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**LOCAL HANDPUMP MANUFACTURE;
A DEVELOPMENT OPTION FOR AID AGENCIES:
ATTITUDES EXPRESSED BY NEW ZEALAND NGOs.**

A thesis
presented in partial fulfilment
of the requirements for the degree
of
Master of Philosophy
in
Agricultural Engineering/Development Studies
at
Massey University, New Zealand

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1994

PREFACE

I gratefully acknowledge the following people who have assisted me in completing this thesis:

Professor Gavin Wall, my supervisor, for his aid and direction in the compilation of this thesis.

Associate Professor Croz Walsh, for his advice and support in completing my studies.

The Massey University Institute of Development Studies, for giving me an appreciation of development issues.

Richard Cansdale, for information on the Makeni Handpump Workshop used in the case study.

Andrew Macdonell, for data on the day to day running of the Makeni Handpump Workshop.

The following development agencies for their cooperation in granting me interviews and answering my questions: Caritas, Tear Fund, VSA, Water for Survival, World Vision.

Wateraid Ghana, for information on local handpump manufacture there.

ABSTRACT

A major reason for implementing water supply programmes is their potential contribution to health. The recently concluded United Nations International Drinking Water Supply and Sanitation Decade (1981-1990) attempted to provide access to clean water and sanitation for everyone in the Third World. There are several problems and constraints which preclude success in this area, many of them are sociological factors concerned with the transfer of technology and practices to cultures other than those in which they were conceived.

Projects are implemented, often by outsiders, involving handpumps for water supply mounted on wells or boreholes. Such systems have a poor record with regard to their sustainability; often the handpump breaks down after donor withdrawal and is never repaired. Donor assisted projects often use handpumps sourced from the industrialised countries and paid for in hard currency, usually \$US. When spare parts are needed they too must be sourced from overseas and paid for in scarce foreign exchange. Local inflation and currency devaluation can make these spares prohibitively expensive. The result has been neglected maintenance and breakdowns.

This thesis examined the potential for local handpump manufacture to address operation and maintenance problems and assess the economic contribution local manufacture could make to the local community through employment and income generation.

A case study of the Makeni Handpump Workshop in Lusaka, Zambia was used to compare the cost, landed in Lusaka, to an aid agency of handpumps sourced from the U.K. and from a local manufacturing operation. The provision of employment and income to local people arising from patronising the handpump workshop was also assessed as a 'developmental benefit'. This was over and above the acquisition of handpumps alone; aid money would be spent directly in the community by choosing a local source of equipment.

Interviews with selected NGOs in New Zealand were conducted to establish their attitudes to water supply projects in general and to local handpump manufacture specifically.

It emerged that local handpump manufacture could be profitable at the small-scale level of the case study and a viable form of income generation. New Zealand NGOs agreed that there should be more to water supply projects than a welfare consideration alone, an element of development should be included. They were supportive of local handpump manufacture where it existed but did not invest in it as a means of income generation.

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ABBREVIATIONS

IDWSSD, (1981-1990).

The United Nations International Drinking Water Supply and Sanitation Decade.

VLOM.

Village Level Operation and Maintenance, later Management of Maintenance. This refers to the suitability of a handpump for repair and maintenance operations to be carried out on it by semi-skilled or unskilled villagers with minimal tools. The idea being that if the pump is easily maintained by the people who depend on it, when it fails it will be more likely that a repair will be made by them. If, on the other hand, repair was dependant on a centralised system of mobile mechanics repairs would be delayed or never undertaken at all.

CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

A major justification for expenditure on water supply projects is their potential to improve health. Water borne and water related diseases are widespread in the Third World. Some are transmitted directly by drinking polluted or contaminated water, others by an inadequate quantity of water being available to maintain levels of hygiene that would prevent their transmission. It is understood that clean water alone has not and will not provide the solution to this complex problem (McGarry, 1977; Black, 1990). Concomitant health education and sanitation are required; there is strong complementarity between these different elements.

The amount of time and effort involved in collecting water, this onerous task usually falling to women and children, should be reduced to help them enhance their lives. At the end of a sixteen hour day, which often entails, collecting water; itself involving a walk of several kilometres carrying a twenty kilogram load, cooking, cleaning, tending livestock, and cultivating the family garden they will have little energy left. When so much time and effort is spent on survival there must seem little opportunity to improve ones lot in life. Development must have a social component, it should contain an element of self development for people; the realisation of their potential when released from oppression in all its forms (Rahman, 1990). Locked into an arduous routine of survival and ill-health this potential can never be realised. The low quality of life experienced by many poor people in the Third World is a symptom of their poverty. Measures taken in the name of development must address their need for income generation as well as welfare provision.

Even after the International Drinking Water Supply And Sanitation Decade, (IDWSSD, 1981-1990), there were in 1990 an estimated 1230 million people without

access to safe water (Black, 1990). Many of these people live in rural areas where treated, piped water supplies are neither affordable or appropriate. Simple handpumps mounted on hand-dug wells or boreholes offer a means both of extracting ground water and sealing the well head against contamination. This source protection itself goes a long way towards improving water quality. (Morgan, 1990)

The potential of handpumps as a solution to rural water supply problems has been known for some time. Various countries have implemented handpump based water supply programmes over the last several decades. In the 1960s in India a borehole drilling project was initiated in response to a period of drought. By 1975 about 150,000 handpumps had been installed. However, it was found in a survey that up to 100,000 of these handpumps were not

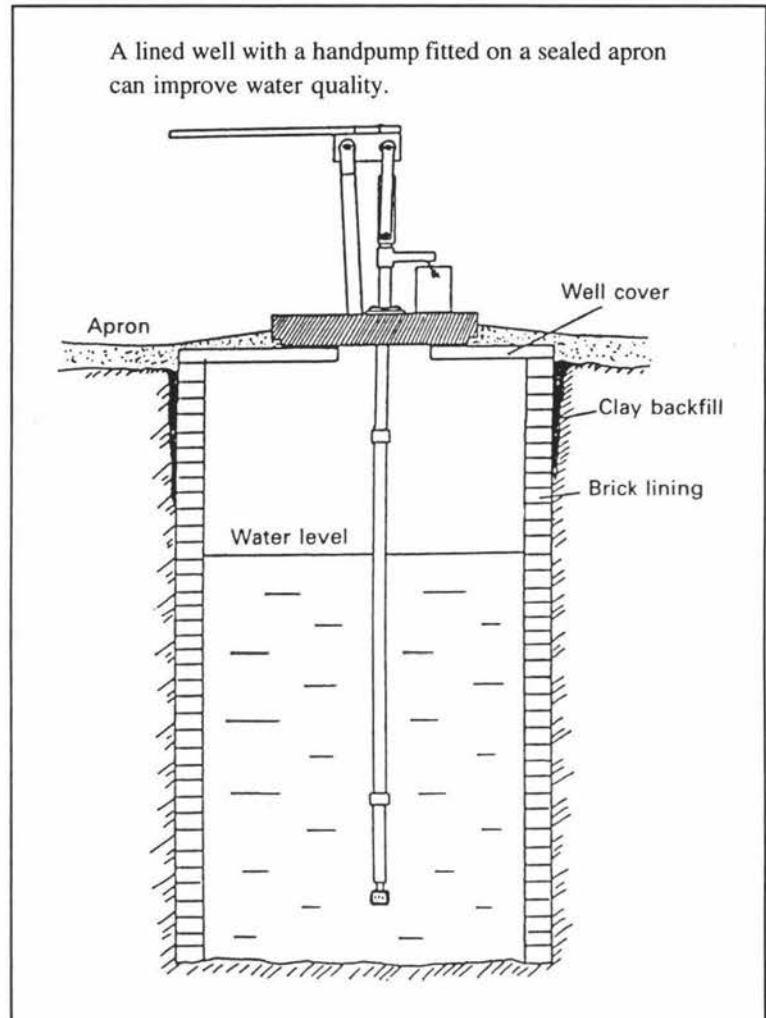


Figure 1 From Morgan,1990:166

operating at any one time (Pacey, 1983). Initial engineering shortcomings were corrected yet still maintenance problems persisted. These problems were finally identified as administration and management failures coupled with a lack of personal responsibility felt by the villagers for the handpumps.

One aspect hindering the maintenance of any equipment is the availability of spare parts. Many handpump projects have involved the importation of large numbers of handpumps made in the industrialised countries. These handpumps operated

Reduced faecal coliform counts in wells with ascending levels of protection.		
Source	Mean <i>E. coli</i> /100 ml sample	Number of samples
Poorly protected well	266.42	233
Upgraded wells	65.94	234
Bucket Pump (overall)	33.72	338
Blair Pump (tubewells)	26.09	248
Bush Pump (tubewells)	6.27	281

Figure 2 From Morgan,1990:253

efficiently for some time with no maintenance, however, once they broke down the problems identified earlier in India compounded by poor spares availability, or lack of foreign currency to buy them, resulted in the handpumps often never being repaired. Sometimes the only recourse was total replacement by a donor agency with a new handpump. The much vaunted goal of sustainability was never attained.

