverse osmosis, floculation etc.).
Sulzer Brothers Ltd.
Water & Wastewater Engineering
CH-8401 Winterthur
Switzerland

2 BIWATER. - Turnkey systems.
Biwater
Biwater House
Station Approach
Dorking
Surrey RH4 1TZ
UK Ph. +44 306 888 188

3 POTAPAK - Packaged Water Purification Systems for Small Communities- No Chemicals.
Potapak Ltd
3 Canal Walk
Newbury
Berks RG13 1DY
UK Fax +44 635 30844

4 AQUAFINE. - Ultraviolet Water Sterilizers - Not as inappropriate as they might sound.

Aquafine Corporation
25230 W. Ave Stanford
Valencia
California 91355
USA
Ph +1 805 257 4770

Aquafine U.K. Ltd
20 Park Street
Princess Risborough
Bucks HP17 9AH
UK
Ph. +44 8444 6026

5 LOVIBOND. - Water test kits. (Does not indicate for what it is testing).
The Tintometer Ltd
Waterloo Road
Salisbury SP1 2JY
UK
Fax +44 722 412 322

6 BERKEFELD FILTER - Reverse Osmosis Plants.
Berkefeld Filter Anlagenbau GmbH
Box 12, D-3100 Celle
Germany

7 SIT Water Systems A/S - Turnkey systems
Ny Vestergade 7
DK-1471 Copenhagen K
Denmark

8 Hendrick Gravity Flow Systems Inc. - Very fine filtration, polyurethane filter panels instead of sand.
GFS
PO Box 525
9 North Main Street
Carbondale
PA 18407
USA

9 AMES CROSTA BABCOCK LTD - Desalination.
Heywood
Lancs OL10 2DX
UK

10 AL-KAWTHER - Desalination.
Al-Kawther Industries Ltd
P.O. Box 7771
Jeddah 21472
Saudi Arabia

USEFUL LITERATURE.

1 Waterlines - Quarterly Magazine
Intermediate Technology Publications Ltd.
103 - 105 Southampton Row
London WC18 4HH
UK Fax +44 71 436 2013

2 Simple Methods for the Treatment of Drinking Water
Gabriele Hebner ISBN 3-528-02021-0
GATE GTZ

3 Slow Sand Filtration for Community Water Supply
J.T. Visscher, R. Paramasivam, A. Raman, H.A. Heijnen
Technical Paper No. 24
IRC ISBN 90-6687-009-5

4 Small Community Water Supplies
Technical Paper Series No. 18
IRC ISBN 90-6687 008 7

5 Developing World Water
Grosvenor Press International Ltd
West Garden Place
Kendal Street
London W2 2AQ
UK

COMPUTER DATA BASE SYSTEMS

CSIR - INFOACCESS, A retrieval system into a database water programme - WATERLIT. Either through a mainframe computer system or CD ROM. Should have all the information you would ever need.

CD ROM is updated quarterly, but CD's have a high licence fee. Although more expensive to purchase, if used infrequently, main frame access would work out cheaper, and is continually updated.

Angela Rethman; Project Manager. Fax 012 86 2869

APPENDIX 3

ORGANISATIONS INVOLVED IN DEVELOPMENT AND MANUFACTURE OF BASIC WORKSHOP OR OTHER EQUIPMENT.

1. ITDG.
   INTERMEDIATE TECHNOLOGY DEVELOPMENT GROUP
   Myson House
   Railway Terrace
   Rugby CV21 3HT
   UK Fax +44 788 540 270

Equipment to make wheel hubs, rims and axles. Hand tools.

2. ApT.
   ApT DESIGN AND DEVELOPMENT
   29 Northwick Business Centre
   Moreton-in-Marsh
   Glos Gl56 9RF
   UK Fax +44 386 701 010

Technical training and enterprise promotion. Designs and plans on equipment such as, sheet metal bending brake (gutter press), sheet metal rolling machine, sheet metal edge folding machines. sheet metal shears, pipe bender.

Each is locally made and light weight; an "intermediate" technology rather than commercial.

3. TOOL Foundation
   Sarphatistraat 650
   1018 AV Amsterdam
   The Netherlands.

Technical designs.

4 NEW DAWN ENGINEERING
   NEW DAWN ENGINEERING (PTY) LTD.
   PO. Box 3223
   Manzini
   Swaziland Fax +268 85016TOOL

Commercial manufacturer of "appropriate technology" equipment: Fence wire frames, diamond mesh machines, barbed wire machine, concrete block machine, sunflower oil expressing machine.

5 WATER WORKSHOPS
Dabane Trust / Water Workshops,
PO. Box 3331
Bulawayo
Zimbabwe Fax +263 9 44073

Diamond mesh machines. "Ovens" Hand pumps. Blacksmithing. Gutter equipment

6 MA -IRRI INDUSTRIAL EXTENSION PROGRAMME FOR SMALL FARM EQUIPMENT.
Agricultural Engineering Division
Bureau of Plant Industry
San Andreas Street, Malete
Metro Manilla
Philippines. Ph. +63 2 598 114

Treadle pump.
Mr. Tom Kroll also has plans of this Treadle Pump from:-
The Social Work & Research Centre
Tilonia 305 816, Madanganj, Dist - Ajmer, Rajasthan, India.

7. UNIVERSITY ZIMBABWE
Dept of Civil Engineering - Attn Mr. Paul Taylor
Training Centre for Water and Sanitiation
PO. Box MP 167
Mount Pleasant
Harare
Zimbabwe. Ph +263 4 303211

Treadle pump.

8. RIIC
RURAL INDUSTRIES INNOVATION CENTRE
P. Bag 11
Kanye
Botswana. Telex 2435 BD

Ovens,

APPENDIX 4

CORRELATION OF TANK CAPACITY TO ROOF SIZE & RAINFALL.

The Botswana Technology Centre has devised a formula to calculate the capacity of a water storage tank for roof water harvesting systems:-

$$V = Ra \times Sc \times Pf$$

where

V = Volume of the tank
Ra = Roof area
Sc = Storage coefficient
Being 0,15 for a rainfall > 400 mm per annum.
Most of Uukwaluudi is 350 - 400 mm average annual rainfall
Pf = Precipitation factor
Being 1,5 to compensate for uneven rainfall distribution over the year.

Using this formula a suitable tank for the school roof at Okashedi would be 34,50 m^3, rather than the 10,00 m^3.tank which has been built.

$$V = 153\ m^2 \times 0,15 \times 1,5$$

This should yield some 90 L of potable water per day; with 95% reliability.

Alternatively an adequate tank for the storeroom / lecture room at the development centre would be 25,00 m^3, rather than the two tanks storing approximately 8,00 m^3.

$$V = 110\ m2 \times 0,15 \times 1,5$$

Which should yield some 65 L of water per day, with 95% reliability.

ALTERNATE FERROCEMENT TANK DESIGNS AND COSTS.

Ferrocement tank construction is an ideal system of forming durable water tanks and is presently used by the programme. However costs associated with the methods and materials used are too expensive.

1. A large proportion of the cost of a tank is that of labour, this could be reduced by employing one skilled to builder who was assisted by non-remunerated community labour.

2. Care should be taken in mixing cement plaster and particular care taken in not constructing an unnecessarily thick final wall. A calculated quantity of cement should be used per tank, and not exceeded.

3. Costs of reinforcing may be significantly reduced by using diamond mesh security fencing instead of poultry wire netting and weldmesh mat. This method would continue to utilise the existing corrugated iron moulds and would also provide further employment to the fence-wire group.

4. A hand operated machine to make diamond mesh security type fencing would be required to make two widths of reinforcing, 1,75 metres high for the tank walls and 3,00 metres wide for the domed top. Diamond mesh, 50 mm x 50mm aperture of 2,5 mm wire is adequate. The outlay for a suitable machine would be approximately 800 Rands landed in Oshikati.

5. Costs of reinforcing mesh and wire netting presently being used by the programme as purchased in November 1992 with prices from the cheaper of two suppliers, are R 335,13 per tank. The 10 m3 tank is budgeted at R 197,00 and the 5,00 m^3 tank at R 163,00 in the UNICEF Assisted Emergency Water Programme, February 1993. Working on a cost of R198,57 per 2,5 mm gauge roll (inclusive of tax) from Cash Build, Oshikati the cost price of reinforcing for the larger 10,00 m^3 tank is R 70,00. At say R 100,00 per tank operators can pay off the machine and gain a worthwhile income. The cost of reinforcing could be further reduced by using black wire rather than galvanised wire.

6. Since guttering is one of the more expensive components of the roof water harvesting, the cheapest guttering should be sourced if a community programme is to be realised. Fabricated guttering cost UNICEF

R 27,64 m² (November 1992 purchases). Cash Build, Oshikati, were advertising guttering at R 6,54 per metre length, (March 1993 price). A 0,45 mm gauge sheet of 0,915 x 1,83 metre galvanised flat iron cost R 36,08 (inclusive of tax), March '93 at Cash Build, Oshikati, R 21,60 m². Fabricated guttering could therefore at least equal manufactured cost.

7. Large quantities of sheet metal purchased from a wholesaler would lower unit costs. Smaller section guttering for smaller roofs would further reduce costs. Again for smaller buildings, scrap sheet metal from old car bodies would considerably reduce sheet metal costs.

8. P.V.C. piping would also reduce guttering costs on small domestic buildings. A 110 mm class B, PVC pipe suitable for use in the atmosphere, cut in half gives an effective cost of R 5,76 per metre of guttering, compared to R 9,04 per metre for the sheet metal guttering. The P.V.C. gutter would have a cross sectional area of 86 cm² compared to 125 cm² for the sheet metal.

9. Savings can also be made on the water outlet. A 15 mm brass bibcock cost R 27,04 each, (November '92), whereas 2,00 m of 13mm reinforced garden hose which could be hooked above the water level in the tank, for the same result, costs R2,60 plus R0,64 for a hose clip. R 3,24 (April '93 prices).

APPENDIX 5

SUGGESTIONS FOR UPGRADING EXISTING TRADITIONAL OPEN WELLS.

1. There are several advantages associated with the upgrading, through lining, of existing open wells:-
   1. Water source and supply is already known and proven.
   2. A cistern, larger in diameter than the well can be constructed on the impervious calcrete layer within the water table. This will significantly increase the body of standing water and inflow to the well, thus appreciably increase yield.
   3. Smaller, lighter and less costly well rings can be used in conjunction with the cistern.
   4. Lining will prevent the well from flooding, thus ensuring a supply of potable water throughout the year and also obviating any need for descent into the well.

2. Construction details: - cistern.
   A 225 mm brick wall cistern of some 2,00 metres diameter should be built on the calcrete, on which the fresh water table is perched. It should be matched in height to a multiple of the well rings which are 200 mm high, say 1,40 or 1,60 metres. The well rings should be laid from the centre of the cistern and concrete slabs laid between the brick wall and the well lining. There should be no mortar in the vertical joints of the brick wall to allow water through and ideally a synthetic membrane should be placed around the outside of the bricks to prevent the ingress of the very fine sands which will reduce the efficiency of the well.

