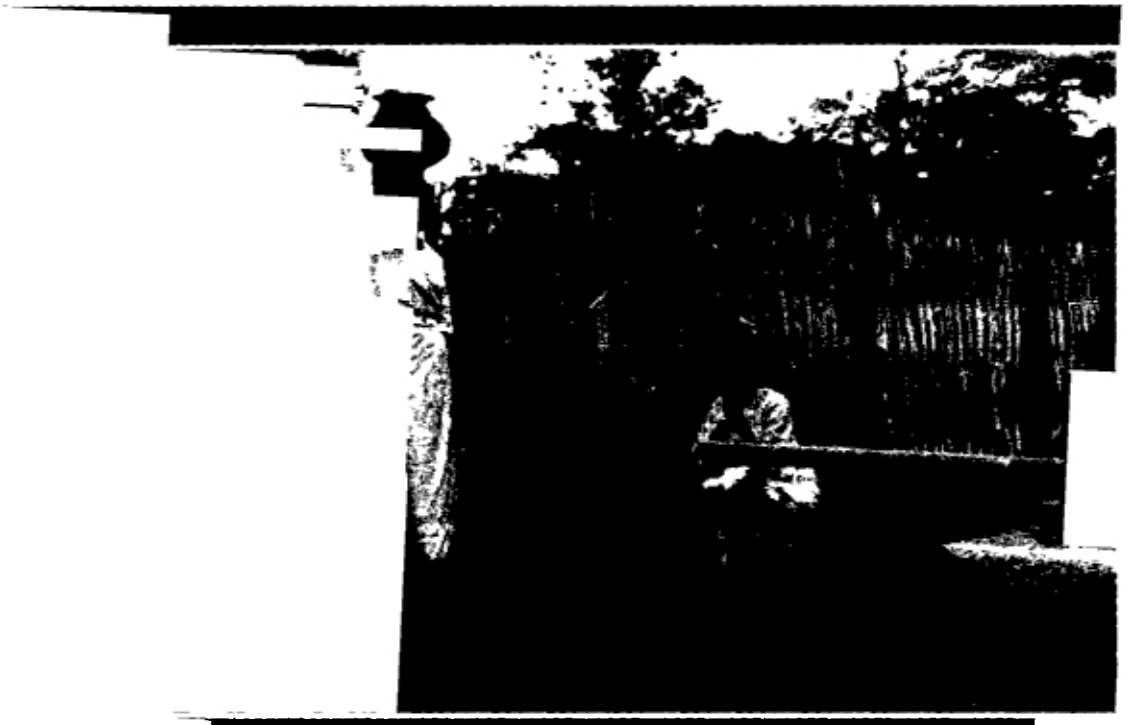
WATER FOR THE VILLAGERS

The Burma Village Water Supply Project



g Kywe
ıh Maung
gwe Thein
an Maung
arry Shaw
on Staples
escha Teckle
uce Walker

A/DAB Evaluation Series
No. 3

Australian International Development Assistance Bureau

WATER FOR THE VILLAGERS

The Burma Village Water Supply Project

AIDAB Evaluation Series No. 3
1988

Aung Kywe
Khin Maung
Ngwe Thein
San Maung
Barry Shaw
Ron Staples
Nescha Teckle
Bruce Walker

Australian Government Publishing Service
Canberra

ISSN 1030-7249
ISBN 0 644 08100 7

This account is based on the Final Report of the Burma Village Water Supply Project: Evaluation, which is dated May 1986 (limited information updating since then has been included but does not alter the thrust of the account). It should not be taken to represent the views of the governments of either Burma or Australia, or of associated agencies.

Technical editorial, typesetting, and layout services were provided by PageCraft Publishing Pty Ltd, PO Box 133, Wanniassa, ACT 2903.

