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### The evaluation of a handpump



#### INTRODUCTION

Papua New Guinea is one of seventeen developing countries participating in a global project concerned with the testing and development of rural water supply handpumps. The project is funded by the United Nations Development Programme (UNDP), Division for Global and Interregional Projects and is being executed by the Water Supply and Urban Development Department of the World Bank. Its principle aim is to "support the global effort to provide, reliable, low-cost water supply systems to serve those in dire need of adequate sources of water in rural and urban fringe areas (ref.1)". According to its chief, the Rural Water Supply Handpumps Project will "provide the necessary technological basis for the development of new, low maintenance and cost-effective handpumps for installation in developing countries (ref.2)".

At its inception in 1980 the Project was directed at laboratory testing, field trials and technological development of handpumps. By 1984 the concerns of the Project had broadened due to the recognition that handpump design cannot be approached in isolation of economic, social and institutional considerations. The articulation of these thoughts provided a healthy stimulus to the Papua New Guinea Handpump Testing Programme to go beyond its original 1983 terms of reference that emphasized the technical evaluation of handpumps. Indeed, a growing realization arose that an evaluation of a more comprehensive nature was required if Papua New Guinea was to successfully employ handpumps on a large scale.

#### THE EVALUATION PROCESS

Whilst the technical assessment of a new technology is recognised as important, the successful design and employment of this new technology depends to a large extent on non-technical factors. The Papua New Guinea Handpump Testing Programme (PNG Programme) is in the midst of an evaluation process which acknowledges this truth. The evaluation process is therefore attempting to address not only technical considerations but economic, social and cultural, institutional, and health considerations as well. In the PNG Programme these separate evaluations are being co-ordinated by the Appropriate Technology Development Institute (ATDI) of the Papua New Guinea University of Technology. The information

obtained from these evaluations will help to effectively integrate the handpump into rural Papua New Guinean society. This has required a multidisciplinary approach which makes as much use as possible of government professionals, university departmental staff and students and UNDP/World Bank consultants. The wider participation and interest in the PNG Programme lays a good foundation for the handpump's future. More importantly, a comprehensive evaluation of a new technology such as a handpump is essential if that technology is to be promoted with any degree of confidence. However due to the pressing needs that exist in rural Papua New Guinea, as well as other constraints such as limited funds, it was felt that the evaluation process could not be too elaborate or time-consuming.

#### TECHNICAL EVALUATION

##### Initial Handpump Selection

In order to conserve finances, human effort and time the PNG Programme took advantage of the results of a programme of ground water development carried out in Malawi from 1980-1982. A seminar co-sponsored by the Malawi government, the United Nations and the World Bank in December 1982 enabled a research engineer from the ATDI to observe a number of field-installed handpumps that included the well-known Blair Handpump of the Blair Development Institute in Zimbabwe. The Blair Handpump design was carried back with the thought that it had potential to meet some of the needs in Papua New Guinea. It also seemed likely that it could be manufactured in Papua New Guinea thus reducing dependence on expensive and hard to maintain foreign-manufactured handpumps.

Since one of the long range objectives of the UNDP/World Bank Project was to promote handpumps that can be manufactured locally, focusing the PNG Programme on such a handpump seemed like a logical decision to make. The resultant handpump now being tested is one of four handpumps in the UNDP/World Bank Project that are derivatives of the Blair Handpump. Forty-five PNG Blair Handpumps are now being field tested. It was beyond the resources at that time to evaluate a greater variety of handpumps. Fortunately there are 76 models

of handpumps being tested world-wide in the UNDP/World Bank Project and the test results will soon be published for the benefit of all.

#### Field Monitoring

This is an indispensable exercise in the evaluation of a handpump. It provides a good idea of how that particular unit might survive in real life situations. Carefully chosen test sites, representative of the various geographical settings in the country are important especially if the number of test sites is small. The PNG Blair Handpump has therefore been installed on coralline islands, in areas of heavy gravels, clay and volcanic sand. They were installed either over hand-augered boreholes or hand-dug shallow wells. Due to remoteness, some sites are monitored infrequently and irregularly. The majority of sites are however monitored on a monthly basis. This is the main monitoring activity.-recording such things as ground water level, a flowmeter reading, volumetric efficiency, sanitary conditions surrounding the well and preventive and corrective maintenance performed.

In the 20 months of monitoring none of the PNG Blair Handpumps have broken down. This may sound like an impressive record except for the fact that the flowmeters register an average daily throughput of only 0.5 cubic meters per day and that the volumetric efficiency has dropped from an average of 0.84 to 0.73. At the present rate of usage it is estimated it would take 5 years to obtain 1000 hours of usage. It was therefore proposed to accelerate the wear process by a laboratory-administered endurance test.