3. Construction details: - well.
   By constructing an underground cistern the well diameter can be considerably reduced, 150 mm diameter P.V.C. borehole casing could in fact be used if an alternate method were used to support the covering slab of the cistern. Concrete well rings are however preferable as a person can then gain entry to the well should it need cleaning out. Well rings can be made and installed by the community and, particularly as the water level drops in the well during the dry season, the most appropriate bucket for drawing water can be installed. Suitable well rings should be 0,90 m internal diameter and 0.20 metres high with a 75 mm wall, weight of this will be 110 kg, which can be moved by either three or four people.

4. Moulds for such well rings should be in three main sections with one smaller vertical vee, sectioned piece to ease removal. Sections should be bolted together and of 5,00 mm plate to prevent denting or buckling. A suitable concrete mixture for the rings is 2 cement : 5 sand : 3 aggregate, Rods should be inserted into the moulds at casting, when these are withdrawn the ring will be sufficiently permeable. A reinforcing ring of 10 mm rod with similar rod "handles" welded to it, should be cast into the top of the ring to act as a handle for moving and as a foot hold when in placed in the well. A flat surface to the concrete rings is quite adequate with one ring placed on top of another, surface to surface with no notched lip. Well rings of dimensions larger than given here, but using the same construction principles can be seen at the RDC workshop at Ongwediva.

5. In order to effectively construct the cistern a de-watering pump might be necessary.

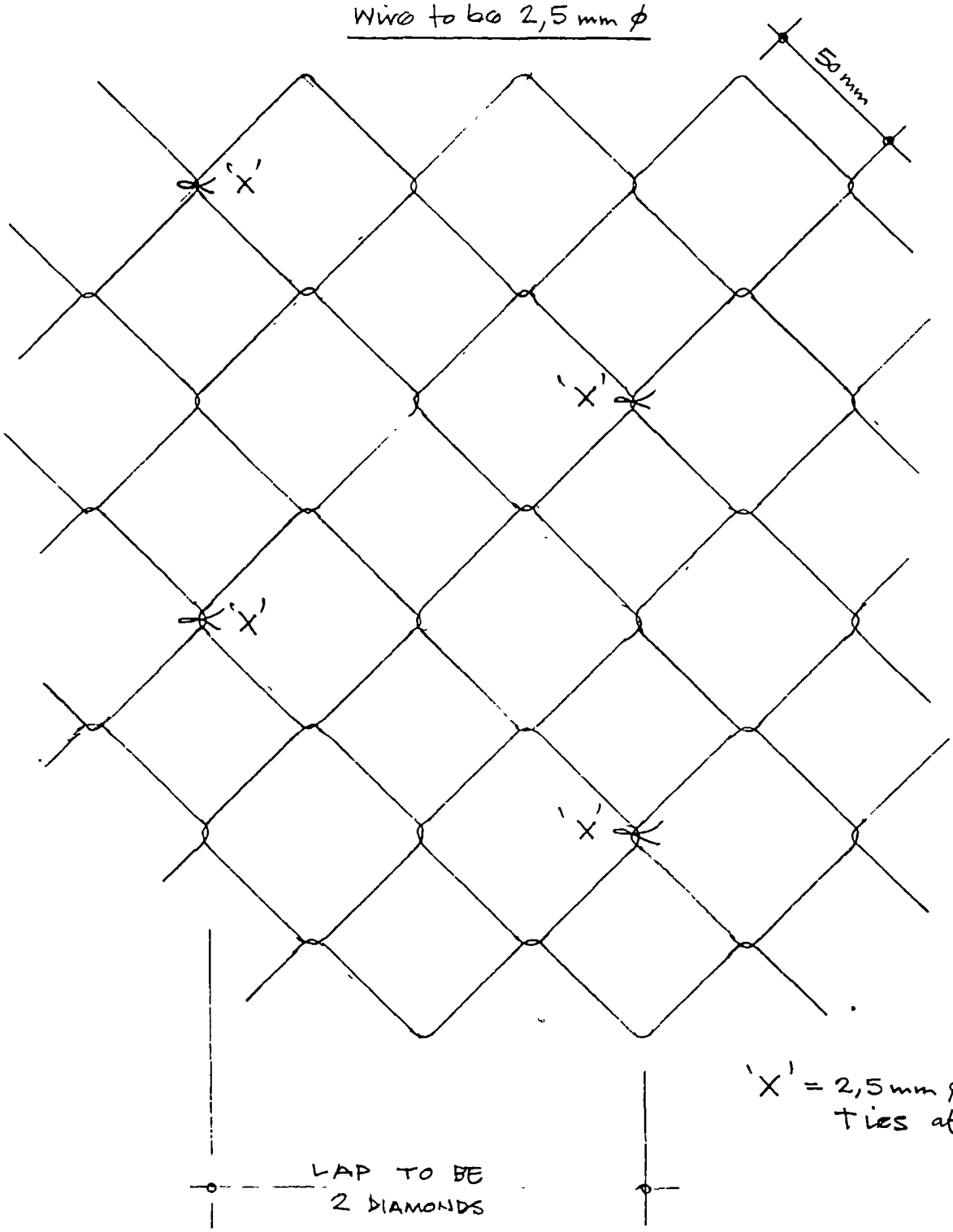
PETER WILLIAMS & PARTNERS
CONSULTING ENGINEERS

Date 30.03.93 Job No B93-36 Sht. No SK1

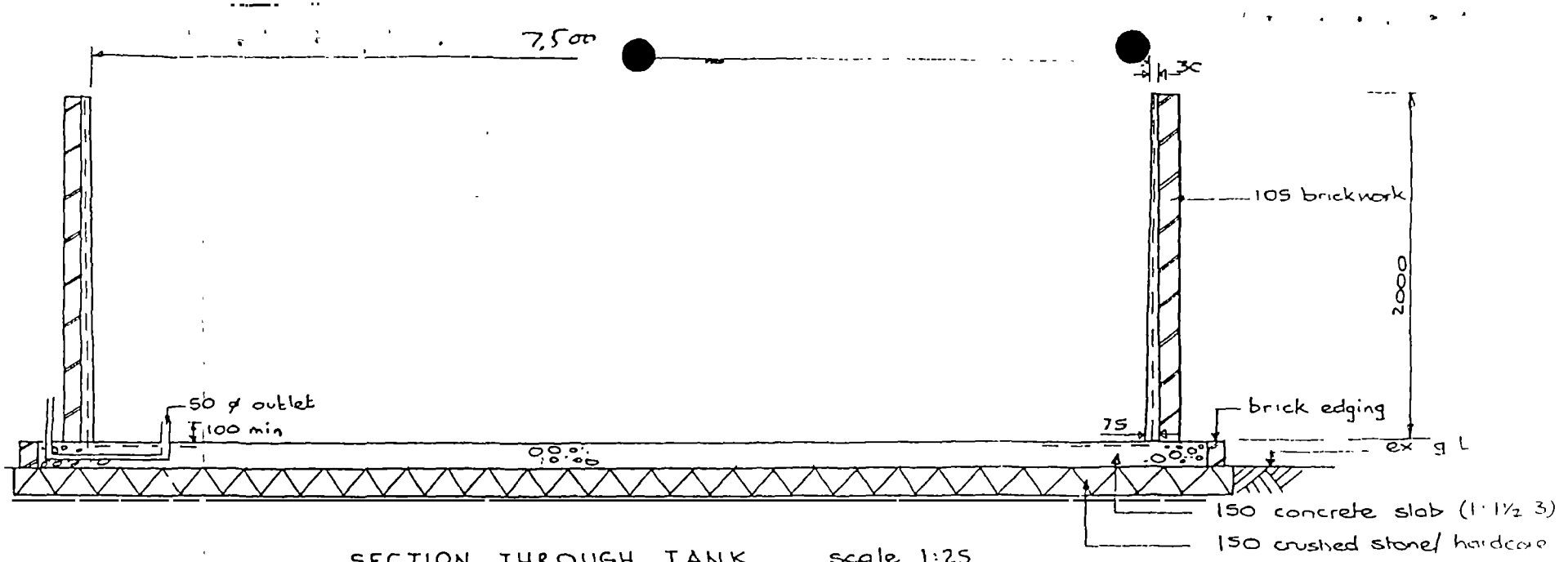
Job MR. HUSSEY Portion STORAGE TANKS

SIZE : 2750 ϕ x 1700 Deep

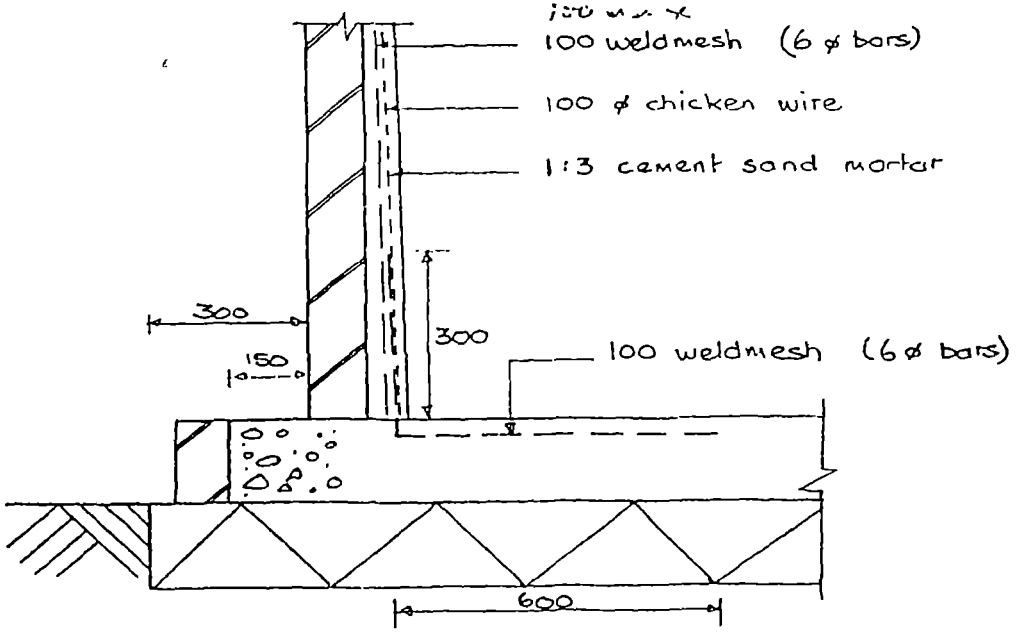
Wire to be 2,5 mm ϕ



'X' = 2,5 mm ϕ Wire
Ties at Lap.