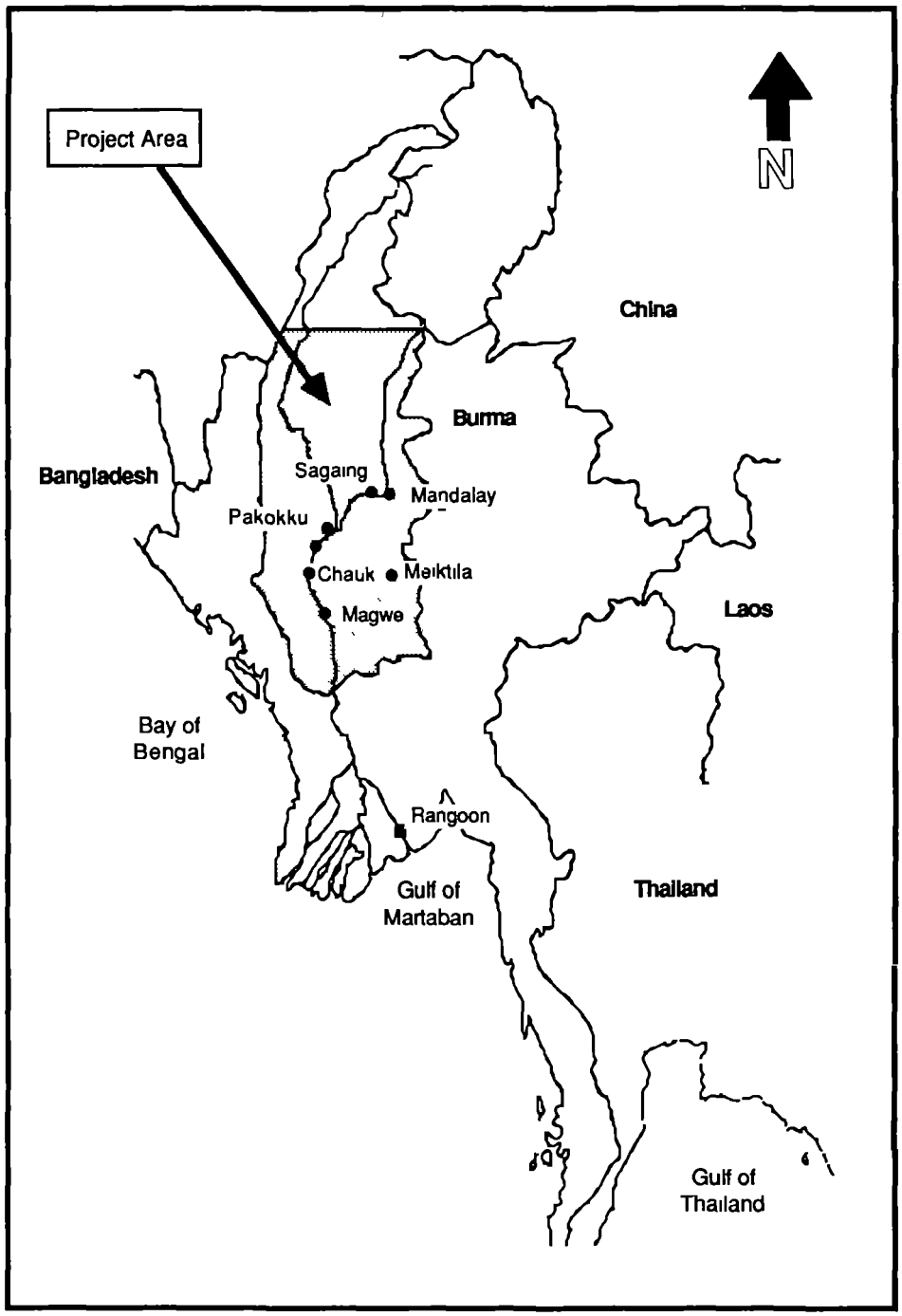
AIDAB Evaluation Series

This series aims to report the results of Australia's overseas aid. Included in the series are edited versions of selected review of ongoing activities, ex post evaluations of completed bilateral projects, and thematic and sector-based evaluations.

Series Editor: Appraisals, Evaluation and Sectoral Studies Branch.

Copies are available from AGPS outlets and the Director, Public Information, AIDAB, GPO Box 887, Canberra, ACT 2601

Contents



The location of the Project

SUMMARY

THE Burma Village Water Supply Project (BVWSP) was initiated in 1978 to supply pumps, engines, pipes, drilling materials, and technical assistance for 1850 tubewells serving two million villagers in the Dry Zone of Central Burma. This is one of the driest areas of south and south-east Asia. The Project, implemented by the Rural Water Supply Division (RWSD) of the Ministry of Agriculture and Forests, was reviewed by a joint Burma–Australia team in November and December 1985, which concluded that the Project was successful since:

- The tubewell targets had been met.
- Villagers were using and maintaining the tubewells, and considered the Project a success.
- The economic rate of return was acceptable.
- Costs were within budget.
- The infrastructure for management and maintenance of the water supply was in place and working.