"It is only now that many policymakers are beginning to realise how importing handpumps from the industrial nations can hinder a handpump project, making sustainable operation and maintenance almost impossible without continued donor assistance."
(Mtunzi and Lombardi, 1993:5)

Another valuable contribution to water supply project sustainability that local manufacture of handpumps can make is in the area of standardisation. When an aid agency donor undertakes a water supply project in a country it may well import handpumps from its home country. Thus in Africa where many donors from several countries have established projects there is a large variety of handpumps each with specific tools and spares requirements (Mtunzi and Lombardi, 1993). An ideal would be to standardise on one or two types of handpump per country (Wurzel, 1992). Sustainability of water supplies will only be accomplished when all factors militating against it are addressed. Local, standardised manufacture could expedite maintenance.

Further discussion of local manufacture versus overseas procurement requires that the broader issue of development and attitudes towards water supply projects be confronted. In financing a water supply project an aid agency may have one or several objectives: the supply of safe drinking water in adequate quantities at an accessible distance from the dwellings of the users may be the only issue of concern; a welfare issue alone. Alternatively, the water supply may be seen as a vehicle for local community development. Employment and income thereby generated for local people and the local capacity built by their involvement in the scheme could benefit them to a greater extent than the water supply alone would have. A deeper, long-term view beyond welfare is needed to realise the full potential of any water supply project (Pacey, 1977).

Table 1. Goals and objectives for water supply improvements in rural areas of developing countries

<i>Immediate Objectives</i>	<i>Further goals—stage I</i> (these follow as consequences when the immediate objectives have been met)	<i>Further goals—stage II</i> (these follow from previous stages if complementary inputs are provided)	<i>Further goals—stage III</i> (these are consequences of reaching the previous goals which follow if there are also inputs on many other fronts)
<p>FUNCTIONAL: to improve the quality, quantity, availability and reliability of the supply</p> <p>OTHER: to carry out this improvement in a manner which (a) secures the support of users; (b) conserves scarce resources (e.g. capital); (c) avoids adverse environmental consequences (e.g. lowering water tables, encouraging mosquitoes)</p>	<p>HEALTH: to reduce incidence of water-borne and water-based disease</p> <p>ENERGY/TIME (ECONOMIC): to save time and energy expended in carrying water</p> <p>SOCIAL: to arouse interest in the further health and economic benefits which may arise from the water supply</p> <p>ECONOMIC: to provide more water for livestock and garden irrigation; (water may be used for this even if it is intended solely for domestic supply)</p>	<p>HEALTH: to reduce incidence of water-washed infections <i>(inputs required: improved hygiene, health education, improved sanitation)</i></p> <p>SOCIAL/TECHNICAL: to ensure good long-term maintenance of water supply and sanitation facilities <i>(inputs required: training, clear allocation of responsibility, build-up of local maintenance organization)</i></p> <p>ECONOMIC: to use energy/time savings and increased water availability to achieve better agricultural output <i>(inputs required: extension work, fertilizer supply, etc.)</i></p>	<p>to achieve the greater well-being of the people through:</p> <p>(a) social change—greater self-reliance in the community, better organization, better deal for the poor, women, etc.</p> <p>(b) improved standard of living - health, nutrition, income, leisure</p>

Figure 3 From Pacey, 1977: 6

Table 1 in figure 3 from Pacey, (1977) shows the potential goals of a water supply project in several stages. Depending on the perspective of the implementing agency the immediate objectives may be the only consideration. Alternatively, further stages may be considered important by an aid agency interested in promoting

development as well as welfare. Local manufacture of a VLOM (Village Level Operation And Maintenance) handpump, as defined below in figure 4, would address maintenance issues and provide employment and income. This approach can be a catalyst for social development.

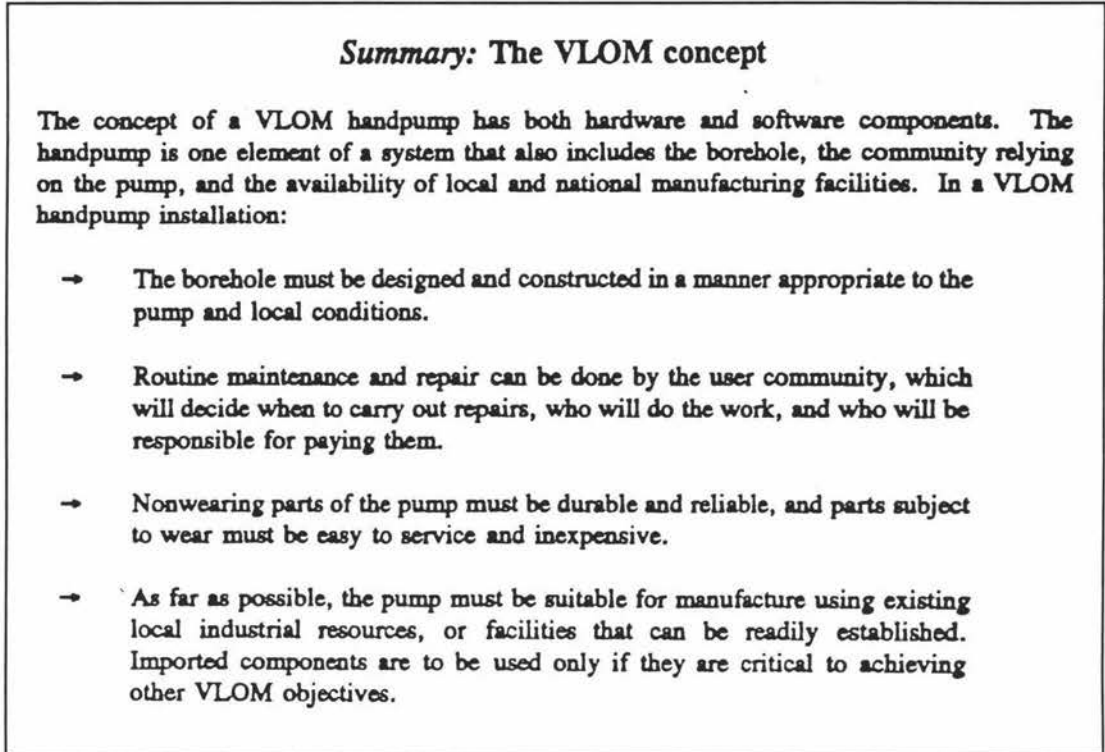


Figure 4 from Reynolds, 1992: 4

Simple handpumps for village water supply were seen by international agencies as a potential solution to water quality and availability problems. Shortcomings in operation and maintenance subsequently emerged and were identified as institutional weaknesses requiring the participation of local people (the users) in the design and construction of water supply systems. Given the above background a question arises as to the role of local handpump manufacture⁽⁵⁾ in supplying handpumps and spare parts. This would avoid the logistical and economic constraints involved in importing similar equipment. Income generation from employment of local people in handpump manufacture would be a developmental spin-off that importing equipment would not engender. It is understood that local manufacture would only address part of the operation and maintenance problems that have been encountered in community water supply projects and programmes. The sociological component affecting the sustainability of these projects would continue to be a major issue in itself.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The manufacture of handpumps in Third World countries was found to be very location specific, it was well established in India where over one million handpumps have been made (Reynolds, 1992). In other areas it has not been so successful. There are many constraints to its implementation in the less industrially developed countries.

The problem of supplying clean water by handpump systems is huge and growing as population increases and old handpumps require replacement. These factors add to the number of handpumps needed and compound the problem of merely extending coverage. An estimate of the number of handpumps that will be needed by the turn of the century was made at the beginning of the IDWSSD in "World Water", the figure arrived at was a minimum of 20 million pumps (World Water, 1981). Reynolds (1992) suggests that 20 million handpumps are needed just to extend coverage let alone allow for replacing worn out handpumps and supplying spares to maintain existing handpumps (Reynolds, 1992).

2.2 VARYING OBJECTIVES OF WATER SUPPLY PROJECTS

An aid or development agency may have several objectives in implementing a water supply project (Pacey, in Agarwal et al, 1980). It may be seen as a welfare issue alone or considered to contain an element of community development also. Pacey went on to describe various levels of community involvement in handpump-based water supply projects as follows over:

- A. Total village self-reliance : village manufacture and maintenance of handpumps;
- B. Partial self-reliance : central manufacture, village maintenance;
- C. The black-box approach : a maintenance-free handpump installed by outsiders.
(Agarwal et al, 1980:39)

Approach A is an ideal and will only work in situations where village artisans exist already (Pacey, in Agarwal et al, 1980). Pacey lists S.E.Asia, India and China as areas where this system could work.

Approach B is a more likely option in Africa for example, where there may not be the local capacity to make handpumps but where, with training, they can be repaired at village level. In time a water supply system based on a type B maintenance regime, (VLOM, village level operation and maintenance) could develop into a total self-reliant system as local capacity increased.

The C option is not a real development option as Pacey noted; it was used in the colonial era by authorities concerned with welfare alone. It suits centralised top-down administration systems and imparts no skills or responsibility to the community served.

2.3 RESEARCH DURING THE IDWSSD

The UNDP/WORLD BANK Water and Sanitation Program was set up in 1982 to test and assess different types of handpumps. Handpumps were subjected to endurance tests in purpose built facilities in England at the Consumers' Association Testing and Research Facility and to field tests in fifteen Third World countries. As well as reliability criteria handpumps were assessed for ease of manufacture in the Third World against three levels of industrial development corresponding to the actual situation in a variety of countries.