SECTION THROUGH TANK scale 1:25

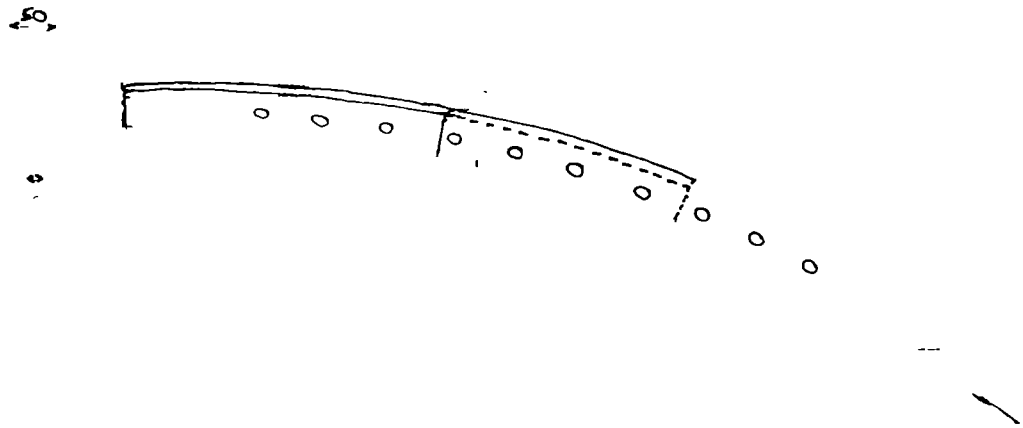


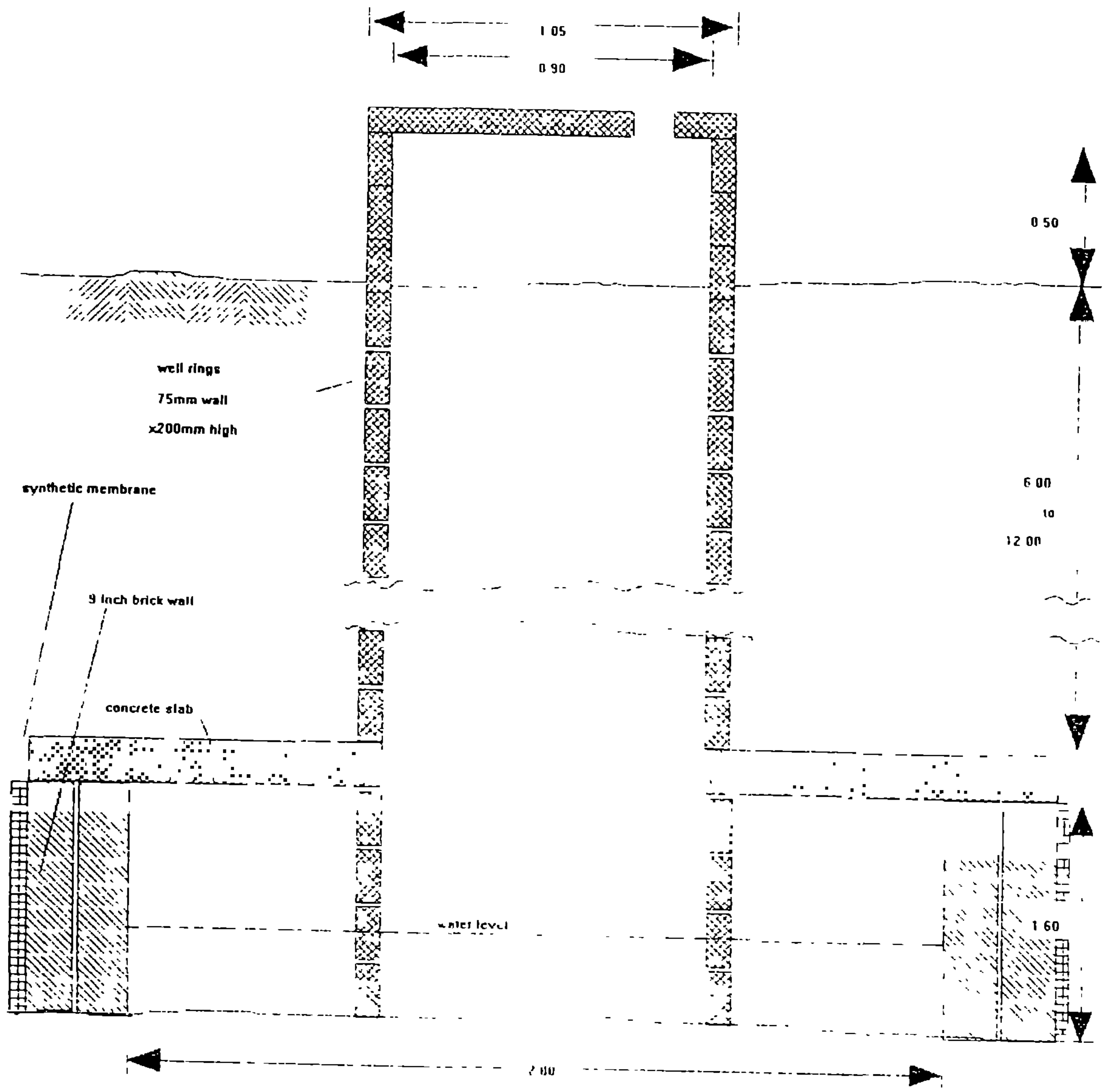
DETAIL OF JOINT scale 1:10

BRICK / FERROCEMENT WATER TANK

UNIVERSITY OF ZIMBABWE
DEPT. OF CIVIL ENGINEERING

DRAWN	M G M
DATE	DEC 1987




1 05
0 90
0 50
well rings
75mm wall
x200mm high
synthetic membrane
6 00
to
12 00
9 inch brick wall
concrete slab
water level
1 60

PETER WILLIAMS & PARTNERS

CONSULTING ENGINEERS

Phone 70013 BULAWAYO P.O. Box 2351

6-4- 1993.

To Mr. HUBBEY.

We are forwarding the following drawings in connection with

WELL SLABS

Ref. No. B93-42

Drg. No.	Bending Schedule	DESCRIPTION	No. of Copies
	SK1	PRECAST SLABS TO FILTER CHAMBER.	5 (A4)
	BS1	" "	5 (A4)

ABF 6419

Yours faithfully,

PETER WILLIAMS & PARTNERS

PETER WILLIAMS & PARTNERS

CONSULTING ENGINEERS

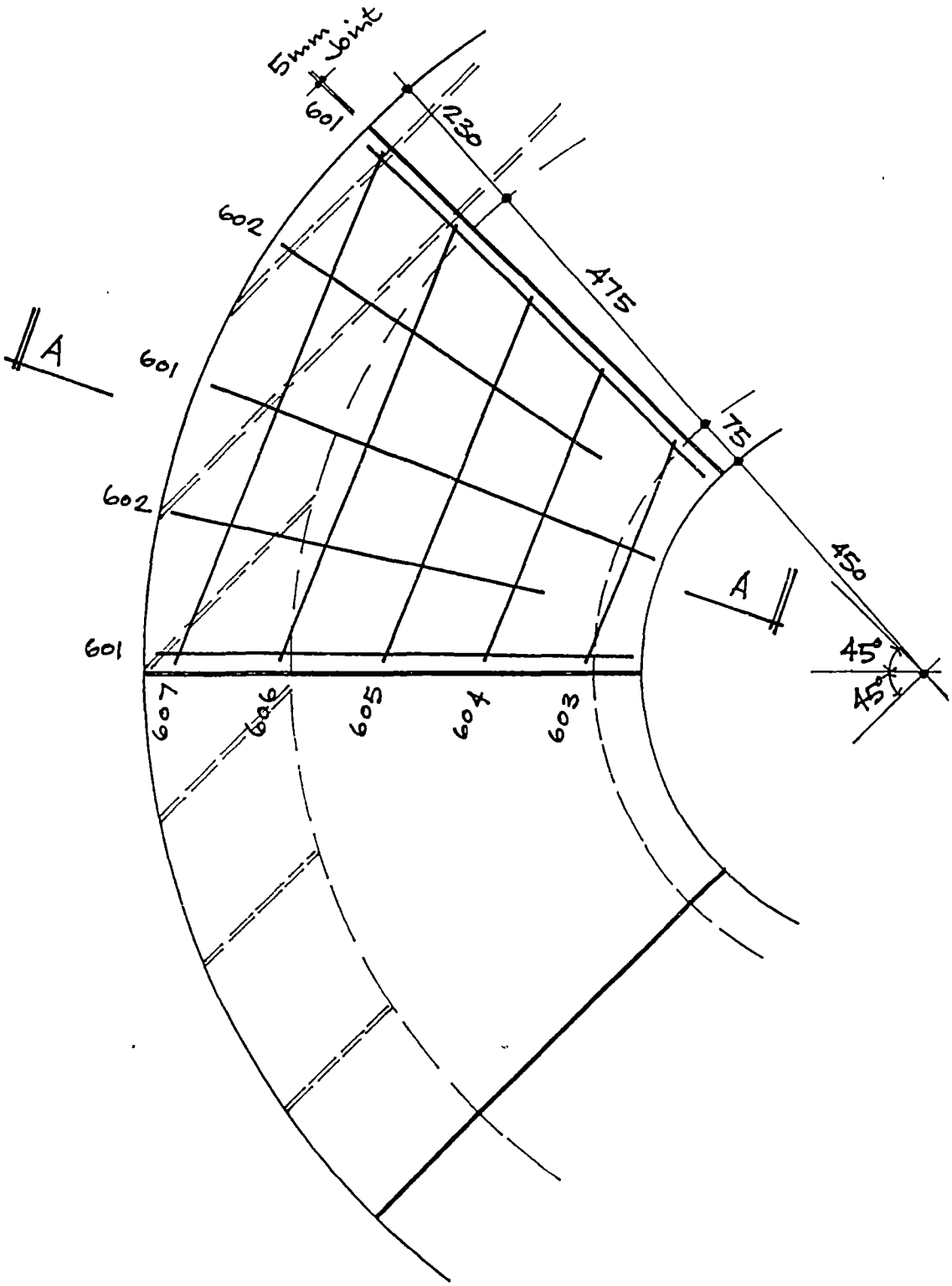
Date 06.04.93 Job No B93-12 Sht No SK1

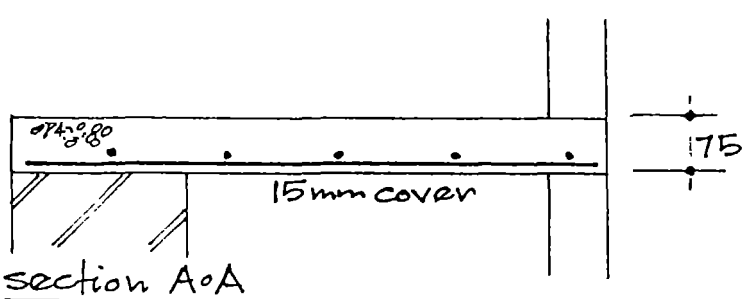
Job. MR. HUSSEY - WELL SLABS

Portion PRECAST SLABS TO FILTER CHAMBER

8 No. PER WELL

USE 25 mPa CONCRETE.





section A-A

Sched. No. BS1 Date 06.04.93

Ref No B93-42

For placing of steel see dwg. No. B93-42/SK1

PETER WILLIAMS & PARTNERS

CONSULTING ENGINEERS

Contract MR. HUSSEY - WELL SLABS.

Portion PRECAST SLABS TO FILTER CHAMBER

abf—8641

Member	Bar mk.	No. in each	Total No.	Type and Size	Length	BENDING AND PLACING Dimensions of ties and stirrups are inside — All other dimensions are overall unless otherwise stated
75 THICK	601	3	24	S6	750	STRAIGHT.
PRECAST	602	2	16	S6	600	"
SLABS	603	1	8	S6	370	"
8 No.	604	1	8	S6	500	"
PER WELL.	605	1	8	S6	620	"
	606	1	8	S6	740	"
	607	1	8	S6	870	"

APPENDIX 6

DESIGN & INFORMATION ON THE BUCKET PUMP

1. A derivation of a Bucket Pump would be the most suitable method of abstracting water from an omufima; shallow well with minimal depth perched micro-water table.