PROJECT PROFILE

The Burmese Village Water Supply Project is part of the Australian and Burmese governments' joint effort to provide a safe water supply to an estimated two million people in the arid Dry Zone of central Burma. Australian assistance was co-ordinated with UNICEF's contribution The Australian managing agent is Coffey and Partners, while the implementing agency for the Burmese Government is the Rural Water Supply Division of the Ministry of Agriculture and Forests. Some key dates are.

- **1977:** Technical feasibility study by an Australian team
- **1978:** Project commenced
- **1979:** The memorandum of understanding was signed on December 28. A baseline socio-economic survey of 159 villages and 7500 households was undertaken
- **1982:** A follow-up survey of the baseline sample was undertaken
- **1985:** A joint Burma–Australia project evaluation was made
- **1986–87:** Appraisal of Burmese request for further assistance in tubewells and the piped rural water scheme in the Dry Zone A $28 million program was recommended There were institutional and budget problems with this proposal
- **1987:** The design of the Taung Zin off-takes was in progress

Costs

Australian contribution. $A37 7 million
Burmese contribution. $A13 0 million

Key Achievements

- 1850 tubewells have been installed, meeting targets, with a 90% drilling success rate
- over two million people in 1600 villages are directly served by the tubewells
- villagers used and maintained tubewells successfully
- water availability for livestock and fire fighting has increased
- costs were within budget
- the infrastructure for institutional support to manage and maintain the water supply and pipes is in place and working
- the economic rate of return approximated the original estimate of 20%

Australia, through the Australian International Development Assistance Bureau (AIDAB), contributed $A37.7 million of the total cost of $A44 million (330 million Kyat[1]). This included an additional Project component to extend a rural piped water scheme. With its own vast underground water resources, Australia has a strong background in groundwater exploitation and conservation.

Village participation in the Project was considerable in terms of commitment of money and labour for pumphouses and tanks, and the management and maintenance of the wells through village committees, as well as the use of water for drinking, washing, cooking, and other domestic use.

RWSD's technical achievement in drilling wells and installing pumps was considerable. This was achieved despite numerous problems, including serviceability of drilling rigs, shortages of cement and spare parts, and the stresses of vastly expanded RWSD operations to meet Project objectives. The Project succeeded in substantially strengthening the capacity and capabilities of RWSD as reflected in the level of confidence displayed in achieving construction and management programs, and the establishment of a workable scheduled maintenance program.

The review, however, did find that the piped water supply program, the Taung Zin Scheme, was behind schedule and had considerable cost over-runs. Some of its problems were attributed to lack of detailed appraisal, and to design being carried out in Australia rather than Burma. This component is unlikely to provide an acceptable economic rate of return, and therefore is only justifiable on humanitarian grounds.

The BVWSP was an extension of a rural water supply program commenced by the Burmese Government in 1952 to provide Dry Zone villagers with a safe, adequate water supply, thereby reducing the incidence of water-related diseases and improving health and productivity. UNICEF was also involved in the Project in supplying drilling rigs.

The IDWSSD[2] target of providing a safe adequate water supply for 50% of this population by 1990 was adopted by the Burmese Government and this was the basis of the request to Australia for assistance. A water sector consultancy company, Coffey and Partners Pty Ltd, was commissioned by AIDAB to undertake a technical feasibility study, and to manage the work.

Technical Achievement

Well drilling was completed with a 90% success rate, despite numerous problems—notably with serviceability of drilling rigs. Pumps and engines were installed on 76% of successful wells. However there were shortages of cement and of pumping units, and while tubewells were being maintained there were problems of organisation and spare parts supply.

Technology Transfer

The transfer of technology was successful across a range of areas including well drilling, pump and engine installation and pump operating techniques. While problems occurred with transfer of maintenance skills, these were due mainly to inadequate planning for a scheduled maintenance program. This was put in order and the RWSD has implemented a program of regular scheduled maintenance for tubewell pumps and engines. The logistics of this operation were complex, but the institutional capacity of the RWSD has expanded appropriately to implement the program.

Transfer of procurement and supply techniques was slowed by existing stores procedures and by delays with delivery of imported equipment and spare parts. Eventually, virtually all supplies became available for their intended use.

Transfer of technology related to the piped water scheme was not fully effective. Although there was extensive technical assistance, successful transfer of technology for the completion of the scheme will require further Australian inputs.

[1]The Kyat officially fluctuates around K7 to $A1 A rate of K20 or more occurs on the unofficial market.

[2]International Drinking Water Supply and Sanitation Decade.