Manufacturing needs in ascending order were found to be:

- 1) Low industrial base, limited quality control
- 2) Medium-level industry, no special processes
- 3) Advanced industry, good quality control

(Arlosoroff et al, 1987)

Some types of handpump were found to be beyond the ability of all but the most industrially developed Third World countries to manufacture and even then would require imported specialist parts and close collaboration with the original manufacturer; the Vergnet hydraulic hand/foot pump and the Monolift/Moyno progressive cavity handpumps were examples requiring high levels of industrial development (Arlosoroff et al, 1987). It was considered important to pick an appropriate handpump for local manufacture in order that the venture be sustainable after any donor assistance was withdrawn (Arlosoroff et al, 1987); with this caveat the World Bank stated:

"There can be substantial cost savings and maintenance benefits where (hand)pumps and spares can be manufactured in the country in which they will be used, and Analysts are urged to consider the advantages of in-country manufacture when evaluating their handpump programs."

(Arlosoroff et al, 1987:77)

2.4 SPECIFIC RESEARCH ON LOCAL PRODUCTION

Two of the most often identified constraints to local manufacture were poor quality control and the high cost of handpumps produced being uncompetitive with imported handpumps of similar design (Arlosoroff et al, 1987; Baumann, 1992). At a recent conference on handpumps in Kenya¹ a paper was presented on the viability of local handpump manufacture (Mudgal and Kumar, 1992).

It concluded with the following prerequisites for success:

- 1) Sustainable and adequate market demand, and an attractive selling price that the market can bear.
- 2) Adequate industrial infrastructure.
- 3) Availability of raw materials and skilled manpower.
- 4) Government trade and regulatory policies conducive to the promotion of local production.
- 5) Economic costs of locally produced handpump to be competitive.
- 6) Ability of local manufacturers to produce quality handpump.

(Mudgal and Kumar, 1992)

Another paper on handpump manufacture in Nigeria identified similar constraints (Fonseka et al, 1992). Some handpump examples cost more to make in Nigeria than to import from India, (India mark 3 with galvanised rising main cost US\$750 made in Nigeria and US\$513 imported). However, another handpump type cost less to produce locally, (an Afridev with stainless steel rising main would cost US\$755 from India and US\$720 to make in Nigeria; both Nigerian prices were without profit to the factory).

The quality control problem can be addressed as it has been in India where 36 licensed manufacturers operate (IRC, 1988). This was done by introducing national standards for handpumps and licensed manufacturing monitored by third party inspectors such as the Crown Agents (Fonseka et al, 1992). As far as cost competitiveness goes it was found to be difficult for local manufacturers to compete as materials imported to make handpumps usually attracted duty whereas complete handpumps imported by development agencies or NGOs could enter most countries duty-free (Baumann, 1992). Baumann (1992) mentioned the possibility of duty exemption for handpump manufacturers in Ghana but expressed reservations as to the ease with which the

necessary permits might be obtained. A case was made for such exemptions in order to establish fair competition and promote local production (Baumann, 1992).

2.5 LOCAL ECONOMIC CONDITIONS

The economies of many Third World countries have been very unstable. This militated against competitive local production. In Nigeria it was found that inter-bank interest rates were 92% and loans difficult to obtain; the Naira had been continuously devalued over a period such that in 1990 a locally made handpump cost 6100 Naira, by the end of 1992 this had increased to 15,500 Naira (Fonseka et al, 1992). A personal communication from A. Macdonell in Zambia regarding local production there gave a figure of 400% for annual inflation. These examples assisted in illustrating the hostile economic environment in which local handpump manufacture must often operate.

The government of a country where local handpump manufacture operated could help by procuring some of the handpumps it needed from the local supplier and publicising future water supply projects to clarify future market potential (IRC, 1988).

2.6 LOCAL CULTURE

All technology is culturally specific. It evolved in a particular situation (Pacey, 1984). In considering the implementation of a handpump production facility the local technology should be considered as part of assessing the projects potential for success (Allen, 1993). This extends to workshop practices where these are established as James Jr. (1984) found in Ecuador; local workshops and foundries were used to making one-off parts to replace worn out components, this they did very well. However, they found it extremely difficult to make a large production run, (1000 handpumps), of identical items. Parts interchangeability was not assured so handpump parts were made to fit, rendering each handpump unique. The potential of standardisation was lost.

2.7 STANDARDISATION

To simplify maintenance operations standardisation on one or two handpump types per country makes sense. Wurzel (1992) made a case for one universal handpump on the grounds of repair logistics and returns to scale of production in local manufacture. Standardisation on two handpumps, one shallow setting type (up to 15m) and one deep setting type (over 15m) has been achieved in Pakistan by UNICEF. Wurzel admitted that specifying only one handpump would mean that deep setting handpumps would be fitted to shallow wells; he justified this expense by the maintenance and production simplification it would promote. Returns to scale in production accrued more readily when one handpump type was made by a limited number of manufacturers. This is illustrated by the table from Wurzel (1992) below showing the experience in Pakistan.

It would be reasonable for any new handpump manufacturing facility to use one of the designs already in the public domain, suitably modified for local conditions and

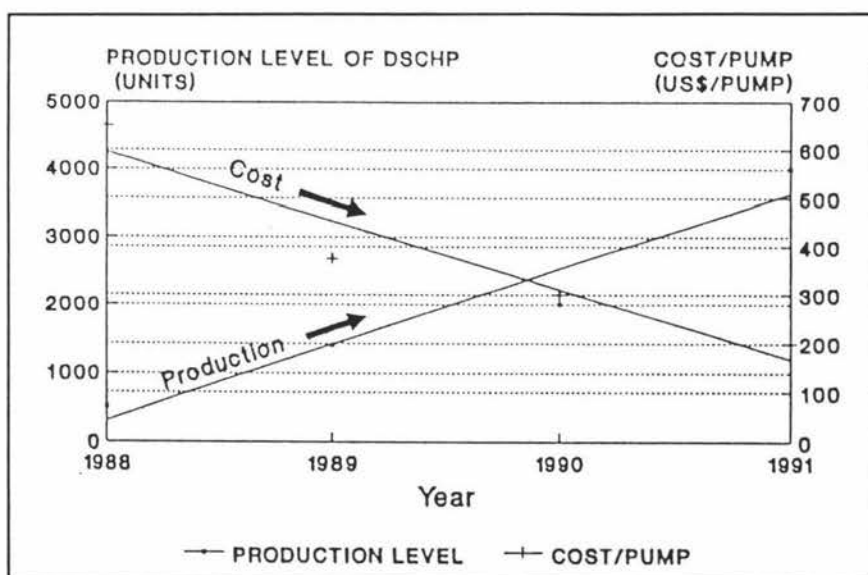


Figure 5 from Wurzel, 1992

materials available. This would save money on research and development and avoid a proliferation of handpump types. Manufacturing operations using designs with fairly wide production tolerances and less demanding processes, making up for low skilled workers by the use of jigs and fixtures to obtain standard component sizing was recommended by IRC (1988).

"To be suitable for local manufacture, (hand)pumps should generally avoid specifications which demand highly skilled processes or use exotic materials."
(IRC, 1988:25)

Reynolds (1992) argued for labour intensive production systems and warned against the type of operation that required high capital investment and a high volume production run in order to recover such investment. Systems capable of producing other goods that were in demand locally would help spread the risk of any investment and enhance the potential for cost recovery and ultimately profit (Reynolds, 1992).

2.8 INSTANCES OF LOCAL PRODUCTION

As the IRC pointed out handpump manufacture could be organised, "from the top down or from the bottom up" (IRC, 1988:120). India provided an example of top down organisation of production. Centralised industrial operations produced the handpumps and spares, they were then distributed around the country. In a bottom up system the major components are centrally made, spares and the simpler parts are made locally in the village or form a cottage industry in the area where the handpumps are used (IRC, 1988). Each instance of local manufacture was location specific and no single prescription can be offered.

"The term 'local' manufacture has a wide range of possible interpretations. The first step is to introduce manufacture of key components into the developing country. . . . Further spread of manufacturing outlets to regional, district or even village enterprises will depend on economic considerations, and on the diversity of industrial skills in the country concerned."
(IRC, 1988:25)

SARVODAYA SL5 HANDPUMP.

This handpump was made in Sri Lanka in a network of cottage industries by women. By including the manufacture of simple tools and farm equipment the

operations were profitable and provided an independent income for the women. The internal components of the handpump were mostly of injection moulded plastic. This was an appropriate technology as it used established in-country facilities and assured consistent component sizing; it also expedited assembly (Wanigasundara, 1984).

PREY VENG PUMP.

In Preg Veng province in Cambodia the Handpump Standardisation Workshop² found an example of local production responding to local demand. Mr.Sok, a local blacksmith/entrepreneur, had been making simple handpumps for private sale. The design used readily available local materials.

"It is a suction (hand)pump using an ordinary PVC pipe as the cylinder and iron rods as a cross head mechanism and metal sheet as flanges. The handle is a wooden stick. The piston seal is cut out of a car tyre and the weighted flap valve is cut out of inner tube."
(UNICEF/Oxfam, 1993:36)

The handpump was bought by individual families or small groups and as such was taken relatively better care of than communal handpumps were. The water table in the area was high, never going below suction depth, and the soil ideal for the jetting method of borehole drilling³; this service was also offered by Mr.Sok as a package along with a handpump. The handpump was said to be suitable only for small user groups; its reliability would be likely to suffer if subjected to communal use (UNICEF/Oxfam, 1993).