2. The stand is fabricated of steel sections, suitable steel to fabricate these sections can be obtained from old vehicle chassis. Drawings of a typical pump suitable for a tube well or borehole follow. An adaption to the windlass stand, with the addition of a cross member to allow it to be bolted to a well cover slab, can easily be made.

3. Although the bucket in the following drawings would be suitable, it too has been designed for a borehole, with a diameter of 90 mm and length of 700 mm. A more suitable container for very shallow water sources would be a bucket approximating the size and dimensions of a builders bucket, however these float very easily. Perhaps the most appropriate bucket would be a three-legged pot with a valve in the bottom similar to that in the diagram. Such a container is durable, would easily fill and would draw water from a very shallow source by virtue of its bottom filling, whilst the legs would prevent the valve coming into contact with the floor of the well.

BLAIR RESEARCH BULLETIN

NO. W 27.

Blair Research Laboratory
Ministry of Health
P.O. Box 8105, Causeway
Harare, Zimbabwe

THE BUCKET PUMP - A COMMERCIAL UNIT

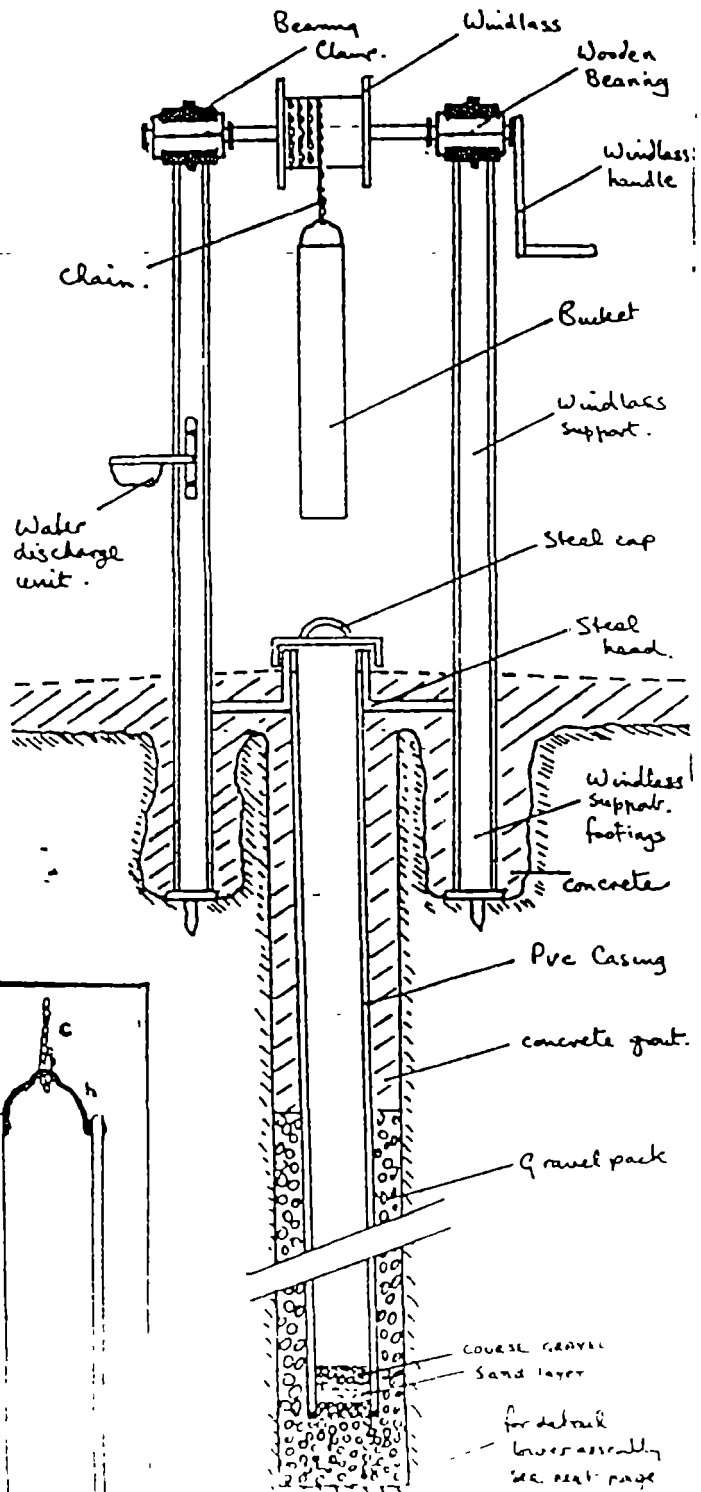
This simple system of raising water has been put on trial by Blair Research Staff for over one year and experimental models are consistently providing good service to date. The system which has been described in earlier Blair Research Bulletins can be made by local craftsmen, but a neat commercial package, made by V & W Engineering of Harare is now available. This bulletin describes this unit and how it operates.

The windlass, steel head and cap, the bucket and the windlass support are all made of steel as shown in the diagram. Hard wood bearings have been retained for long trouble free service. A simple steel poppet type valve has been designed for the bucket, which provides a fast filling rate and also long life.

The frame of the bucket pump has been designed so that the lower end is immersed in a concrete anchor, thus making the whole assembly very secure.

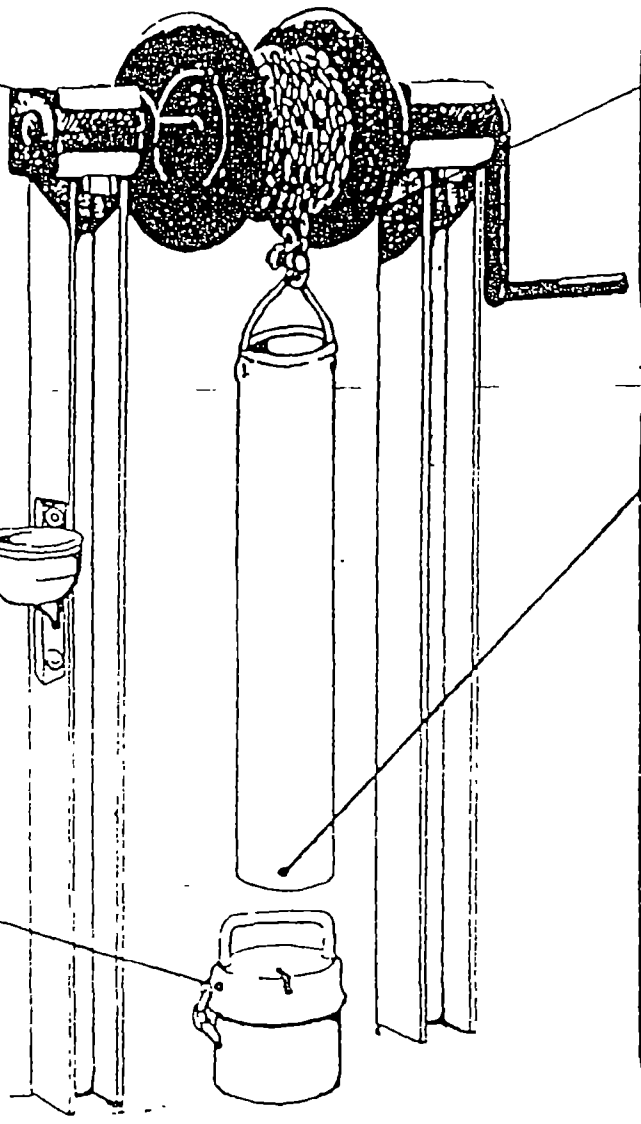
A special water discharge unit has been designed by the manufacturer to further increase hygienic use of the system. In this case a full bucket of water is discharged into the waiting family water vessel by inserting the bottom of the tube-bucket into the water discharge unit. This has the effect of opening the valve in the bucket and discharging the water from one bucket to the other very hygienically.

The system has been designed to raise 5 litres of water at one time, and the standard model is mounted over a PVC tubewell [illegible]



BUCKET

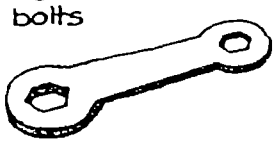
Maintaining the bucket pump



CHECK 1
Bearing Block
- Tighten nuts and bolts

CHECK 2
Water Discharger

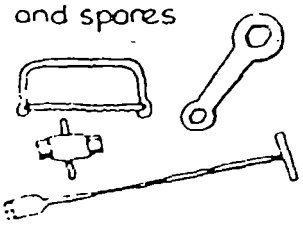
Tighten nuts and bolts



CHECK 3
Steel Head

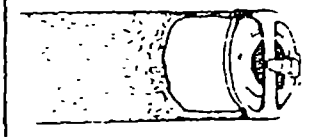
Keep the lid on

CHECK 6
Check all tools and spares

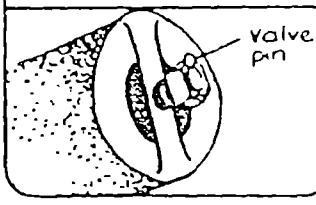


CHECK 4
Chain
- Connect chain tightly to the chain barrel and bucket.
- use wire if necessary

CHECK 5
Bucket Valve



- Inspect the valve
- Tighten valve nuts
- Check valve seal replace if necessary, remove sand and grit
- Inspect valve pin



CHECK THIS PUMP EVERY WEEK!
COMPLETE YOUR CHECK BOOK EVERYTIME
REPORT PROBLEMS IMMEDIATELY

Draft Educational Material
Developed by Sue Laver
Graphics by Graham Williams

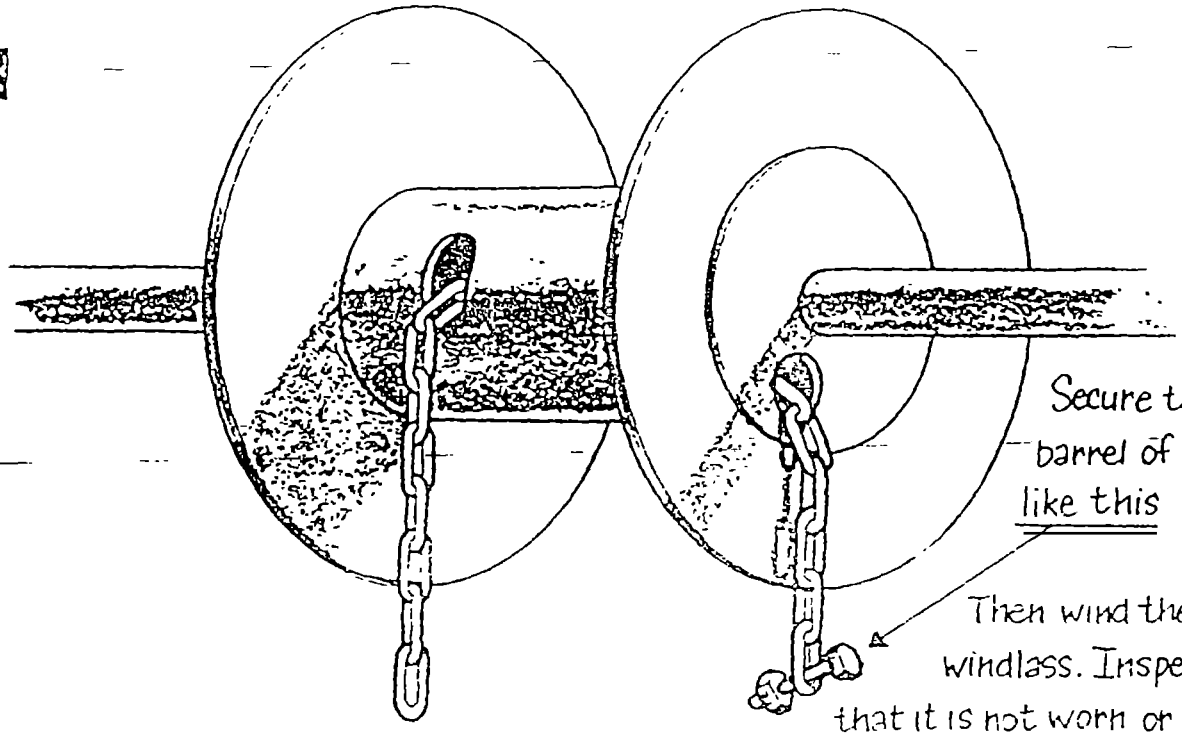
4-7

Extra information

about maintaining and making minor repairs to the bucketpump.