Sustainability

Sustainability depends to a large part on the durability of the technology which is being transferred. This in turn depends on the RWSD retaining personnel with the skills required for tubewell development and management, and on the further development of these skills. The organisational structures required at institutional and village level are well advanced. Future development assistance should promote this process.

Economic Analysis

The project came close to achieving the estimated economic rate of return of 20% for its tubewell component. However, the Taung Zin scheme, as predicted, had a very low rate of return. This suggests that a more detailed investigation of alternative technology was needed.

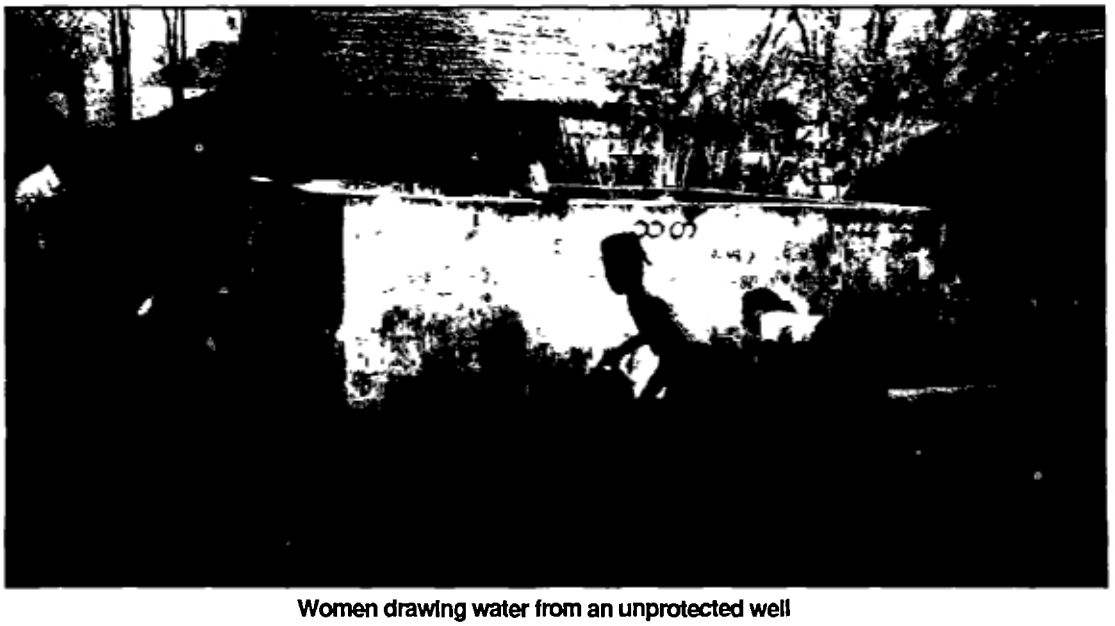
At the village level, although tubewells are not used year round and their use does not account for total domestic water consumption, the benefits appear substantial. Capital and operating costs were such that the small level of net benefits received made the well worth while in most instances. Nevertheless there was scope for increased usage and for further improvements in productivity to increase net benefits.

Project Impact

In a water supply project, impact is difficult to assess. Although the expected impact on health was not measurable, it was considered that if used in conjunction with support programs in health and sanitation education, increased water supplies would help improve health. While women, men, and children collected water, a central role of women in domestic water use was identified.

Increased productivity was also difficult to measure, but the well users were very positive about the perceived improvement due to the use of tubewell water. There was a significant reduction in the amount of time taken to get water and the time saved was used productively.

One very evident impact of the project was that on the RWSD of the Agricultural Mechanisation Department (AMD). Personnel tripled during the project and institutional expansion at organisational, managerial and technological levels successfully enabled the capability and capacity of the RWSD to meet project demands. This was achieved with considerable flexibility as the emphasis of the project changed from construction to ongoing maintenance. However, the resources of the Division were overstretched, indicating that consultants and advisers need to be more responsive to the Burmese way of doing



Women drawing water from an unprotected well

things if the results of the project are to be sustained.

Project Extension

The Australian Government has been requested by the Burmese Government to extend the project. A further 1750 new tubewells are planned, together with the rehabilitation of 1800 existing ones, and the continuation of the Taung Zin Piped Water Supply Scheme.

The objective is to extend the provision of safe water sources to 50% of the rural Dry Zone population by the end of 1990 in line with the IDWSSD target. This will involve the provision of appropriate and sustainable technology, and the development of institutional infrastructures within Burma.