Reliability can be measured in two ways. The usual engineering measure is "mean time before failure" (MTBF). Another method deemed to be more appropriate for handpumps was to measure mean down time, the explanation from Arlosoroff et al in figure 6 over clarifies the difference. As can be seen even if the Prey Veng handpump broke down a lot it was so easy to repair and Mr.Sok on hand nearby that down time might only be a few hours. By this measure it was quite reliable as people

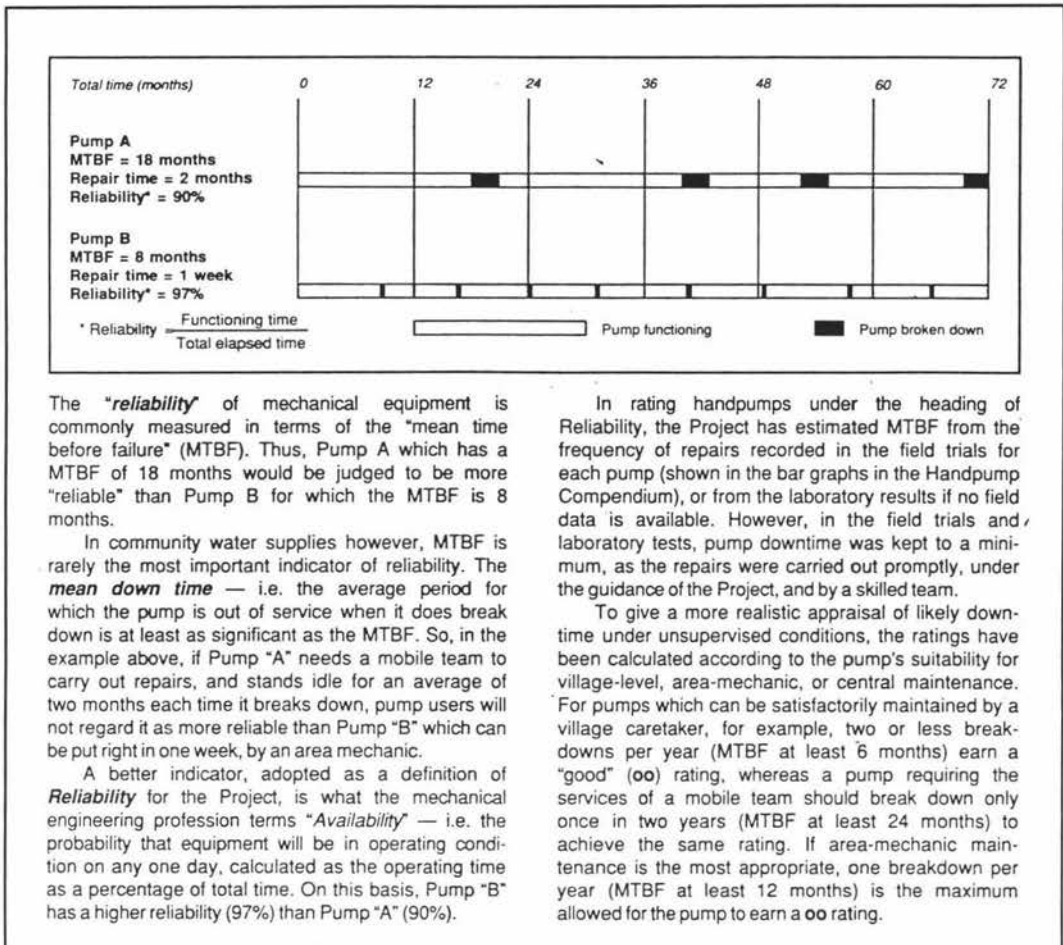


Figure 6 from Arlosoroff et al, 1987: 76

would not have to revert to traditional, potentially polluted, sources of water while waiting for the handpump to be repaired.

A point mentioned in the report was that no sanitary seal was fitted to these wells. There was no concrete apron fitted around the neck of the well casing so contamination could percolate down into the aquifer and pollute the water there, thus contaminating the source of supply for many users.

The relatively high price paid for this simple pump, (US\$ 25), was taken to show the willingness to pay for individual water supplies expressed by the people. There was seen to be potential for private sector involvement in water supply, and replication of this type of venture would be encouraged as an income generating activity (UNICEF/Oxfam, 1993:37).

SHINYANGA PUMP.

The Shinyanga handpump was originally designed for the people of Salawe village in Tanzania. Made from simple material it was intended that the local people would be able to make it themselves. It was later used on a wider scale in the "Shinyanga District Shallow Wells Project" for which a manufacturing facility was established. An important component of the project was the inclusion of source protection as part of its objective. The shallow wells were lined with locally made cement bricks and the handpump was mounted on a concrete apron which protected the source from surface run off.

INDIA MK2.

This now well known handpump was developed in Jalna, India, with UNICEF assistance. It was given an Indian Standard (IS 9301, { 1984 }). It has been manufactured in large numbers and exported to several countries. Manufacture has also begun in Mali, with technical assistance provided (Arlosoroff et al, 1987). A MK3 version has been developed that allows the piston to be withdrawn from the pumping cylinder through the rising main, this comes closer to the attainment of the VLOM concept (Reynolds, 1992).

AFRIDEV PUMP.

This handpump was developed specifically for VLOM and manufacture in a Third World country. It is made from readily available materials and uses established production techniques. It was developed from a handpump designed in Malawi on the Livulesi Valley Project. This indicated that it was possible to both design and manufacture a handpump for use in a Third World country within that country. Manufacture began in Kenya in 1985 (Reynolds, 1992).

TARA.

This is a low lift direct action handpump developed and made in Bangladesh, locally available materials have been used. In 1988 5000 had been installed and by now (1993) 60,000 should be in operation, installed by the government (Reynolds, 1992). The cylinder, rising main, and piston operating rods were made from uPVC pipe. It is a VLOM handpump, easily dismantled and repaired in the field. Spare parts could be improvised with what was locally available; some form of leather would be needed for the piston seals and old car tyre inner tube for the flap valves.

ROWER PUMP.

The Rower (hand)pump was originally developed in Bangladesh. It was designed with local manufacture in mind and used simple materials and techniques. It is a suction handpump so is limited to areas where the water table is within 7m of ground level. Intended originally for small scale irrigation it does not provide the levels of source protection afforded by other more orthodox handpumps. The Rower handpump is operated from a bending or sitting position, a tee handle is connected directly to the piston rod which is moved up and down the cylinder by the operator using a rowing motion.

2.9 LOCAL CAPACITY

The Third World is by no means a homogeneous group of countries. There can be found a wide range of cultures, economic systems, levels of industrial development and poverty. Some countries, like India, already have a developed industrial base, others, particularly in Africa, have little industrial capacity. As the World Bank feasibility studies on Ghana (Baumann, 1992) and Nigeria (Fonseka et al, 1992) found this imposed another constraint on local handpump manufacture. However, the reports looked at the potential for large scale operations aimed at supplying the whole country's

requirements for handpumps; this need not be the only option for local production. It could be started on a small scale and expanded as demand increased. NGO assistance would likely be on this smaller scale.

2.10 CONCLUSIONS

There was evidence of many attempts at local production of handpumps on a variety of scales from cottage industries (Prey Veng and Sarvodaya handpumps), through project specific regional production (Shinyanga handpump), to national production facilities that have expanded into the export of reliable, high quality handpumps (India MK2/3).

The handpumps made on a small scale cottage industry basis tended to be for use in areas where conditions were favourable. They were often suction handpumps operating where the water table was within 7m of the surface and in situations where they were privately owned or where user groups were small. The geological conditions of the areas in which they were used were also favourable, alluvial flood plains in Bangladesh; similar deltaic areas in Cambodia; in such areas well construction is easier. These factors lead to the requirement for less exacting tolerances in manufacture and lower stresses on the handpumps when in use; their simple, light construction and accessible components made them very suitable for local repair (VLOM). As the depth to the water table and user group size increase the strain on components of the handpump increase. Their manufacturing tolerances need to be more exacting in order to lift water from greater depths, their construction more robust and wear resistant in order to cope with longer periods of use per day. It should be appreciated that there would be a great difference in the demands placed on a handpump by a family of eight people in an area where the water table is three metres from the surface and one where the handpump served two hundred people drawing water from a fifty metre depth. In the latter case a well made high quality handpump is required as an inferior product would not survive for long under such arduous service conditions. These deep well handpumps were the most difficult to manufacture successfully, there was a greater need for advanced machining operations and quality control practices. These requirements

were more easily met by larger manufacturing operations and in surveying the literature it has been noted that most deep well handpumps were made by larger, well established companies.

The economic conditions in many Third World countries were not conducive to business success. This was mentioned in the literature as a major constraint; the cost of borrowing money and local inflation rates being the principal ones noted. Unfortunately this is the economic environment in which local manufacture must operate at the moment. Pricing distortions in the form of import duties on raw materials and often none on complete handpumps further militated against local production.