Draft Educational Material
Developed by Sue Lever
Graphics by K de Waard.

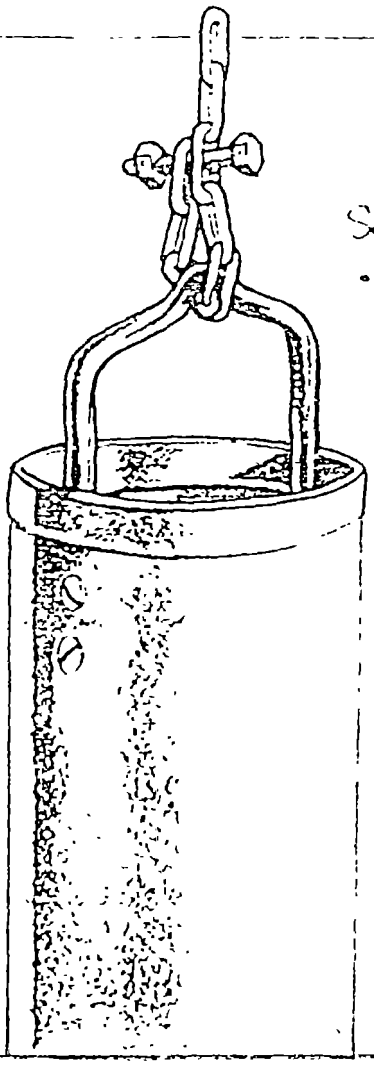
1



Secure the chain on the barrel of the windlass like this

Then wind the chain onto the windlass. Inspect the chain to see that it is not worn or rusted. Replace if necessary!

2

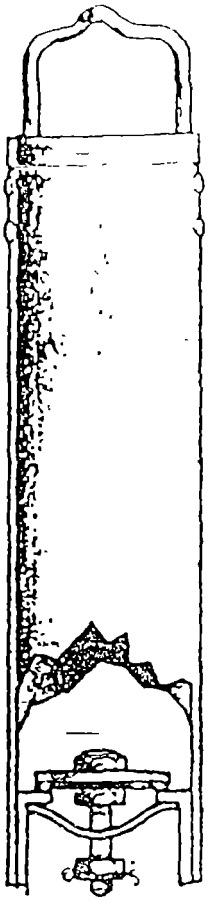


Secure the chain to the bucket.

- Use a nut and a bolt to do this.
- Wire can also be used for this task if necessary

Adjust the chain

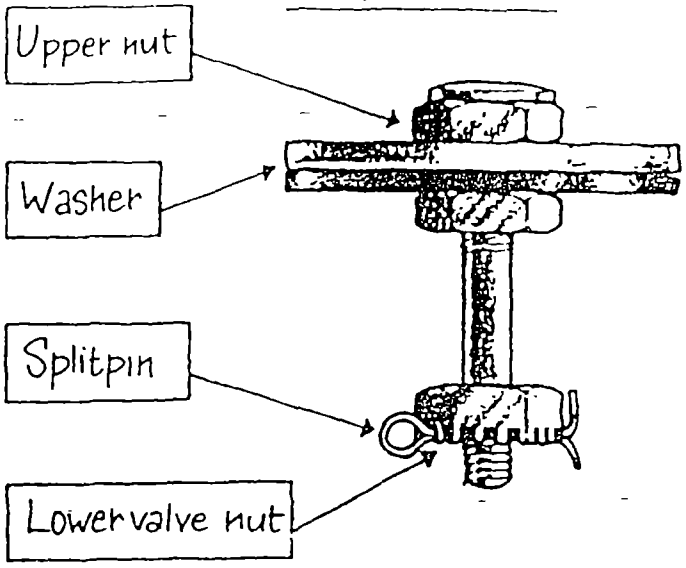
3



The bucket

The bucket valve is inside the bucket

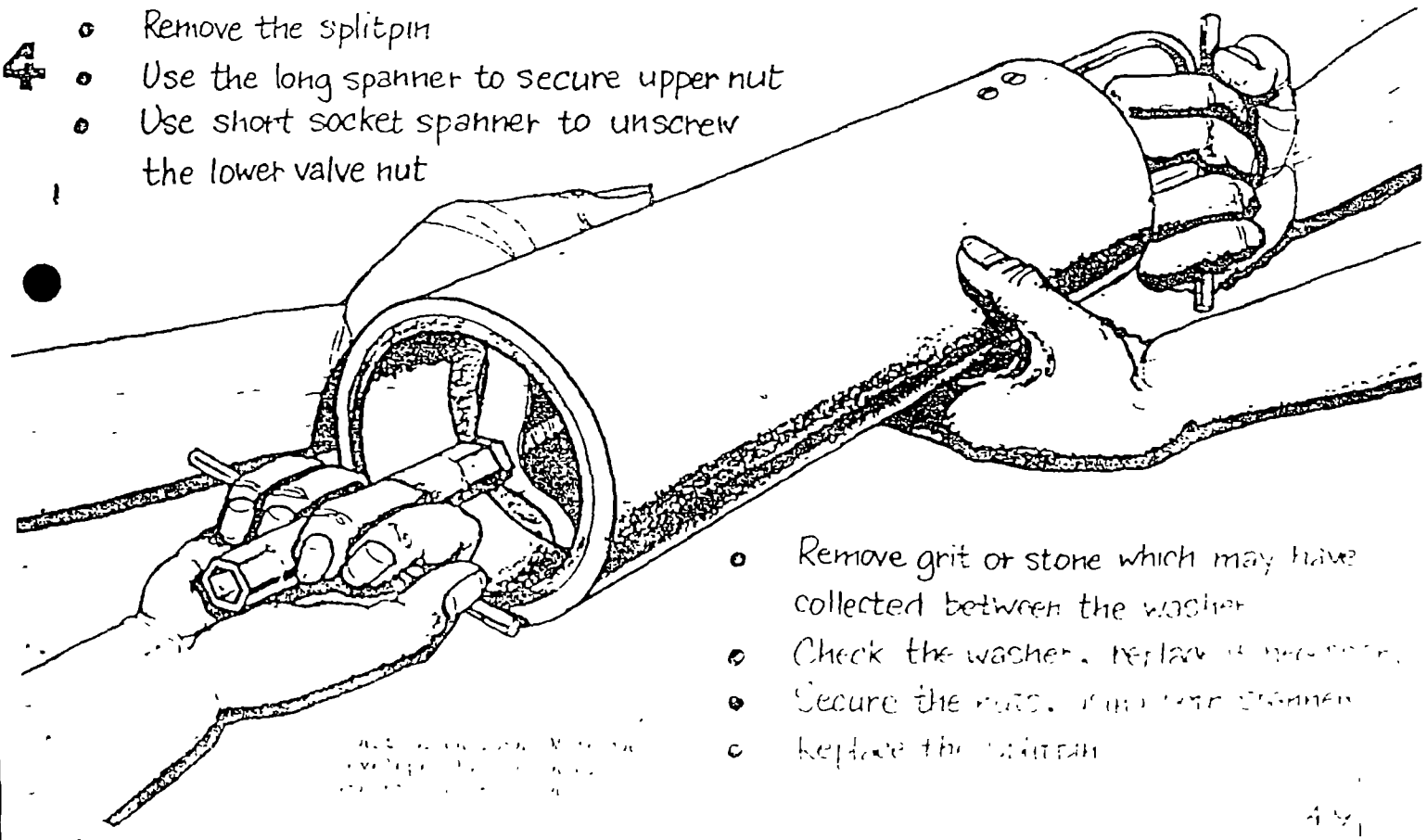
The bucket valve



4

To replace the washer:

- Remove the splitpin
- Use the long spanner to secure upper nut
- Use short socket spanner to unscrew the lower valve nut



- Remove grit or stone which may have collected between the washer
- Check the washer. Replace if necessary.
- Secure the nuts. Tighten with spanner
- Replace the bucket

GENERAL WARD STATISTICS

WARD _____ DATE _____

DISTRICT _____

HUMAN POPULATION			
Overall Population			
Men			
Women			
Density			
Unemployed			
Percentage School Attendence			
ANIMAL POPULATION		Total	Lost Through Drought
Cattle	(Beef)		
	(Draught)		
	(Dairy)		
Other Livestock			
	(Goats)		
	(Donkeys)		
	(Sheep)		
	(Pigs)		
	(Chickens)		
GEO-PHYSICAL			
Total Hectarage of Ward			
Average Hectarage for cultivation per Farmer			
Total Hectarage for grazing			
Possible yield per Farmer	Maize		
	Sorghum		
	P/millet		
	Ground nuts		
WATER SOURCES			
Dams	(irrigation)		
	(medium)		
	(small)		
Weirs			
Sand Abstraction Units			
Wells	(working)		
	(non-working)		
Swamps			
Grinding Units			
FINANCIAL			
Average Income per Capita			
Government Expenditure	Health		
	Education		
	Roads		
DEVELOPMENT			
Number of existing Projects			
Number of possible Projects for Water Workshops			

Test TSHELANYEMBA Area _____

Councellor Questionnaire Date _____ Name _____

Is there a bus service to town
How often does it run
How much does it cost

Numbers of
Schools
Clinics
Business Centres
BoreHoles
Dams
Wiers
Grinding mills
Blacksmiths
Tinsmiths
Carpenters
Bakeries
Stores

Banking Facilities
POSB
Banks
Building Socs

Grain Depots
Cotton Depots
CSC Depots

Possible map showing the situation of these facilities

Anything else

Number ____ MZIMUNI Y/N ____

Date _____ Area _____

WATER WORKSHOPS - A PROGRAMME OF DABANE TRUST

FEASIBILITY STUDY ON ARTISAN WORKSHOPS

A Questionnaire for Community Members

1 Relation to Head _____

2a Head of HouseHold Sex (M/F) ☐

b Waged Occupation Industrial ☐ Rural ☐

c Spouse

Waged Occupation Industrial ☐ Rural ☐

3 Total number of people living in your Kraal ☐

4a How many of these earn an income locally ☐

b What jobs do they do .