At the time of the review, Australia had provided substantial assistance to the rural population of the Dry Zone of Burma, through the provision of equipment and technical expertise. The assistance enabled the development of the ground water resources industry, as well as the institutional capacity of the AMD, and provided the target population with a safe, reliable water source.

Carrying water by the traditional method, with new water pipes evident in the background

INTRODUCTION

AUSTRALIA has considerable experience in all areas of development for the exploitation and conservation of groundwater. With sedimentary basins covering nine million square kilometres of its continent, Australia has extensive expertise in water drilling, hydrographic surveys, training, and drilling and pumping technology. Thousands of remote bores provide water for people, stock, and irrigation. They utilise technologies well adapted to arid areas of the developing world.

In the late 1970s, the World Health Organization of the United Nations declared 1980–90 as the International Drinking Water Supply and Sanitation Decade (IDWSSD), following surveys which identified clean water as a major constraint to health in developing countries. (The background to the IDWSSD is given in Appendix 1.)

The Burma Village Water Supply Project (BVWSP) was initiated by the Burmese Government as an important element of Burma's contribution to the IDWSSD. The Burmese Government had set a target for the provision of safe drinking water to 50% of its rural population, involving the construction of 13 500 new village water supplies by 1990. To meet these targets, the Burmese sought Australian assistance to extend the rural water supply. They placed special emphasis on increasing national self-reliance in the production of equipment and materials.

Following consultations with Burma, a technical feasibility study was conducted in 1977, which concluded that the Project would have a positive impact on the social and economic welfare of the village population of the Dry Zone of Central Burma. The Project was undertaken jointly by the governments of Burma and Australia, with some assistance from UNICEF.

The Project was intended to provide an estimated two million people in the arid zone of Central Burma with a safe, adequate water supply (estimated by Burma at 36–46 litres per person per day). The Project objectives were to reduce the incidence of water-related diseases among the villagers, resulting in a general improvement in health and nutritional status, and a reduction in the physical difficulties of fetching water from long distances in the dry season. The Dry Zone of Central Burma is unusual in south and south-east Asia in receiving extremely little rain for five months of the year. Further, its sandy soils retain little wet season water.

The 1977 study found that the Burmese had the necessary technical and logistical competence for the Project, that they could obtain the necessary staff to carry out the project with minimal external assistance, and that they had the financial capability to pay for its local cost component.

At that time, UNICEF was already providing assistance for a Dry Zone tubewell project, which involved the provision of drilling engineers and hydrogeologists as UNICEF advisers. A decision was made to coordinate Australian assistance with that already provided by UNICEF.

The Project was to provide 3100 tubewells in Dry Zone villages from 1978 to 1986, and to rehabilitate and expand the existing Taung Zin Piped Water Supply Scheme which used water pumped from the Irrawaddy River.

A Memorandum of Understanding (MOU) signed between Burmese and Australian governments specified Australia's contribution. Australia was to provide:

- drilling rigs and ancillary equipment for developing 1850 village tubewells;

- pumps, pipes and other materials for the Taung Zin Scheme;
- technical assistance to support the Burmese personnel working on the Project; and
- ongoing evaluation and monitoring of the Project's performance.

Under the MOU, the executing authority for the Australian Government was the Australian International Development Assistance Bureau (AIDAB). AIDAB appointed Coffey and Partners Pty Ltd to implement its commitment to the Village Water Supply Project. The implementing agency for the Burmese Government was the Rural Water Supply Division (RWSD) of the Agricultural Mechanisation Department (AMD) of the Ministry of Agriculture and Forests. The UNICEF contribution to the Project was managed through their office in Rangoon. Responsibility for overall development and direction of the Project was with a Project Coordinating Committee (PCC).

The anticipated economic rate of return of the tubewell project was 20%. The Taung Zin project return was less than 5%, justifying that component only on social welfare grounds.

The foreign exchange component of the project was met jointly by the Australian Government and UNICEF. The Australian financial contribution until 30 June 1986 was just under $A38 million.

The Project was monitored by RWSD and Coffey and Partners in terms of drilling and pump installation performance, while the Institute of Economics in Rangoon carried out two major monitoring surveys, assisted by the monitoring and evaluation consortium. In late 1985 a full review was carried out by a team comprising representatives of the Burmese and Australian governments.