The literature suggested that the area of local manufacture will become increasingly important in the future as its potential for enhancing project sustainability and replicability became more widely known. There have been failed attempts at instituting local manufacture as well as successes. Early "Water And Sanitation For Health Project" activities met with mixed results (Campbell, 1993). Others have mentioned the difficulties of establishing local manufacture (Baumann, 1993; Morgan, 1993; Rosenboom, 1993). However, where appropriate, there are possibilities offered by local production that are worth achieving. Amongst these were standardisation of equipment that can lead to more sustainable water supplies through simpler operation and maintenance; parts would be available within the country in which they were needed and purchasable in the local currency.

There was also the developmental dimension to consider in connection with local handpump manufacture. Employment can be generated and income provided. The Sarvodaya Shramadana movement, a Sri Lankan NGO, has set up handpump workshops throughout the countryside. Young women were employed as workers because the responsibility for collecting water traditionally fell to women. The manufacture of handpumps addressed several problems at once. It made water more readily available to people in the villages and the technology of water supply more accessible to them; the people were shown how the simple handpumps worked and how to repair them, spare parts were available locally which expedited repair and obviated their importation thus saving foreign exchange. Employment was created for the women who manufactured the handpumps, the resulting income brought new freedom and independence; relief from centuries old oppression. The workshops did not focus on

handpump manufacture exclusively, simple farm implements and hand tools for which there was a known local demand were also made. A diversified product range was found to enhance profitability.

Other manufacturing operations are likely to provide local employment although this was often not emphasised in the literature. The focus was usually on technical feasibility of local production and economic competitiveness. The employment and earnings from sales generated by the manufacture of the India MK2 and 3, together with foreign exchange saved, should have been of considerable benefit to the national economy.

There was some mention in the literature of the potential savings of foreign exchange and the assistance to project sustainability from the local manufacture of handpumps and spares, these points were, however, given less attention than the potential constraints to local manufacture.

Local manufacture of handpumps is an example of import substitution. This development strategy was tried in the 1960s and failed. The current wisdom in development agencies is that economic growth is best achieved through export led growth; production for the global market in the sector in which a country has a comparative advantage. Earnings thus obtained, it is suggested, can be used to import goods such as handpumps, produced in countries which do so most efficiently. It is alleged that everyone benefits from production occurring in the most efficient areas; this does not seem to have worked for the Third World (Korten, 1990).

Handpump production in the Third World has the potential to stifle research and development of handpumps in the industrialised countries. If obtainable locally and more cheaply there would be no need to import them. The literature urged manufacturers in the industrialised countries to continue research and explore the possibilities of joint ventures with manufacturers in the Third world; this has been done successfully in several African countries. Capacity for research and development will be needed in the Third World firstly to match designs accurately with needs and conditions; this has occurred, notably in research leading to the development of the India mk2 and 3, Afridev, and Tara pumps. A second reason for local research capacity is that the logical conclusion of increasing in-country production is ultimately an end to handpump manufacture on any scale in the industrialised countries. Without local

innovations and improvements Third World manufacturers could end up merely copying old First World designs as occurs in the vehicle industry in India today. However, the above scenario is not unfolding at the moment. There is research on new materials and designs continuing in the industrial countries to date; Reynolds (1992) offered the following areas for investigation in figure 7. Of the previously quoted 20 million handpumps needed in the Third World many will be supplied through bilateral aid programmes. These usually involve conditions that oblige recipients to spend the aid money in the donor country, this is known as 'tied aid', (New Zealand is a notable exception to this practice). Thus it is likely for the foreseeable future that there will be a market for handpumps manufactured in the industrialised countries that operate tied aid schemes and therefore an incentive for research and development to continue.

Summary: Opportunities for future handpump research	
Rising mains	<p>Develop VLOM connector systems (this is already under way with the support of ODA and GTZ)</p> <p>Develop quality standards and quality control procedures, including simple tests, for uPVC pipes manufactured in developing countries</p> <p>Develop design guidelines for plastic rising main assemblies, including suggested material and dimensional specifications</p>
Bearings	Investigate elastomeric materials for use as nonsliding bearings; develop practical designs
Cylinders	<p>Investigate design and manufacture of elastic pumping elements (as used in the Vergnet pump) to reduce cost and improve reliability</p> <p>Test and develop practical designs for sealless pistons and solid-state valves</p> <p>Review, assess, and develop further methods of protecting cylinders against sand contamination</p>
Direct action	Develop improved designs for pump rod and rising main pump connectors and centralizers
Corrosion	Assess techniques for combating corrosion, including cathodic protection, plating techniques, coating with plastics or rubber
Pump rods	Develop reliable, easy-to-release couplings

Figure 7 from Reynolds, 1992.

1. The International Handpumps Workshop. Kakamega, Kenya. November 8-12, 1992.
2. Handpump Standardization Workshop. 17-18 February 1993. Held at The Water Management Office, Teuk Thla. Cambodia.
3. In the manual method, sometimes called 'sludging' as used by Mr.Sok a small pit is dug and its sides sealed with clay/cow dung. A G.I.pipe is placed vertically in the pit and filled with water. One operator stands on top of a scaffold using his hand like a flap valve on the end of the pipe. With assistance from one or two other operators using a lever connected to the pipe it is plunged up and down. The pit is kept full of water, the operator at the top removes his hand on the down stroke; water and mud spurts out and the pipe sinks lower into the ground.

CHAPTER 3

OBJECTIVES OF THE STUDY

3.1 OBJECTIVES

From the literature reviewed there emerged a case for the promotion of local handpump manufacture. This study had the following objectives:

- (1) To compare the cost of Rower type handpumps landed in Lusaka, Zambia, when sourced locally from the Makeni Handpump Workshop in Lusaka and when imported from S.W.S. Filtration Ltd. in the United Kingdom.
- (2) To determine the attitudes, actions, and knowledge of selected New Zealand NGOs, involved in water supply projects, towards local handpump manufacture. This would then be contrasted with the information obtained from the literature and the case study.

3.2 LIMITATIONS OF THE STUDY

It is acknowledged that the study is limited in that it deals with one manufacturing operation and cannot be generalised for the entire Third World; experiences and conditions are different in every country, even between areas within countries. Data and resources available precluded a full and rigorous economic analysis of the costs and benefits to Zambia from the establishment of the Makeni Handpump Workshop. The study was conducted as a desk exercise with personal interviews conducted at the selected NGOs.

CHAPTER 4

CASE STUDY OF LOCAL HANDPUMP MANUFACTURE

4.1 INTRODUCTION

The Makeni Handpump Workshop was the manufacturing operation examined in this case study. It was started with NGO aid assistance from the UK and at the time of the study operated from the premises of the Makeni Ecumenical Centre in Lusaka, Zambia. The workshop was self financing and did not receive support on an ongoing basis. At the time of the study it was managed by a British VSO volunteer, he had an assistant who was being trained to take over management duties upon his return to the U.K.

4.2 RESULTS AND DISCUSSION OF QUESTIONNAIRE FROM MAKENI HANDPUMP WORKSHOP

(The questionnaire is included as appendix 1. All prices as of 2.7.93. Local inflation 400% per annum)

- (1) The cost of the Rower pump in local currency was K 35,000. This converted to \$64 US at the official rate or \$54 US at the shadow rate on the date given above. PVC pipe to connect the handpump to the water source cost K 1500 or \$2.73/2.31 US per metre.
- (2) Manufacturing the handpump required the importation from the U.K. of valves and seals at a cost of \$25 US per handpump set.

(3) The exchange rate for the Kwacha to the US\$ was :

US \$ 1 = K 550 Official

US \$ 1 = K 650 Shadow

(4) The Makeni Handpump Workshop employed five people including a British VSO volunteer, it was stated that the workshop might take on more staff in the near future. As well as Rower pumps the workshop made its own version of the India MK2 handpump and offered manual well drilling equipment for hire. It was the intention of the manager to offer a well drilling service as part of a package with a handpump in the future.

(5) The monthly wage paid to employees was K 32,000 plus occasional overtime. This was the same as a teacher got at the Ecumenical Centre of which the workshop was a part.

In US dollars this was \$58/\$49.

(6) The employees were all young men with only a wife or girlfriend to support except the manager's assistant who had a wife and two children.

(7) It was intended that the manager would be replaced by his assistant when the period of his assignment concluded. The workshop would then be completely under local control.

(8,9,&10) The workshop stocked all necessary spare parts for the handpumps and would install them wherever possible if the site was local. Installation of the Rower pump was not a difficult job so the purchaser could do it. The workshop could repair handpumps as needed, however the Rower pump had proved very reliable.

The locally made Rower pump was very competitively priced against the U.K. sourced equivalent, as will be seen later, despite the cost of importing valves and seals. The workshop employed five people and may expand; in all eleven people were supported at the time of the study by wages paid by the workshop. The VSA volunteer manager was training his local assistant to take over when he returned to the U.K. thus

building local capacity in organisation and management. The handpumps were readily available to the public in local currency.

The whole operation had to survive under extremely difficult macro-economic conditions. The constant high inflation may jeopardise future market demand as the handpumps become ever more expensive. At the time of the study the workshop was running at a profit. This was considered by the manager to be of great importance; that the operation be financially independent and profit making, not supported by aid funding. There was agreement from Oxfam on this issue, in the long run such undertakings must be self sufficient otherwise an atmosphere of dependency would be perpetuated (Hurley, 1990).