Crop Farming	☐	Teaching	☐
Cattle Farming	☐	Community work	☐
Goat Farming	☐	Building	☐
Garden	☐	Craft	☐
Food for Work	☐		
Development Project	☐	(which organisation) _____	
Other work, please specify _____			

c Any financial contributions from others Y/N ☐

d Estimated total income per month $ ☐

(Including any contributing kraal members money from town or income received from farming or other sales)

5a What is the acreage of your arable land ☐

b Do you grow crops Y/N ☐

	Cash	Consumption		Cash	Consumption
Sorghum	☐	☐	Melons	☐	☐
Maize	☐	☐	Beans	☐	☐
Millet	☐	☐	Sunflower	☐	☐
Ground nuts	☐	☐	Cotton	☐	☐
Round nuts	☐	☐	Other _____	☐	☐
Rapoko	☐	☐	_____	☐	☐

6 Which of the following items do you own

Plough	☐	Cultivator	☐	Harrow	☐	Bicycle	☐
Scotchcart	☐	Planter	☐	Wheel Barrow	☐		

7a Numbers of livestock

Cattle	☐	Goats	☐	Poultry	☐	Sheep	☐
Donkeys	☐	Pigs	☐	Rabbits	☐	Other _____	☐

b Are you prepared to sell livestock in order to buy neccesary items Y/N ☐

8a How many children go to school ☐

b School fees / term ☐

c Do you buy food Y/N ☐ Estimate food purchase / month $ ☐

9a Do you or members of your Kraal need the services of a Blacksmith Y/N ☐

b Which services do you need

Repair	☐	Household items	☐	Building materials	☐
Agricultural tools	☐	Irrigation equipment	☐		

10a Will you use the Dabane Trust Workshop Y/N ☐

b Why _____

c Why not _____

11 Which of the following have you or a member of your Kraal used

Carpenter	☐	Tinsmith	☐	Grinding mill	☐
Baker	☐	Repair service	☐	Dress makers	☐
Grain Depot	☐	Cotton Depot	☐	CSC depot	☐
Local Store	☐				

12 Where do you buy most of your manufactured goods

From Town ☐ From local manufacturers ☐

13 Where do you sell your own produce

In Town ☐ At local markets ☐

14 How many times do you take the bus into town each year ☐

15 Which of the following banking services do you use

	Local Branch	City Branch
POSB	☐	☐
Building Society	☐	☐
Bank	☐	☐

16 Respondents comments _____

17 Other Comments _____

WATER WORKSHOPS - A PROGRAMME OF DABANE TRUST

FEASIBILITY STUDY ON ARTISAN WORKSHOPS

A Questionnaire for Workshop Members

Date _____ TEST Tshelanyemba Name _____

1 Head of HouseHold Sex (M/F) ☐ Age ☐
Occupation Industrial ☐ Rural ☐
2 Spouse Sex (M/F) ☐ Age ☐
Occupation Industrial ☐ Rural ☐

3 Number of Children ☐
Number of people living at home ☐

4 Position in the Workshop

_____

5 Estimated monthly wage from Workshop

0 - $50 ☐ $100 - 150 ☐ $200 - 250 ☐ > $300 ☐
$50 - 100 ☐ $150 - 200 ☐ $200 - 300 ☐

6 Do you have any alternative sources of income

Crop Farming ☐ Garden ☐
Cattle Farming ☐
Craft ☐
Teaching ☐
Other projects ☐
Other, please specify _____

7 Estimated total disposable income per month (Include all contributing family members)

0 - $100 ☐ $200 - 400 ☐ $700 - 1000 ☐ > $1500 ☐
$100 - 200 ☐ $400 - 700 ☐ $1000 - 1500 ☐