Only occasionally were the pumps observed in use as the peak hours of water collection were outside of normal working hours. This lack of observed usage inspired a study where university anthropology students would live in a village to determine who the main users were, how the pump was used and what type of water collection containers were used. The observation and questioning of the users assisted in the ergonomic design of the present version of the PNG Blair Handpump.

#### Laboratory Testing

During the initial phase of the Rural Water Supply Handpumps Project, The Consumers' Association Testing and Research (CATR) Laboratories in the U.K. were contracted to carry out tests on handpumps. Since 1980, twenty-three handpumps, manufactured in both developing and developed countries, have undergone a battery of user trials, performance tests and endurance tests. Each pump also underwent a detailed engineering assessment. Although not as indispensable as field testing, laboratory testing is nevertheless valuable in predicting or authenticating

field results, often at a minimal cost to the programme.

It was felt that before the PNG Blair Handpump could be certified by the ATDI for widespread use in Papua New Guinea a series of tests similar to those administered by the CATR were required. Of particular importance it was felt that an accelerated endurance test was required. The CATR administers a 4000 hour endurance test whereas our field-installed pumps had only received an average of 400 hours of usage. The ATDI, therefore undertook this venture constructing an 8 metre high testing tower with research funds from the University of Technology. Proving a home-grown technology, in-country, may have some positive psychological effects on the final acceptance of the handpump by government leaders and the general public.

#### Operation and Maintenance

Regardless of handpump some maintenance will always be involved in keeping it in satisfactory operating condition. The long range objective of the UNDP/World Bank Project.-to develop handpumps which conform to the Village Level Operation and Maintenance (VLOM) principle.-recognizes this.

The prospects of the PNG Blair Handpump attaining the VLOM standard seemed promising. However due to the complete absence of breakdowns in the village setting there were few opportunities to test whether a village caretaker could maintain the PNG Blair Handpump. To compensate for lack of actual breakdowns in the field, a workshop on the installation and maintenance of the PNG Blair Handpump was carried out in February 1985. Thirty candidates, one from each community government area in Morobe Province attended. They were all young men with a grade 6 to 10 level of education. Very few of the course attendees had any difficulty at all in assembling or installing the handpump. Each attendee also fabricated and tested an actual piston/foot valve. This workshop therefore enabled the ATDI to state with reasonable certainty that the PNG Blair Handpump has good potential for reaching the VLOM standard.

The VLOM concept suits PNG very well due to the inaccessibility of a large portion of its rural areas. The village caretaker, backed up by a district technical officer, may prove to be the most efficient and effective maintenance management system for Papua New Guinea.

#### ECONOMIC EVALUATION

Handpumps are strongly promoted by the World Bank as they often provide one of the simplest and least costly methods of supplying rural populations with water. Obviously the handpump with the lowest initial cost, fewest

wearing components and requiring the least maintenance would be the most economical alternative. The PNG Blair Handpump with its one moving part, standard UPVC plastic and galvanized iron pipes and fittings and ball valves using glass marbles results in an initial capital cost of about 40 kina (1 kina = 0.71 pounds sterling) for both above and below ground components. This is an affordable amount for a small village.

For a cost analysis and comparison of different handpump designs, all the relevant life-cycle costs should be considered. According to Environment and Development in the Third World (ENDA), the cost factors which should be taken into account include "initial capital costs, economic life, cost of replacement of vital parts involving lump sum, annual maintenance and operation and rate of discount (ref.3)". Presently maintenance data on the PNG Blair is sparse and data on the other pump models being tested world-wide is not readily available either. With the completion of the laboratory endurance and field tests an economic evaluation will then be possible.

There are of course other economic benefits indirectly resulting from better health and greater convenience. These anticipated benefits are intangible ones and difficult to assign values to. They are however real and important economic considerations requiring in-depth study in order to assess the full impact of the handpump.

#### SOCIAL AND CULTURAL EVALUATION

A water pumping device for a community water supply is a small technical device in a complex economic and socio-cultural system. Water supplies, being a vital need, are often vested with deep cultural meaning and traditions. In Papua New Guinea the situation is even made more complex with over 700 distinct language and tribal groups, often with quite varied beliefs and customs.

Since an effective handpump installation project is a blend of technology, institutions and people, understanding the social and cultural background of the people deserves generous attention.

The UNDP/World Bank Project recognizes this and provides a form to help assess social and cultural factors. Guidelines for using this form state that it should be administered by an anthropologist to ten percent of the households in a village. It is recommended that this is done at least twice a year, once during the rainy season and once during the dry season. It attempts to document water usage patterns and user views since the ultimate success of a handpump installation will depend on user acceptance.

Teams of anthropology students administered the forms several times throughout the PNG Programme. This necessitated staying in villages several days at a time. People volunteered information quite freely and seemed to appreciate this outside interest in their views. The anthropology students were eventually able to modify the Project form in order to better suit the Papua New Guinea situation.