4.3 ROWER PUMP SOURCED IN THE UNITED KINGDOM.

(Exchange rate used as of 1.11.93. one pound sterling = \$1.4807 US.)

The price of a Rower pump sourced in the United Kingdom and transported to Lusaka, Zambia was found to be:

Basic handpump = \$ 185 US.

Handpump and piping with filter = \$ 370 US.

The price used for comparison was the basic handpump price from each source:

United Kingdom = \$ 185

Zambia = \$ 64 (official rate of exchange)

$185/64 = 2.89$ The Zambian Rower pump was close to 1/3rd the cost.

Some discussion of the cost comparison is necessary. As mentioned earlier it was not possible to obtain detailed costs incurred in setting up the Makeni Handpump Workshop in order to perform an economic analysis discounted over time, thus obtaining the true costs and benefits to Zambia. It would also have been necessary to use shadow prices for exchange rates and labour rates; the local currency is overvalued as indicated by the presence of a 'black market' for 'hard'currency, and it is likely that there are a large number of underemployed people in Lusaka. Therefore the market rate will not always be paid and does not reflect the opportunity cost of labour. An appropriate

discount rate would also be required; these figures were not readily available. Therefore the perspective of an independent aid agency was taken. Costs of setting up the workshop could be taken as sunk costs, that is money that would have been spent anyway, whether or not a particular agency bought handpumps there or not. Therefore, from an agency perspective, it came down to a straight comparison of the ex-factory price (at Lusaka) of the Zambian handpump against the cost, insurance, and freight price (to Lusaka) of the U.K. sourced handpump. Under these circumstances the Zambian handpump had a price advantage of close to a factor of three.

It was quite clear, on a cost-only basis, which source of handpumps an aid agency should use. However, there may be other factors involved in this choice that may be addressed as follows:

- (1) Tied Aid : The study was confined to non-government organisations which do not tie their aid funding.
- (2) 'Free' handpumps from large organisations : This was seen as a major constraint to the establishment of competitive local production; it would be impossible to run a "for-profit" business that gave away its produce. The manager of the handpump workshop noted the large number of donated handpumps, vehicles, and money in Africa and that this fostered dependency on continued external assistance. Giving free hand-outs to the poor was a short-term answer that may not even help to correct the problem (Hurley, 1990; Macdonall, 1993). Those responsible for the administration of aid funding must consider this and act appropriately; looking to the future may suggest that local production of simple goods required for development was a worthwhile investment.
- (3) Reliability of supply : It may appear to an agency, especially at a distance from Zambia, that it would be more expeditious to order a batch of handpumps from a known and reliable source and freight them to Lusaka. A little forward planning and notice of requirements to a local factory could allow them to 'gear-up' for a larger than normal production run. It was frequently emphasised in the literature that quality was a problem in local manufacture, it is indeed important that a locally made handpump be competitive on quality as well as cost. A well run operation was essential to take

advantage of its proximity to the market for its equipment and to be able to improvise and change quickly in response to changing demand.

(4) Delivery time : It may be thought that a local manufacturer would be poor at meeting delivery dates and quantities. This may well be the case in poorly run operations. However, there are many constraints on accurate timing of most undertakings in the Third World. Delays in supply of raw materials and other vital inputs well beyond the control of the manufacturer are common. This must be weighed against the logistical constraints of transport within the Third World that imported equipment will face especially in this and similar cases. Zambia is a landlocked country in southern Africa, equipment from the U.K. may be air freighted which is very expensive (and possibly why the U.K. sourced Rower pump is so costly), taken overland through Tanzania on the Tanzam railway or by Truck. The railway has had a record of delays in freighting goods in the past; a quarter of its freight cars may be unusable at any one time, half its locomotives under repair (Todaro, 1989). There are more tortuous routes overland by railway and road through Mozambique and Malawi or South Africa and Zimbabwe; land transport by truck is constrained by a lack of all weather roads and insufficient haulage capacity. Locally available equipment could obviate much expense, logistical problems and delays.

It is important for an agency concerned with development issues to weigh up the community benefits accruing from the use of locally manufactured handpumps. In this case there is a cost advantage to purchasing from a local source, this may not always be so. As was found in the analyses by the World Bank in Ghana and Nigeria cited earlier it was often not possible to compete with imported equipment. If price is the only decision factor then local manufacture will not get off the ground in many countries. It is pertinent to examine the 'developmental' spin-off resulting from the purchase of locally manufactured goods; what the agency 'gets for its money'.

In this case, see over:

- * Three handpumps for the price of one.
- * Five people paid wages which support eleven people in all.
- * Manufacturing and management skills imparted to local people.
- * Greater likelihood of project sustainability due to spares availability, local product familiarity, and purchase possible in local currency.
- * Savings in foreign exchange, aid money going directly into the local economy.
- * A reduction in import and aid dependence.

CHAPTER 5

NEW ZEALAND NGO PERSPECTIVE ON LOCAL HANDPUMP MANUFACTURE

5.1 RATIONALE BEHIND CHOICE OF NGOs

The following table (1) lists New Zealand Non-governmental Organisations in alphabetical order with those most obviously not involved in development projects omitted eg, Campaign for Nuclear Disarmament, Forest and Bird etc. They are taken from "A Directory of Development Organisations Aotearoa/New Zealand" (3rd Edition). This is published by The Centre for International Development Education and Action (IDEA). The directory lists their main areas of concern and action, this assisted in selection as there were many NGOs which were not involved in any development activities. Those that were involved in development activities abroad were further divided into NGOs undertaking water supply projects. From this group those able to assist with the questionnaire were selected. Several agencies stated that there may have been more knowledge of water supply strategies and projects at the host country or local NGO partner level, however they did not have the necessary knowledge within New Zealand to answer the questionnaire. Several well known NGOs concentrate on fund raising within New Zealand; projects are then supported through their sister organisations in Australia or the United Kingdom. Others deal directly with local NGO partners in Third World countries, their New Zealand activities consist mainly of administration, fund raising, development education, and networking with other NGOs.

* Whilst not directly involved in development projects many of the organisations below address a major issue within the development spectrum; human rights, people's understanding of development issues in the First World through development education, etc. Equitable development can not occur until all the conditions preventing it are corrected.

TABLE 1

<u>NGO TITLE</u>	DEV. INVOL	POSS.	CHOS.
AUCKLAND DEVELOPMENT EDUCATION CENTRE (ADEC).	NO		
AFRICA INFORMATION CENTRE.	NO		
AMNESTY INTERNATIONAL.	NO		
CATHOLIC COMMISSION for JUSTICE, PEACE and DEVELOPMENT (CARITAS).	YES	YES	YES
CHRISTIAN WORLD SERVICE.	YES	YES	NO
CORSO.	YES	YES	NO
COUNCIL for MISSION.	YES	YES	NO
DEVELOPMENT EDUCATION TRUST.	NO		
ERITREA SUPPORT GROUP.	NO		
FRIENDS OF THE PACIFIC.	NO		
CENTRE for INTERNATIONAL DEVELOPMENT and ACTION (IDEA).	NO		
INTERNATIONAL PEACE and JUSTICE UNIT (IPJU).	NO		
LATIN AMERICA SOLIDARITY.	NO		
NEW INTERNATIONALIST Ltd.	NO		
NZ CHURCH MISSIONARY SOCIETY.	YES	YES	NO
NZ RED CROSS SOCIETY.	NO		
OXFAM NEW ZEALAND.	YES	YES	NO
PHILIPPINES SOLIDARITY NETWORK.	NO		
SAVE THE CHILDREN FUND.	YES	YES	NO
SOROPTIMIST INTERNATIONAL.	YES	YES	NO
TEAR FUND	YES	YES	YES
THE HUNGER PROJECT.	YES	NO	NO
TRADE AID (NZ) INC.	NO		
UNICEF.	YES	YES	NO
VOLUNTEER SERVICE ABROAD (VSA).	YES	YES	YES
WATER FOR SURVIVAL.	YES	YES	YES
WORLD VISION OF NEW ZEALAND.	YES	YES	YES

Key: **DEV.INVOL** = NGOs involved in development activities.
POSS. = NGOs undertaking water supply projects.
CHOS. = NGOs chosen from the Poss. category that were able to assist with the questionnaire.

NGOs in the possible category were contacted by letter or telephone to establish whether they could assist with the questionnaire.

5.2 METHODOLOGY OF SURVEY

The survey used was a personal interview type. Head office staff (with the necessary background knowledge) from each of the NGOs selected, went through the questionnaire with the interviewer for a period of between 45 minutes and 1 hour. A sample copy of the survey can be seen in appendix 2. Respondents had the choice of several pre-determined answers and were allowed to give more than one response to each question as it appeared appropriate to them. Time was allowed for elaboration of answers as necessary and these comments were recorded by hand.

5.3 RESULTS AND DISCUSSION OF INTERVIEWS

The following points arose from the information gained from the interviews:

(1) All five NGOs questioned considered that water supply projects should address more than the welfare issue alone. Water supply was seen as complimentary to development; health and water quality were inextricably connected.

Other factors mentioned were:

- * Time saved for women, the usual water carriers, could be spent on productive activities or child care.