8 Which of the following items do you own

Plough ☐ Cultivator ☐ Harrow ☐ Bicycle ☐
Scotchcart ☐ Planter ☐ Wheel Barrow ☐

9 What is the acreage of your arable land

(0 - 5) ☐ (5 - 10) ☐ (10 - 15) ☐ (> 30) ☐
(15 - 20) ☐ (20 - 25) ☐ (25 - 30) ☐

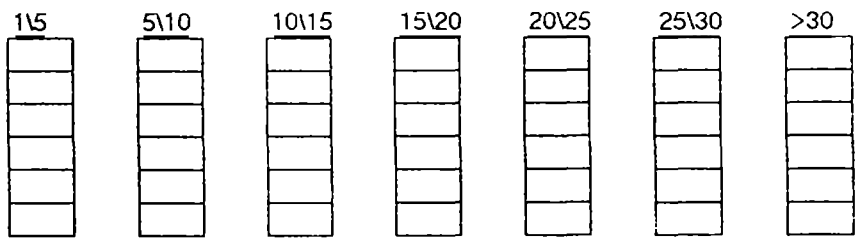
10 Do you grow cash crops Y/N ☐

Sunflower ☐
Maize ☐
Sorghum ☐
Ground nuts ☐
Millet ☐
Cotton ☐
Other _____

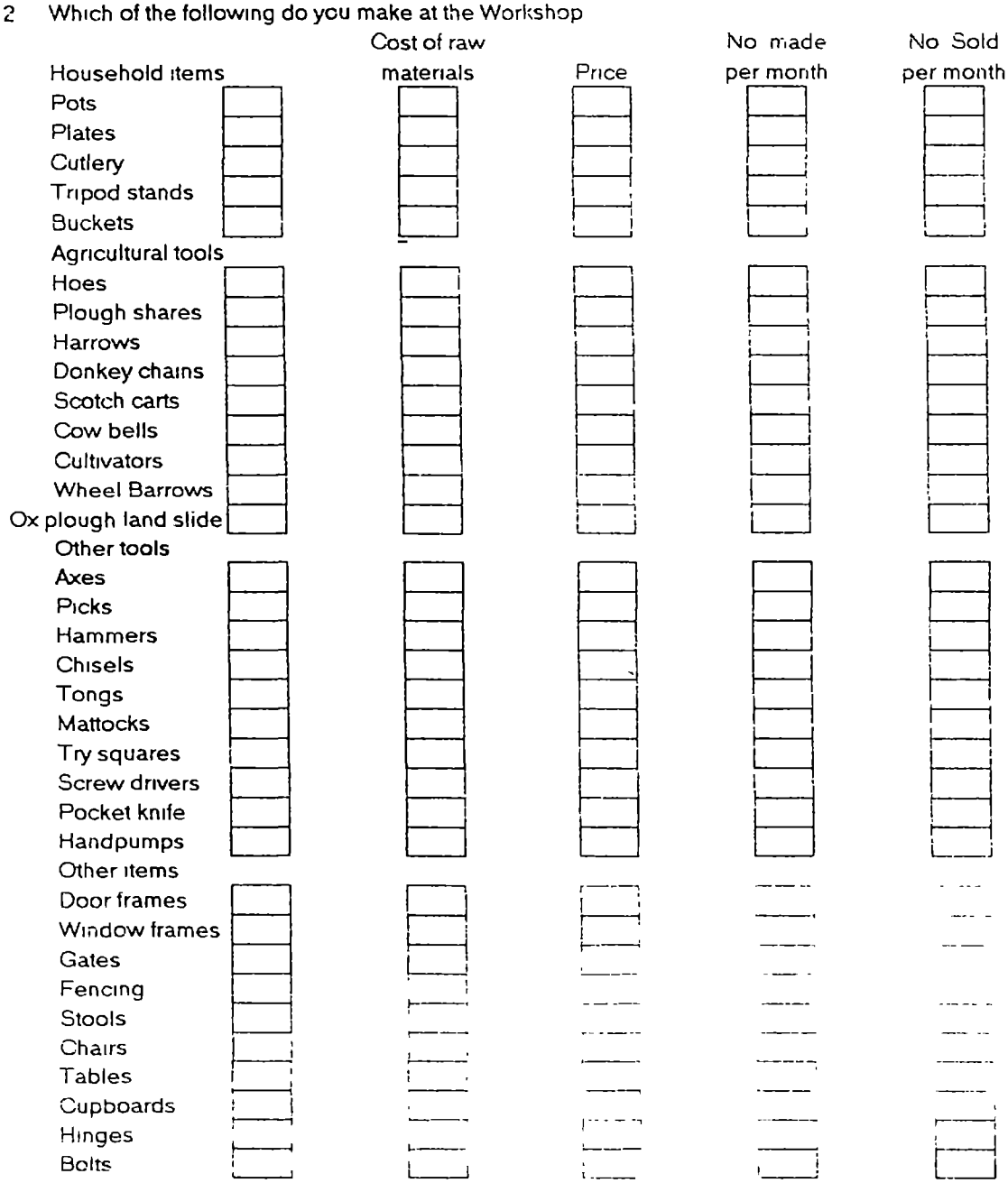
Do you grow grops for consumption Y/N ☐

Maize ☐
Sorghum ☐
Ground nuts ☐
Millet ☐
Other _____

11 Numbers of livestock



12 Which of the following do you make at the Workshop



13 Where do you get most of your raw materials

From Town ☐ From local manufacturers ☐

14 Where do you sell your goods

In Town ☐ At local markets ☐

15 How many times do you take the bus to town each month

0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐

>4 ☐

16 Which of the following banking services do you use

	Local Branch	City Branch
POSB	☐	☐
Building Society	☐	☐
Bank	☐	☐
Other	_____	

17 Which of the following banking services does the Workshop use

	Local Branch	City Branch
POSB	☐	☐
Building Society	☐	☐
Bank	☐	☐
Other	_____	

18. Further Information

i When did you join this group _____

ii Why did you join _____

iii How far is it from your home _____

iv Is this convenient for you _____

v Which raw materials do YOU use and where do you buy them _____

vi How do you transport these materials _____

vii How do you publicise your products _____

viii Is there a good market for your products _____

ix Is there any competition/similar workshop in your vicinity _____

viii Is there a good market for your products

ix Is there any competition/similar workshop in your vicinity

x How do you cost your products what do you consider

xi Who does the bookkeeping in your group

xii How is the wage or salary calculated

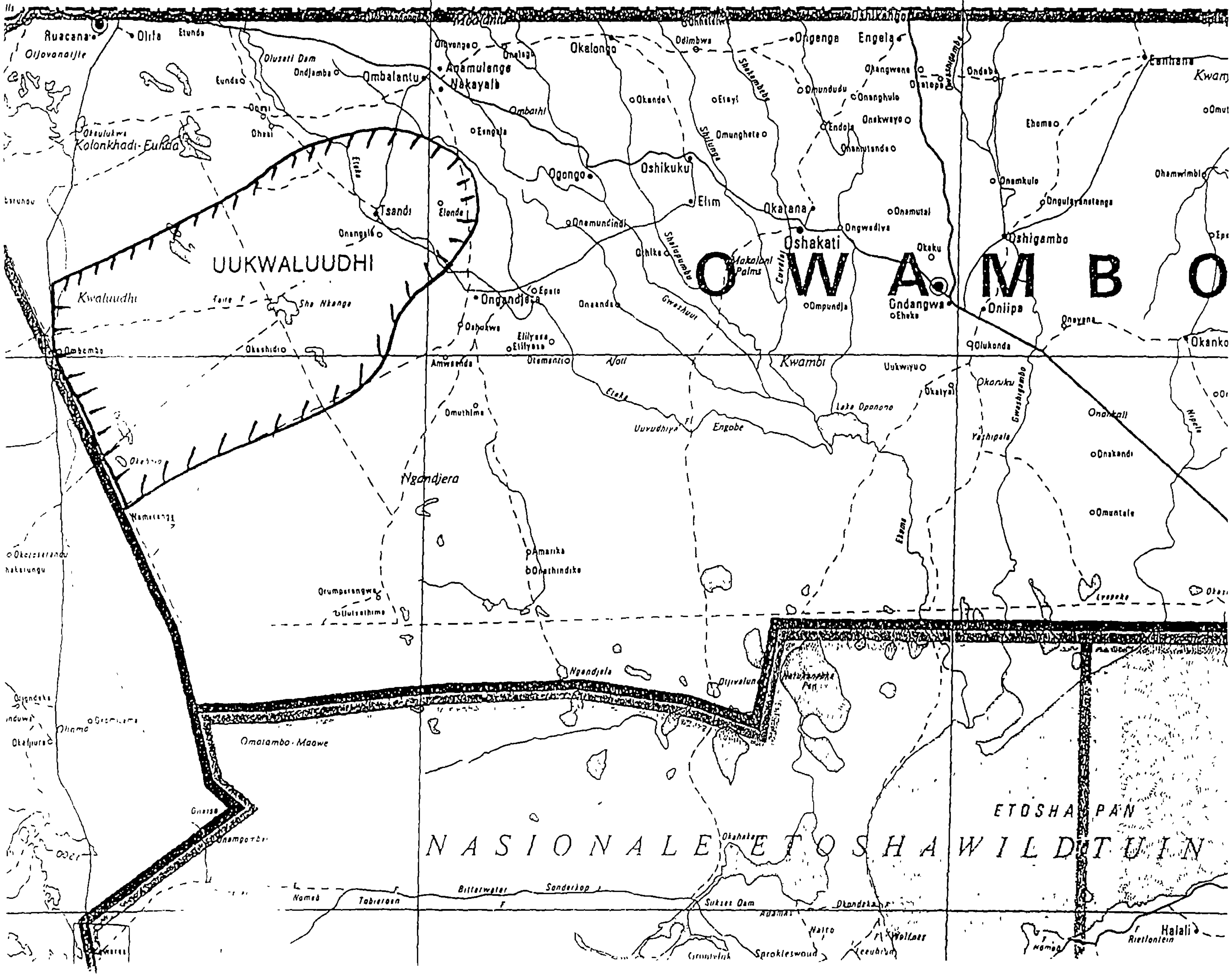
xiii When are the salaries made available