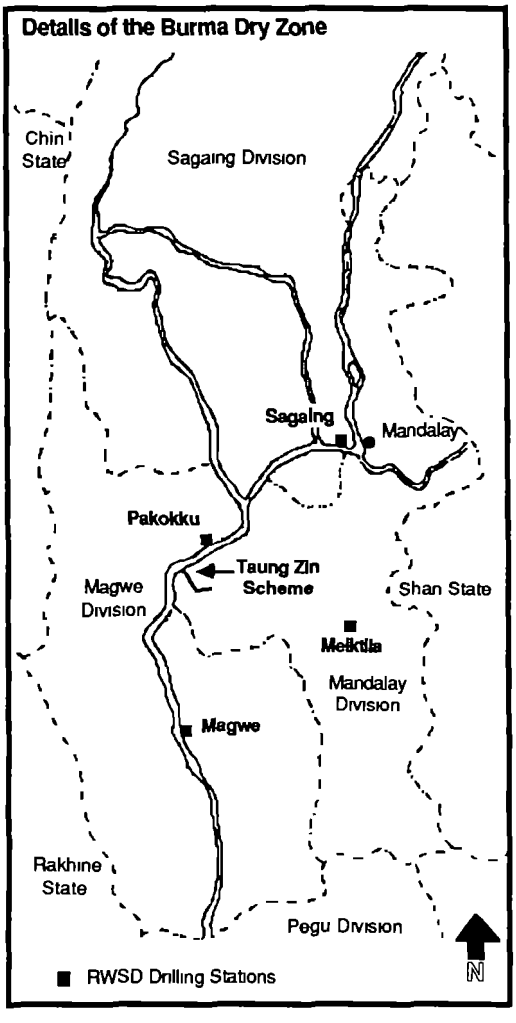
The Burmese Government has applied to the Australian Government for funds to extend the project to 1990. The review is considered essential to enable consideration to be given to the proposal.

Village women attending a formal opening of a new water supply

THE PROJECT SETTING

The Dry Zone

The focus of Project activities is the Dry Zone, which comprises the northern part of the flat plains of central Burma. It covers most of the three divisions of Mandalay, Sagaing and Magwe shown in the location map at the front of this volume.The Dry Zone contains around one third of both the area and the population of Burma. Thus about 11.7 million of the national population (34.04 million in 1983) live in this Dry Zone which is shown in more detail in the map on this page.



The Dry Zone has a pronounced and variable dry season from November to March–April during which little or no rain falls (Figure 1). Unlike the remainder of Burma, it gets little rain in the cool season. The average annual rainfall over five regions in the Dry Zone is 758 mm but this figure hides wide and unpredictable variations.

The soils of the Dry Zone are generally light sandy or gravelly and almost structureless. The clay content and water holding capacity is low in most areas and as a result surface water is difficult to impound. As a result wells and streams dry up very rapidly in the dry season.

Water Availability and Use

During the dry season, water may be carried long distances, and often relatively small quantities are available. A considerable amount of time of all household members may be devoted to carrying water. Professional water carriers also sell water in most villages.

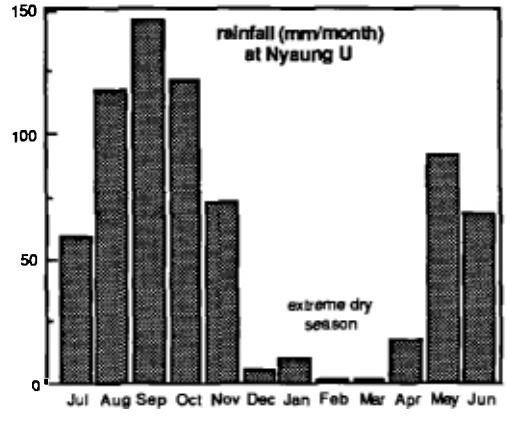


Figure 1. Average monthly rainfall (mm) at Nyaung U for 1970–83

Villagers in Burma differentiate between water used for drinking and that used for other purposes. Drinking water is from traditional sources or tubewells. Usually it is kept in earthenware jars inside the house and is always filtered and allowed to settle before use. Waste water is generally disposed of within the household compound, and is often used as drinking water for livestock.

Villagers are aware of water quality, and of the relationship between water and health. This awareness is expressed through some of their practices, such as drinking boiled water as tea, and washing hands before meals; however, handwashing after defaecation is not uniformly practised and washing habits vary enormously. An awareness of the association between certain diseases and water is evident in the classification of diseases according to season. It is generally believed that diarrhoea and dysentery are common at the beginning of the wet season and eye infection and skin diseases in the dry season.