(3 out of 5)

- * In situations where children collected water time saved could allow them to go to school. (1 out of 5)
- * Agricultural development was seen to depend on water supply as one of its inputs. (2 out of 5)
- * Water supply projects were often part of a larger community development programme which attempted to improve people's lives on a broad front. (3 out of 5)

An example of people's powerlessness in adverse conditions was given by one agency:

In parts of India during periods of drought people with access to and control over water supplies have great power over those without. This has meant that people have had to sell their children to obtain water. A water supply open to everyone would free the disadvantaged from this abuse of power.

(2) All five agencies were involved in rural water supply systems, both handpump and gravity types depending on local conditions. One of the five sometimes supported peri-urban and urban systems depending on circumstances and needs. Reasons given were:

- * That the agency had a rural or village level focus and that most of the poorest people live in these areas. (5 out of 5)
- * Urban systems were seen to be large investments beyond the scope of the smaller agencies. (1 out of 5)
- * When the agency operated through in-country partner organisations, the local agency chose the type of projects. (2 out of 5)

All five said that a health education and sanitation component was integral to their water supply projects. Health and sanitation were considered interconnected with water supply. The water supply project was often part of a larger community development programme.

(3) Three agencies stated that wherever possible equipment was sourced from the host country, none of the agencies obtained equipment directly from their home country (N.Z.). There were also three responses to the 'other' category. This generally meant that equipment passed through a third party, either a larger agency donated handpumps to the project or the N.Z. government supplied equipment (in this case it was sometimes obtained in New Zealand). When working through local agency partners it was their choice of equipment and source, this was usually local. In some of the well established project areas where the agency had a long term presence expatriate staff had designed handpumps specifically for local manufacture; it was also noted that high quality handpumps were available from India (India MK2 and 3) and were used throughout Asia by the agency.

(4) Cost was a major factor determining choice of equipment, three of the five listed this as important. Two saw reliability and speed of supply as important. There were two responses to spare parts back-up and three to 'other'.

Reasons given were:

- * Limited funds meant that the cost of equipment was a consideration. (2 out of 5)
- * The availability of donated handpumps and equipment dictated choice in some cases. (2 out of 5)
- * Specific projects often demanded different responses so it was difficult to generalise. (1 out of 5)
- * Again choice was often in the hands of local project partners. (2 out of 5)

- * In an emergency situation it was considered more important to get the equipment there quickly and efficiently so it would be imported in such situations if this would expedite the operation. (1 out of 5)

(5) Two out of the five agencies had not considered investing in local manufacture although they did source handpumps locally wherever possible. These were either areas where their involvement was not great or that did not apply as they operated through in-country partners. One agency had attempted local manufacture in the Pacific region but not in Asia; two others sourced equipment locally and gave a 'YES' answer but had not actually invested in local manufacture. The agency with experience of local manufacture stated that it had not been a success and did not prove to be sustainable. Others had not been asked by project partners for such support or had no need to produce locally as donated handpumps were available.

(6) All the NGOs stated that they considered local handpump manufacture could be an income generating activity for local people.

- * There was seen to be a need for income generation and that if local materials were used it could be an area for small business investment. (2 out of 5)

- * It was considered possible to include handpump manufacture as part of a vocational training scheme. (1 out of 5)

- * As handpumps would be available close to where they were needed it was felt that such a business would be viable. (1 out of 5)

(7) Three out of the five agencies were involved in handicraft production, three of them also assisted in the manufacture of simple goods for the local market. One agency stated that they helped in the production of import substituting goods and three were involved in agricultural and livestock projects.

Comments were:

- * There was some experience of handicraft projects that had failed, in this case 'Eco-tourism' would be tried. (1 out of 5)
- * Loans to poorer people and micro-enterprise development; low interest loans for locally proposed projects considered viable by the locally staffed management team. These business ventures could be in any sphere; it was noted by the agencies concerned that there was a 90% repayment record on such loans. (2 out of 5)
- * It was considered to be important to train local people in skills that would advance their living standards such as agricultural produce for consumption or sale. (1 out of 5)
- * Market potential had to be assessed beforehand.
(1 out of 5)

(8) Two agencies were not directly aware of instances or publications about local handpump manufacture. Three responded positively and stated that they knew something about local handpump manufacture.

- * It was mentioned that although there was little knowledge within New Zealand field workers in the host countries would be more aware and information could be obtained from them if needed. (3 out of 5)

(9) One agency thought that it would not help to have locally available spares; this was related to knowledge of a failed project where handpumps were made locally. Neither the local manufacturing enterprise nor the water supply project itself proved sustainable; local manufacture alone was no guarantee of success. The four other agencies felt that local manufacture would help sustainability.

Reasons given were:

- * Local familiarity with the product and lower cost spares would help towards self-

sufficiency and break reliance on imports. (2 out of 5)

- * The handpumps and spares would be available to local people. Imported equipment would not be available due to the need for foreign exchange to which they have no access and the bureaucracy involved in customs clearance and import licensing of which they have no knowledge. (2 out of 5)

- * Training of local people in operation and maintenance was emphasised. (1 out of 5)

(10) One NGO stated that both technological and sociological factors were important in project success and could not be prioritised. Three noted sociological factors as the most important and one said they had no experience of failed projects. This agency worked through indigenous organisations which responded to village requests for assistance.

Points noted were:

- * There were sometimes arguments over ownership, water rights, and land ownership amongst the local population that caused operation and maintenance problems. (2 out of 5)

- * It was felt that local people could and should be trained in operation and maintenance and paid by results as a possible solution to past failures. (3 out of 5)

- * In general it was agreed that the community had to be involved in all aspects of the project from the beginning; site selection, access to the facility, maintenance etc. There had to be a feeling of ownership and local commitment, a water committee with local leadership and accountability was suggested. (4 out of 5)

5.4 DISCUSSION

From the interviews it can be seen that there was general agreement that water supply projects could represent more than a welfare intervention, they often formed part of a greater community development scheme aimed at improving every facet of people's lives. The manifold interlinking causes of poverty were well understood by all the agencies; also that interventions must be designed to promote equity and avoid appropriation by established elites.

There was more support for rural water supply systems. This reflected the greater percentage of people in the Third World who lived in rural areas and that they were often the poorest members of society; also several agencies had a declared 'poverty focus' in their projects.

Concomitant investment in health education and sanitation provision was universally considered important in order to realise the full health potential of improved water supply systems.

Equipment was generally sourced within the host country, so local manufacture would be supported where it existed but not actually invested in. A common factor influencing equipment choice was cost; the generally small budgets of the NGOs required them to be very cost effective; accountability to their donors (the public) demanded positive results from their investments. Where 'free' handpumps were available this was the cheapest alternative, although it is questionable how well this promoted development if the handpumps were imported by a larger agency from its First World home base.

There was one agency that had supported local handpump manufacture which had failed, others had not invested in local manufacture but procured handpumps locally if possible. It may well be difficult to justify establishing a handpump manufacturing operation as part of a water supply project. The extra time and funding needed would make it much more difficult to get the project up and running. It is probably easier where equipment is not already available locally to import it and get on with the project rather than spend time and money on an extraneous investment. It does depend on the terms of reference of the project; if it is aimed at community development then the self-reliance accruing from making the equipment needed locally would be a powerful

argument for instituting local manufacture as part of any such scheme.

There was a focus on the more traditional types of income generating schemes amongst the group of NGOs surveyed; handicrafts, livestock projects, and simple goods for local sale.

The micro-enterprise development scheme sounded promising. There is no reason why local handpump manufacture could not be funded from such a source, as long as the local entrepreneur had a well thought out proposal. The excellent repayment rates on loans noted by the agencies concerned make it apparent that the poorer members of society can be good, reliable managers of investment if given the chance.

General awareness of instances of or reports on local handpump manufacture was not high. It may well be that it is not a subject that the New Zealand staff need be fully aware of, more the domain of in-country staff. Most considered locally made, readily available handpumps would enhance operation and maintenance possibilities, however, the sociological factors such as the community not feeling the facilities to be theirs and thus not their responsibility were seen as the major problem facing the attainment of water supply sustainability.

CHAPTER 6

CONCLUSIONS

From the literature reviewed, the case study, and the NGO interviews there emerged a series of conclusions which may be drawn from the evidence assembled:

- (1) There was a consensus between the literature and the NGOs that water supply projects can and should address more than the welfare issue:**

It was agreed that a new water supply alone would not engender true development of a community, it would be a welfare provision only and possibly generate further dependence on external assistance. It was seen as very important to fully involve the community in any new facilities proposed. Concomitant health education and sanitation provisions were universally felt necessary by the NGOs in order to obtain the full potential benefits of a new supply of clean drinking water.

Agricultural development was regarded as contingent on an adequate water supply in many areas. Improvement in a water supply could in such cases be the first step towards a more nutritious diet or extra income. Involvement in agriculture was a reflection of the agencies' overall rural focus in their development projects. It was understood that the majority of the poorest people live in the rural areas of the Third World.

Another way in which aid money spent on water supply projects could engender more than welfare provision and dependence arose from the case study. The Makeni Handpump Workshop operated at a profit and employed local people. By investing in local handpump manufacture people's capacity to address their own developmental needs was increased as well as the immediate need for handpumps met.

Most of the NGOs felt that locally available handpumps and spares would simplify and enhance the operation and maintenance of water supply systems.