xiv How much is spent on electricity

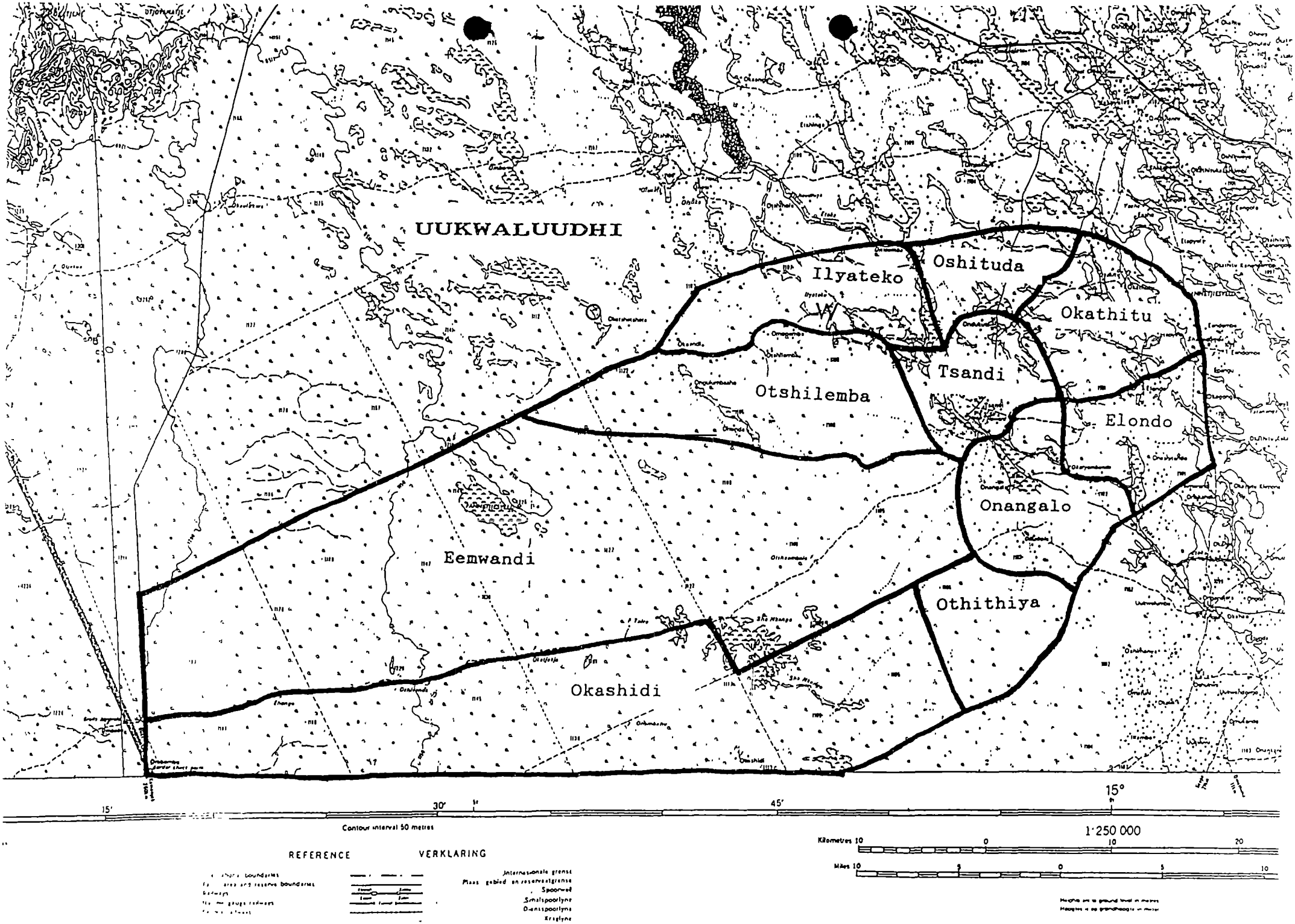
xv How are the meals organised

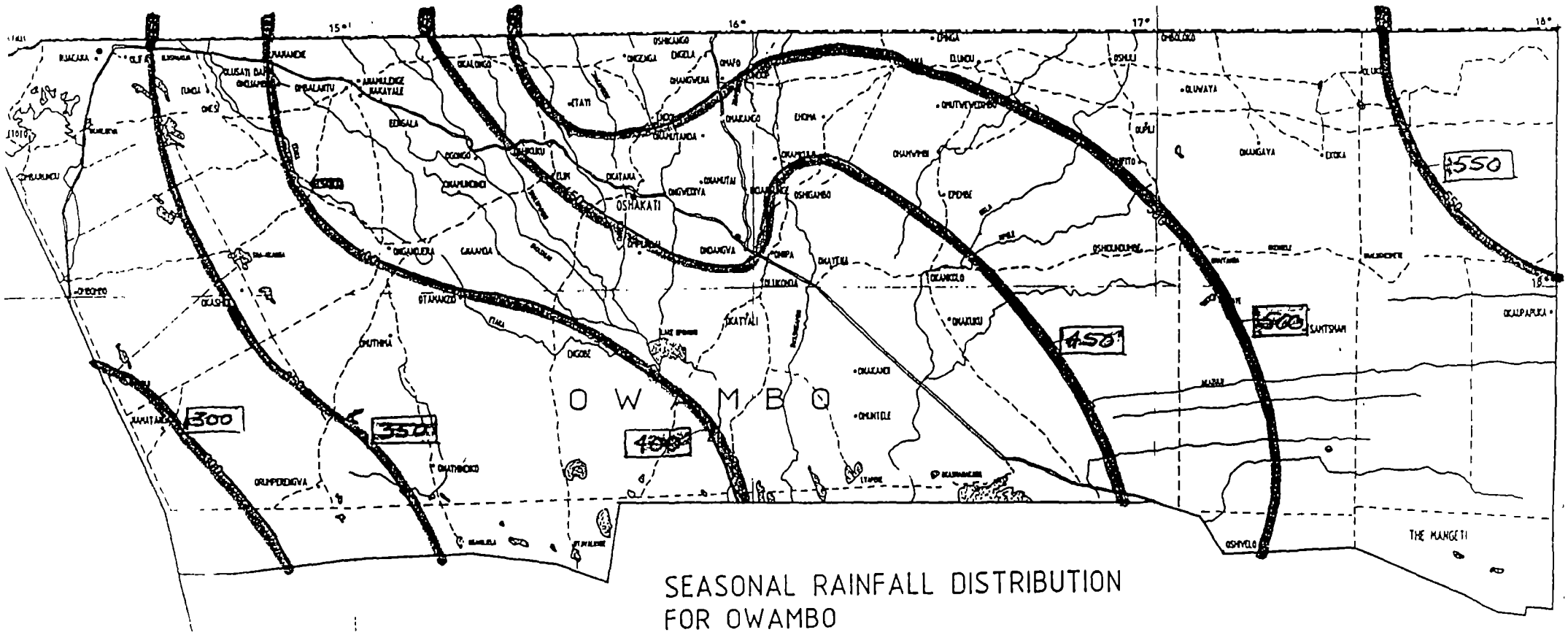
xvi What do they cost

xvii Anything else



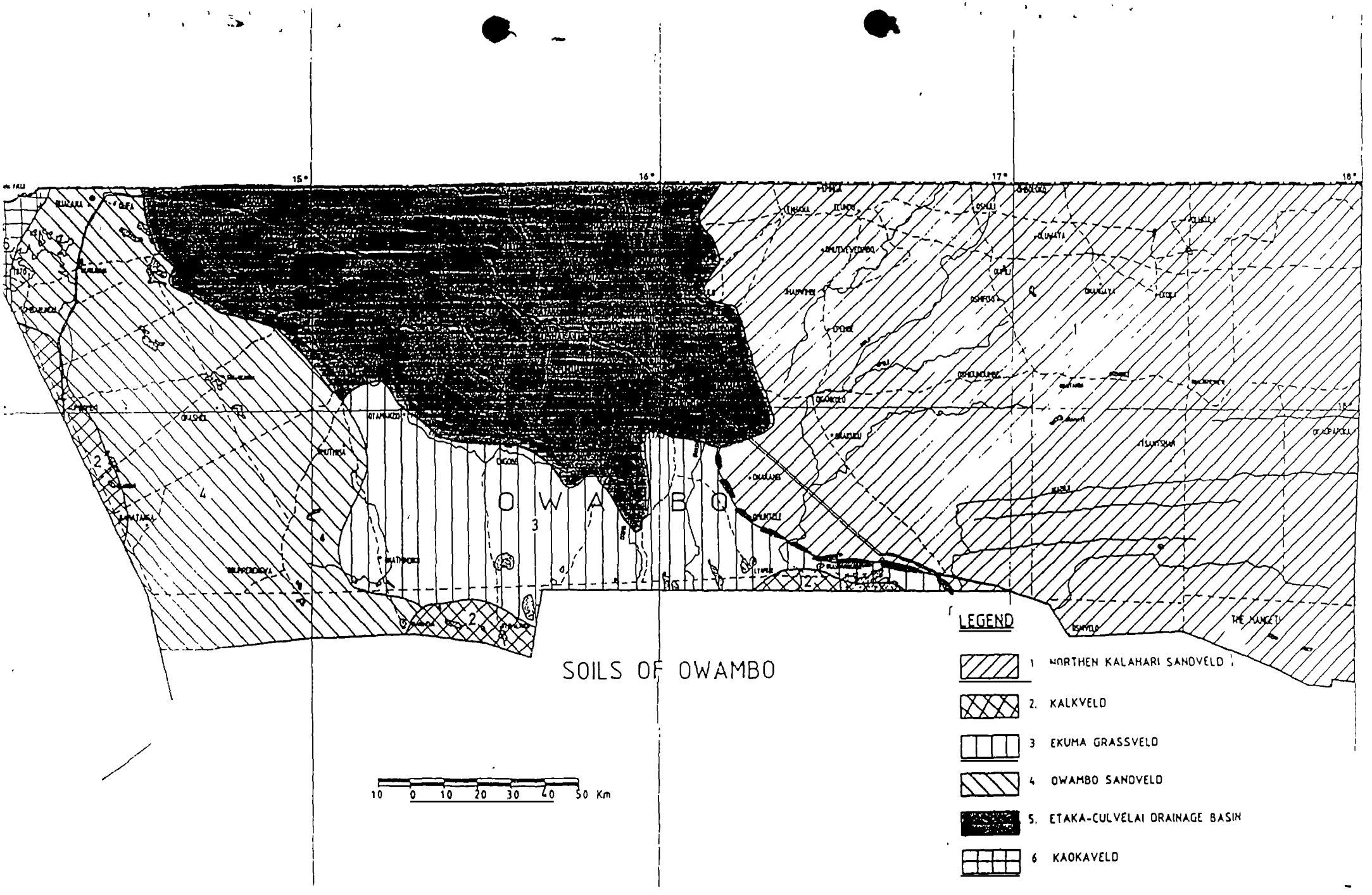
IABP/Uukwaluudhi Project Area


UUKWALUUDHI
Ilyateko
Oshituda
Okathitu
Tsandi
Otshilemba
Elondo
Onangalo
Eemwandi
Othithiya
Okashidi
15°
15'
30'
45'
Contour interval 50 metres
REFERENCE
VERKLARING
Internasionale grense
Spoorweg
Smalspoorlyne
Dranspoorlyne
Kraglyne
1:250 000
Kilometres 10 0 10 20
Miles 10 5 0 5 10



SEASONAL RAINFALL DISTRIBUTION
FOR OWAMBO

10 0 10 20 30 40 50 Km



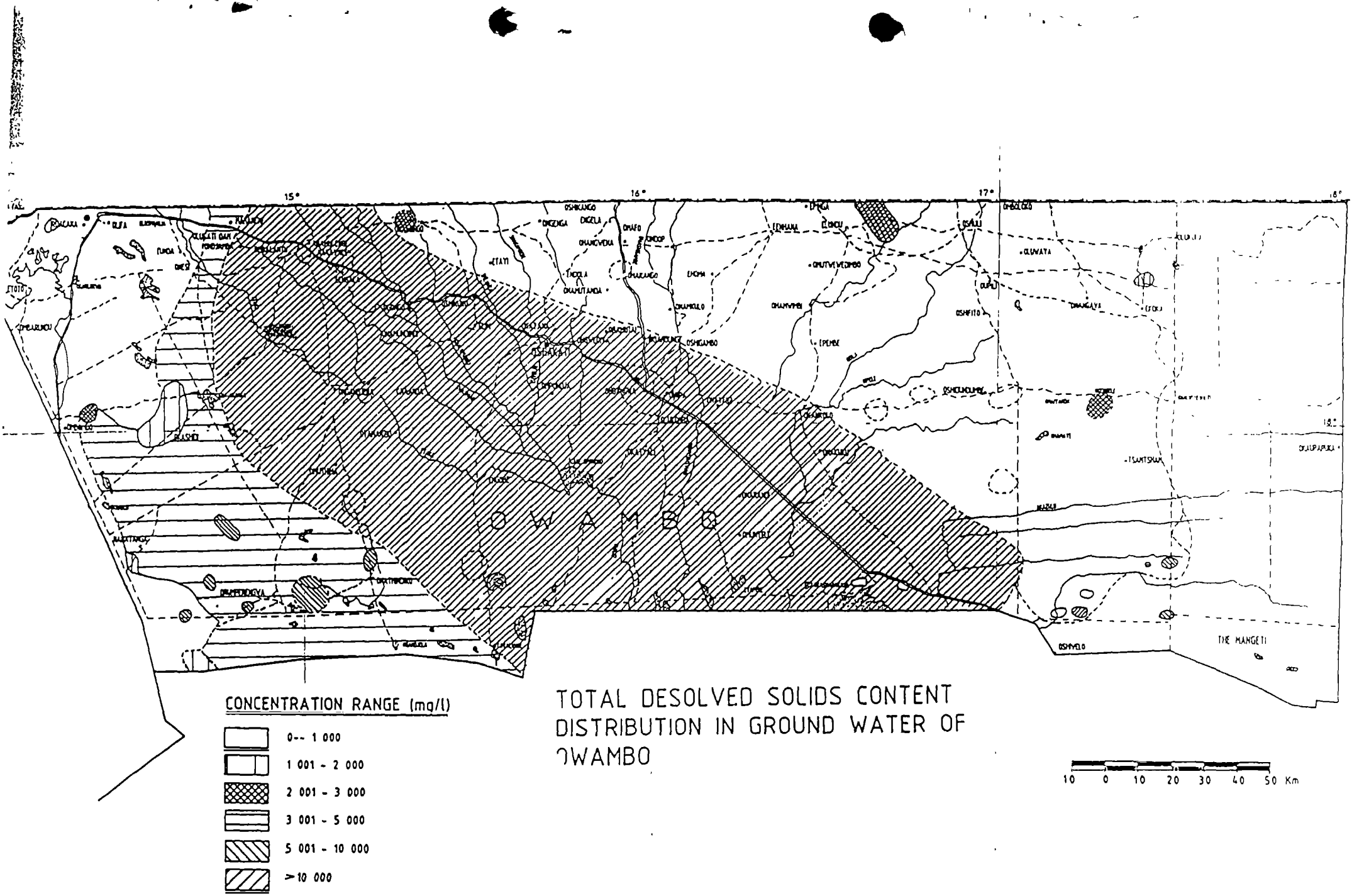
SOILS OF OWAMBO

DRAINAGE SYSTEM OF OWAMBO

100 150

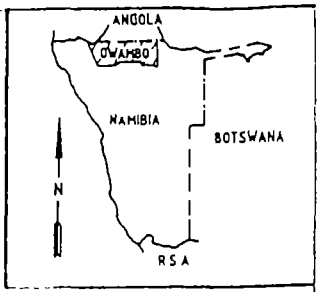
Kilometre

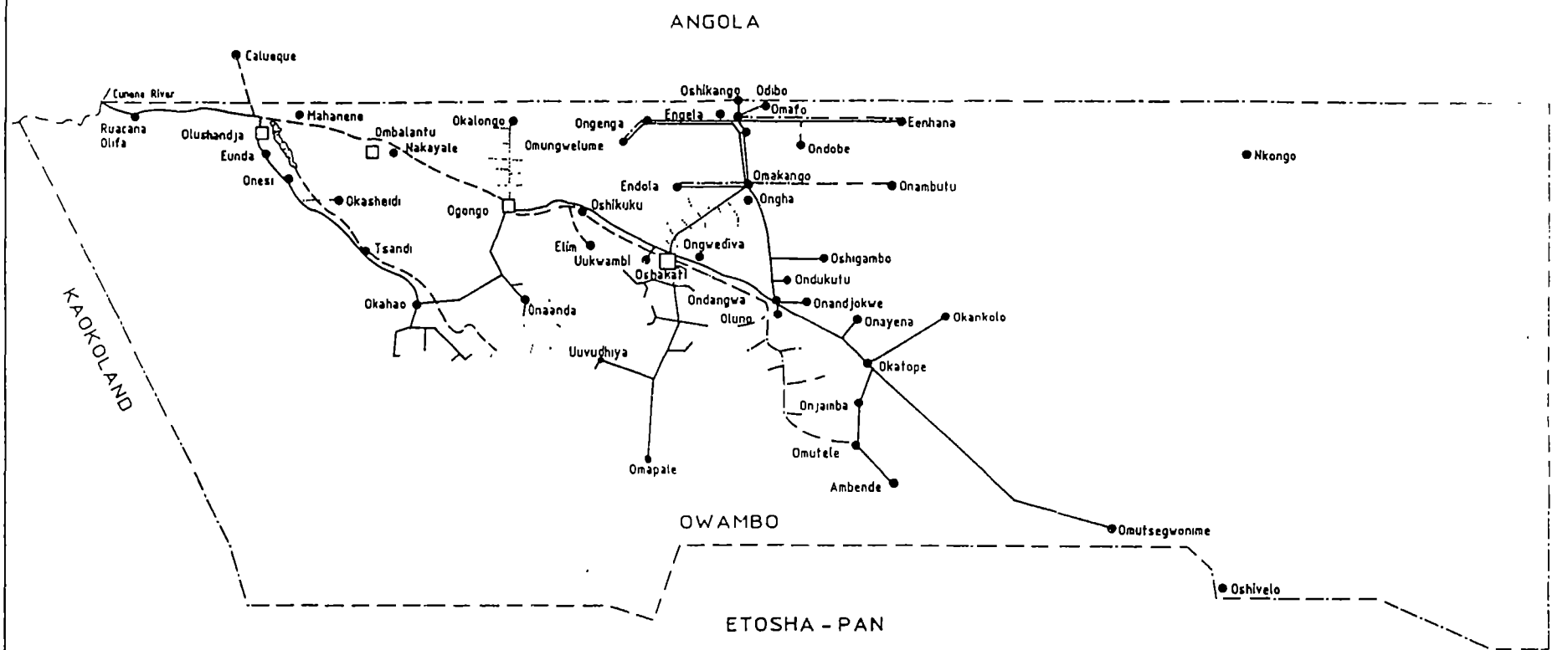
Cuvelai Drainage Basin



TOTAL DESOLVED SOLIDS CONTENT DISTRIBUTION IN GROUND WATER OF OWAMBO

EXISTING AND PROPOSED PIPELINES AND CANALS





LEGEND

- EXISTING PIPELINES
- CANALS
- PROPOSED PIPELINES UNTIL 1995
- PIPELINE UNDER CONSTRUCTION
- PURIFICATION WORKS

10 0 10 20 30 40 50 60 70 km

SCALE 1 1250000

REPUBLIC OF NAMIBIA
DEPARTMENT OF WATER AFFAIRS

OWAMBO WATER SUPPLY NETWORK

SURVEYED		CHECKED		CHECKED	
DESIGNED		APPROVED		APPROVED	
DRAWN		P J MARITZ SECRETARY WATER AFFAIRS			
TRACED					