In rural Burma there appears to be no strict division of labour beyond the domestic sphere, and in occupational roles there appears to be no specific gender-based specialisation. Thus, activities such as water carrying are the responsibility of both women and men; however, women are responsible for the use and management of water within the home, and so have a large impact on the water-use practices of the household.

Health

The Burmese People's Health Plan (PHP) recognises that sanitation, disease control and health education are important components in water supply programs. Health indicators show considerable improvements in general health in recent years: infant mortality, for example, has decreased from 13% to 4.5% since 1961.

In Burma several interlocking health institutions offer basic health services to rural areas. It is the aim of the Rural Health Department, in consultation with the RWSD, to follow the supply of water with health programs in health education and sanitation. Most villages have a midwife and many have volunteer health workers. Their duties are complementary. The duties of the health worker include home visits to check hygiene conditions in the house and compound, and encouraging the care of water storage facilities. The midwife focuses on women and children. Her duties involve regular visits to encourage proper use and storage of drinking water.

International experience with rural water supplies shows that improvement of water supplies is unlikely to result in a reduction in disease without support programs in health education and sanitation. Consequently, target populations need to change their habits and behaviour towards water collection and use where necessary, to reduce their exposure to contaminated water before improvement in their health status can be expected. Women are a key to such changes.

Society and Religion

Burma has over 100 indigenous groups and a variety of languages is spoken. While most religions are represented, approximately 85% of the population is Buddhist and Buddhism is a pervading force in the social, political and economic history of Burma. Buddhist values

A villager carting water

influence development, and the use and management of water, and therefore are of interest in the BVWSP.

A religious belief which has a direct bearing on the BVWSP is the merit associated with the act of giving water. To donate water to anyone other than one's family is a merit-making deed. The nobility of water giving is so strongly felt that the RWSD engineers associated with the project said that they particularly enjoyed their work because it involved the act of giving water. In some villages when a well-to-do member of the community engages in fund raising for water or is engaged in some religious ceremony, those who cannot afford to be involved financially give their labour free so that they too may share in the merit. This belief may partly explain why there appears to be little difficulty for most villages to raise sufficient funds for the construction of a water tank, and why some wealthier people are willing to donate quite large amounts of money. It may also partially explain why some villages set water charges in such a way as to enable poor members of the community to have access to tubewell water.

The Economy and Resources

Burmese development efforts since 1974 have been characterised by social and economic policies aimed at minimising foreign involvement, and maximising indigenous knowledge and skills. Buddhism, the focus of cultural, social and economic, as well as religious life, provides the guiding principles in this development process. Its adherence to these principles makes Burma unusual in the developing world: it has built upon its own resources to achieve development on its own terms without sacrificing traditional value systems.

Burma has a centrally planned and regulated economy with a policy of nationalisation of major industries and the use of indigenous skills and resources.

The Kyat is the unit of Burmese currency. It fluctuates in value around K7 to $A1 (average K7.2 over 1979 to November 1985), but a rate of K20 or more occurs on the unofficial market.

Agriculture

In the mid 1970s, the emphasis of Burmese Government policy moved to an agriculture based economy with industrialisation focused on import substitution. Policies included:

- increasing agricultural production through improved inputs and techniques
- increasing the domestic processing of agricultural products
- using international aid and loan money for public investment projects.

These policies have been more successful than earlier policies, and Burma's economic performance shows a real growth of GDP averaging 5.9% a year over the five years to 1985, or 3.9% per capita. The agriculture sector performed better than any other major sector with the value of net production rising an average of 4.8% annually since 1977. Burma's exports totalled K33726 million ($A4818 million) in 1983–84 of which 78% were agricultural products, mainly rice[1].

Since 1977, agricultural policy has aimed at increasing crop yields and areas sown. There has also been a policy of diversifying the crops planted in order to broaden the rural income base and to expand the range of agricultural exports. The Dry Zone regions affected by the BVWSP are targets for this policy, and in recent years production and yields of the new (non-rice) crops have grown (yield has increased by around 7% *per annum* since 1977). The potential for improving rural incomes in Dry Zone areas as a result of this growth is considerable.

The Dry Zone is also important since it contains about half of Burma's livestock, which are used for meat, milk, hides and other products as well as for draught purposes. Several programs have been introduced to increase livestock output in recent years and their numbers have grown rapidly. Per capita consumption of meat and dairy products has risen markedly.

[1]Since this evaluation, export prices and economic growth have fallen substantially.