- (2) **There were constraints to handpump manufacture in Third World countries noted in the literature, NGOs mentioned the difficulties of instituting any income generating scheme:**

Certain prerequisites for success were identified:

The local economy had to function at a certain level of efficiency to allow a business venture to survive, although in the case study the Makeni Handpump Workshop operated in an economy with 400% annual inflation. There also had to be a market for the handpumps produced.

Quality assurance was identified as a weak area in many countries as there was no tradition in this sphere of local industry. The case study manufacturing operation used some parts imported from the United Kingdom and was initially begun with investment from a United Kingdom charitable organisation. This was similar to the joint ventures recommended in the literature for incipient handpump manufacturing industries and could be an ideal way to institute similar new operations.

- (3) **There has been much research into handpump design which has produced new, robust, more easily made handpumps. Several are appropriate for local manufacture and indeed have been designed with this in mind; they are in the public domain to obviate any problems with patents.**
- (4) **A major contribution that local manufacture could make to project sustainability was identified as standardisation on one or two types of handpump per country or region:**

Standardisation could be achieved by importing a limited range of handpumps however, local manufacture of such a range would mean that spares would be more readily available and purchasable in the local currency without recourse to importing them. This would enhance project sustainability. Standardisation on a limited number of handpumps also enhanced production profitability by its returns to scale in manufacturing; this suggested that local manufacture should focus on a popular or common type of handpump in the area, one of which there was local knowledge and acceptance.

- (5) It has been found that higher returns and more certain success can be achieved by producing a number of diverse products (Sarvodaya Shramadana, hand tools) or offering complete packaged services (Mr Sok, boreholes and fitting) as well as handpumps:**

Unless local demand is very high it is difficult to see how handpump production alone can be profitable over time once the market becomes saturated. Diversification into well drilling or digging and lining, hiring out equipment, making other simple products for which there is a known local demand, making water storage tanks, latrine digging and building, or maintenance of such facilities could provide the impetus for business survival and growth. Demand for handpumps will be different for specific areas, in Prey Veng province, Cambodia, Mr. Sok's simple handpumps were bought by local people to establish their own private water supplies. The price paid was high (\$25 US) indicating a high willingness to pay in that area. This can not be assumed in all areas as people with little money will not be able to buy handpumps no matter how much they want or need them. Under these circumstances local production would likely fail in orthodox economic terms as there would be low demand in areas of great need.

The case study of the Makeni Handpump Workshop revealed that it is indeed possible for a small operation to run at a profit. It provided another example of product diversification by supplying handpumps and spares, well drilling equipment hire, and in the near future a well drilling service. From an aid agency perspective handpumps bought there were not only cheaper than imported equivalents and spares more readily available but by patronising a local manufacturer local people benefitted from the employment created. This scenario could be replicated in similar situations by an agency prepared to take a long-term view of development.

The complex interlocking causes of poverty will not be rectified in the short-term, only their symptoms treated by well-meaning outsiders. If people are to realise their own potential; education and training leading on to gainful employment is imperative in order that they may confront their poverty.

(6) The NGOs were interested in the concept of local handpump manufacture, however, only one of the five had direct experience of its operation:

Unfortunately this example was a failure in the specific cultural and economic setting in which it was founded. There had been no other investment in local manufacture of handpumps and there were other priorities for the agencies' limited finances. However, where available locally sourced equipment was used.

Investment in local handpump manufacture could be a worthwhile option for an agency with a long-term view. Self-sufficiency in the supply of one of life's most basic necessities, clean water for everyone, must be considered a valuable achievement for any society.

(7) The NGOs focused on agricultural projects, handicrafts, and small business ventures other than handpump manufacture in their income generating schemes:

Many of the projects mentioned in the NGO interviews focused on areas of existing knowledge and expertise within the communities involved. It had been found more effective to build on existing knowledge than introduce a completely unknown system and train people right from basics in its operation. This lesson has a bearing on any proposed investment in handpump manufacture. An attempt at instituting handpump manufacture in an area where there is no tradition of light engineering is likely to be futile without extensive training for the prospective employees. It may be more effective to concentrate on areas where light industry has been established. Handpump manufacture could build on this rather than be the community's first experience of manufacturing.

The NGOs agreed that local handpump manufacture could be a viable income generating scheme given conditions conducive to its success.

- (8) From the literature and the case study it emerged that local manufacture was more successful when operations concentrated on simple handpumps of the suction and low-lift (up to 15m) types.**

Manufacture of the simpler types of handpump has been more successful. This suggests that they should be the type any new manufacturing operation chooses to begin with. Expertise would be gained and quality control techniques learned from experience in making them. The employees thus imbued with the requirements for precise workmanship could progress to the manufacture of the more exacting deep-well handpumps and other related equipment.

CHAPTER 7

RECOMMENDATIONS FOR FURTHER RESEARCH

The case study of the Makeni Handpump Workshop might be extended as follows:

Firstly, a thorough economic analysis, given the necessary information, of the costs and benefits over time to Zambia of the operation could be undertaken and investment justified on its economic return. Capital is a scarce and costly resource and its use should be justified as it has an opportunity cost; investment in a handpump manufacturing business means investment forgone in another sector.

The benefits variously referred to as 'developmental spin-off', and 'local capacity building' could be more accurately assessed:

Who becomes employed by a handpump manufacturing operation? Are people previously unemployed taken on and their lives improved through income earned?

Are their families' lives enhanced through better nutrition or education?

If there is some staff turn-over where do they go, what do they do?

Are their chances of subsequent employment enhanced by their experience in handpump manufacturing?

These sociological factors are difficult and time consuming to measure but they would reveal how effective an intervention has been in promoting people's realisation of their potential; true development.

A measure of the backward linkages to primary industry of a handpump manufacturing operation would be useful in assessing its overall effect on the economy of a country. Does it rely on imported raw material or utilise locally available materials thus fuelling a demand for them?

Are there any forward linkages such as exports which earn foreign exchange?

Has a local artisan workforce evolved around fitting and repairing the handpumps thus creating more employment?

Improvements in operation and maintenance effected by the availability of locally made handpumps and spares could be assessed:

Does their local manufacture enhance accessibility to spares for those who require them?

Are there fewer broken handpumps in an area with access to locally made parts than in an area without?

Is there greater coverage of an area by protected water sources using handpumps when there are locally made handpumps available?

Are there more privately owned hand-pumped water sources in an area with readily available low-cost handpumps made in the country than in an area without?

APPENDICES

APPENDIX A

ZAMBIAN HANDPUMP WORKSHOP QUESTIONNAIRE.

1. Ex.factory price of Rower pump in local currency 1993 prices?
2. Cost of imported valves etc per pump?
3. Exchange rate US dollar to Kwacha Official and Black Market?
4. Number of employees?
5. Wages paid to employees?
6. Families supported by wages earned ie size of extended families of employees?
7. Are you training a local counterpart?
8. Spare parts supply, do you get regular orders for spares, have you a stock of spares available; price of spares?
9. Who fits pumps you, users, local contractor, other?
10. Who repairs pumps?

APPENDIX B

NGO QUESTIONNAIRE.

Name of agency. _____

1. How does your organisation see water supply projects:

As welfare considerations alone; clean water supply the only issue; or
welfare with an element of development involved?

A. WELFARE.

B. WELFARE/DEVELOPMENT.

If A why only welfare?

If B why? Show examples of this in practice.

2. What type of water supply projects does your organisation support?

A. RURAL HANDPUMP SCHEMES.

B. RURAL GRAVITY SCHEMES.

C. PERI-URBAN SCHEMES.

D. URBAN.

Reasons for supporting specific type of projects?

Do they have a Health Education/Sanitation component?

A. HEALTH EDUCATION.

B. SANITATION.

C. BOTH.

D. NEITHER.

If A, B, or C why was the additional component felt necessary?

If D why was it not felt necessary?

3. From where does your organisation obtain equipment?

A. HOME COUNTRY.

B. HOST COUNTRY.

C. OTHER.

Give details where several countries are used as sources. Why was the current system used? Any change over time?

4. What factors determine the source of equipment?

A. COST.

B. RELIABILITY/SPEED OF SUPPLY.

C. QUALITY OF EQUIPMENT.

D. SPARE PARTS BACK-UP.

E. OTHER.

Explain 'other'.

5. In projects requiring handpumps has your organisation ever considered sourcing them from a local manufacturer or investing in local manufacture as part of the project?

A. NO. If NO why not?

B. YES. If YES, was the outcome:

A. POSITIVE.

B. NEGATIVE.

6. Does your organisation consider local handpump manufacture to be a viable income generating activity for local people?

A. NO.

B. YES.

Reason for answer, elaborate, opinions/evidence?

7. What are the usual products involved in income generating schemes funded by your organisation; what have been their outcome/success?

A. Handicrafts for tourists/export.

B. Simple goods for local sale.

C. Import substituting goods.

Outcome of projects/lessons learned?

8. Are you or others in your organisation aware of any reports, studies or instances of local manufacture of handpumps?

A. NO.

B. YES.

9. There have been many instances of operation and maintenance failures in handpump based systems. Do you think that availability of locally made handpumps and spare parts would help address this problem?

A. NO.

B. YES.

In either case why? Justify answer.

10. What do you see as the main cause of failures in community water supply systems?

A. TECHNOLOGY.(inappropriate/incomplete transfer etc).

B. SOCIOLOGICAL.(not a felt need/no feeling of community ownership).

Any other comments?

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