The overall results have shown that the rural populations have strong attachments to their traditional water sources and have some mistaken beliefs about handpumps. These two factors may explain the lower than expected handpump usage rates. These overall results also led to the important conclusion that an input of health education is vital if the full potential of a handpump is to be realized.

#### INSTITUTIONAL EVALUATION

There have been some timely policy-related developments in Papua New Guinea which should help a technology like the PNG Blair Handpump establish itself. Firstly, the responsibility for rural water supplies was transferred from the Department of Works to the Department of Health. This is widely seen as a wise move since effective water supply is inextricably linked with health education and sanitation activities. Concurrent with this came the adoption of a new National Policy for Rural Water Supply and Sanitation. Many who had input into the policy were involved with or aware of the Papua New Guinea Handpump Testing Programme. The policy contains statements which give priority to simple schemes that can be constructed, operated and maintained by the community and that technologies used be of standard designs as far as possible. The policy also has the intent of increasing the capabilities of provincial and community governmental bodies for installation, management and maintenance of water supply and sanitation systems. There is also the intent to conduct necessary health education programmes and water quality monitoring

Rural Water Supply and Sanitation Surveys are now being conducted in a number of Provinces by the Department of Health and the World Health Organization. The provincial plans which result may call for the wide-scale deployment of a technology such as the PNG Blair Handpump. While these surveys are taking place, the Department of Health is assessing what human and financial resources will be required to meet its new mandate.

Even though there may not be sufficient structure at present to implement a large scale rural water supply and sanitation programme, national policies now exist which will permit such a programme to be built.

## HEALTH EVALUATION

Of the many benefits that can be derived from a properly utilized water supply, improved health is undoubtedly the most important. Water supply alone however cannot be expected to bring the desired health benefits unless accompanied by the practises of "personal hygiene, health education, sanitary excreta and waste disposal (ref.4)". This truth must be recognized if the potential good effects of the handpump are not negated by poor sanitation. Sanitation is therefore a vital consideration for the success of any future handpump installation programme. For this reason it was thought necessary to evaluate the health factors surrounding the use of handpumps. This exercise would help ensure that the health benefits of a VLOM handpump could be maximized in the village setting.

The most basic question to be dealt with concerning the PNG Blair Handpump was whether or not it was delivering good quality water. Each test site underwent bacteriological and chemical water quality tests. These were compared with water quality results for the alternatively used traditional sources. The contrast in results was very dramatic showing that most handpump sites satisfied both the WHO and Papua New Guinea standards, whereas many traditional sources in use were grossly polluted.

Although results were predictable, it is believed that it was an important exercise to perform in-country. The results could be used as a tool in the health education process of Papua New Guinea citizens.

To evaluate what health impact the PNG Blair Handpump was having, it was decided to study one representative village in great detail. It was proposed to compose a team of engineering, medical and anthropology students to study the water usage patterns and assess the health status of that community. This study, now in progress, will result in a detailed layout plan of the village indicating the location of all households and water sources. A house to house survey will then try to link water usage patterns with the health status of various households. The preliminary findings of this study seem to indicate that the PNG Blair Handpump is not having any noticeable impact as people still prefer to use river water for washing and drinking and there are no pit latrines. These findings were quite sobering but will be useful as baseline data for comparison purposes once good water supply, health education and sanitation practices are in effect.

Other health-related factors presently being considered are concerned with the hardware and peripherals of a handpump installation. These include the design of a sanitary wellhead,

concrete apron and soakaway and other facilities that may complement a handpump installation such as a bucket shower facility or a washing slab. These peripherals can encourage the more effective use of the handpump and result in increased health benefits.

## CONCLUSION

Papua New Guinea's involvement with the UNDP/World Bank Rural Water Supply Handpumps Project has been a very profitable one. The Project provided a good foundation for carrying out technical, economical, social and cultural evaluations of the handpump. Since the PNG Handpump Testing Programme was being carried out with a view to the early and wide-scale employment of a VLOM handpump, the ATDI initiated institutional and health evaluations as well. The health evaluation in particular was thought essential as it underscored the need to employ the handpump in the context of a sound programme of water supply, health education and sanitation.

Carrying out these separate evaluations resulted in a wide participation of Papua New Guinea professionals and village people in the development process. A comprehensive evaluation carried out in-country makes sense when it is realised that citizens of that country will have to live with the decisions made.

By the time Papua New Guinea is ready to implement a large scale rural water supply and sanitation programme the PNG Blair Handpump will be shown appropriate or inappropriate for meeting some of the existing needs. If proven by the evaluation process outlined above it is felt that the PNG Blair Handpump could be employed in Papua New Guinea with a high degree of confidence and effectiveness.

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