Village and Community Participation

Villages in the Dry Zone were involved in the planning and implementation of the BVWSP in a variety of ways. Village Tract Councils were involved in the selection of villages targeted for tubewells. The criteria for selection were:

- size of population
- health status
- degree of scarcity of the water and the distance of travel to fetch water during the dry summer months
- wide geographical distribution
- ability of the village to contribute to the cost of the water supply system
- cost per head of the installations
- assurance of responsibility for operation, maintenance and normal repair of the system
- willingness to cooperate with the support sector agencies in the promotion of health, sanitation and education.

There was considerable village involvement in the project implementation stage. Village Water Committees were formed to collect funds from the community for the construction of holding tanks and pump houses. These committees also determined appropriate water charges, their means of collection, and established a system of accounts. They also supervised water distribution, paid the pump attendant, and arranged and paid for fuel supplies. There was a strong feeling within these committees of ownership and responsibility for the water supply.

There is a technical infrastructure within villages which provides skills for an impressive range of trades and crafts. Many of the domestic products used in Burmese life are produced in a variety of cottage industries found in the villages. Unlike many other developing countries, Burma appears to have a tradition of craft-based technical skills and a regional spread of industrial trade skills. There are many economic activities which provide essential sources of income for families in the Dry Zone especially at times of the year when the demands of agriculture are reduced. These skills provide a sound basis for the operation and maintenance of the engines and pumps.

Technology and Project Inputs

Burma has an ongoing policy aimed at reducing foreign domination of the economy. This emphasis on self-reliance has hastened the development of a number of light industries to help meet local demand for products. In the water sector, there is an active program for local production of tanks, pumps and engines.

The BVWSP requires energy to pump water, except in the few instances where artesian water is available. Burma is virtually self-sufficient in primary energy and imports almost no petroleum fuels. Its energy production potential from hydro, natural gas, oil and coal reserves is considerable. However total crude oil production has been static at 10 to 11 million barrels per year since 1979, although known oil reserves are considerable, and there is surplus refining capacity. Therefore, the major constraint to increased petroleum fuel supply appears to be the extraction of crude.

While crude oil production has been static in recent years, demand for petroleum fuels has increased considerably. As a result, market prices of these fuels have increased substantially over the period in relation to the official price. Diesel is allocated to Township Councils at an official price of around K1 per litre. However, there is a considerable private market in fuel, and diesel costs K5 to K6 per litre in rural areas.

Allocations of fuel to villages with tubewells were very variable (both between villages and over time), and ranged from those who got all fuel from government allocation to those who got none; however, there was no case seen where pumps were not operated because villages were unable to pay for fuel.

The villages that were to receive tubewells through the BVWSP had to provide, from their own resources, a tank and pumphouse.

Cement is an essential requirement for their construction. Burma produces its own cement, and, at times, the export of cement has conflicted with domestic need, causing fluctuation in domestic supplies, and there have been severe shortages from time to time. Although cement production has been fairly static, supplies of cement for the domestic market now are increasing.

The Institutional Setting

The Constitution of the Socialist Republic of the Union of Burma, promulgated in 1974, created a one-party system of government with an elected People's Assembly to review the working of the central power organs. The existing administration consists of an infrastructure ranging from the People's Assembly down to the Village People's Councils[1], the smallest official government unit.

Development Planning in Burma is of a consultative nature involving technicians and people's representatives to the level of the Village People's Council. Development is organised according to a series of Four Year Plans. The fifth Four-Year Plan commenced in April 1986.

Organisational Structure

The organisational structure for the implementation of the BVWSP, shown on the next page, identifies the primacy of RWSD in the project, with involvement from AIDAB and UNICEF, and highlights the emphasis on coordination.

The BVWSP is unusual in its organisational approach. The responsible line agency (RWSD) implements, and is responsible for the Project. Thus the Australian component of the Project consisted of technical and commodities assistance which enables the agency to implement the rural water supply program.

The coordination of project activities was intended to occur through a committee comprising Burmese Government departments, international organisations involved in the Project, the Australian Embassy and AIDAB representatives. The effectiveness of this committee as a coordinating mechanism across departments and involving other external agencies involved in the rural water sector in the Dry Zone, is evident from the scarcity of its meetings (three over a period of ten years).

Three divisions of the AMD other than RWSD became involved as the Project developed and priorities changed. The divisions and their responsibilities were:

Division	*Responsibility*
Works Routine	Maintenance Scheme
Administration	AMD Training School
Equipment & Stores	Stores Function

There were four RWSD drilling stations in the Dry Zone, each controlled by a station engineer who had responsibility for all project activities within his area except for the Taung Zin Scheme.

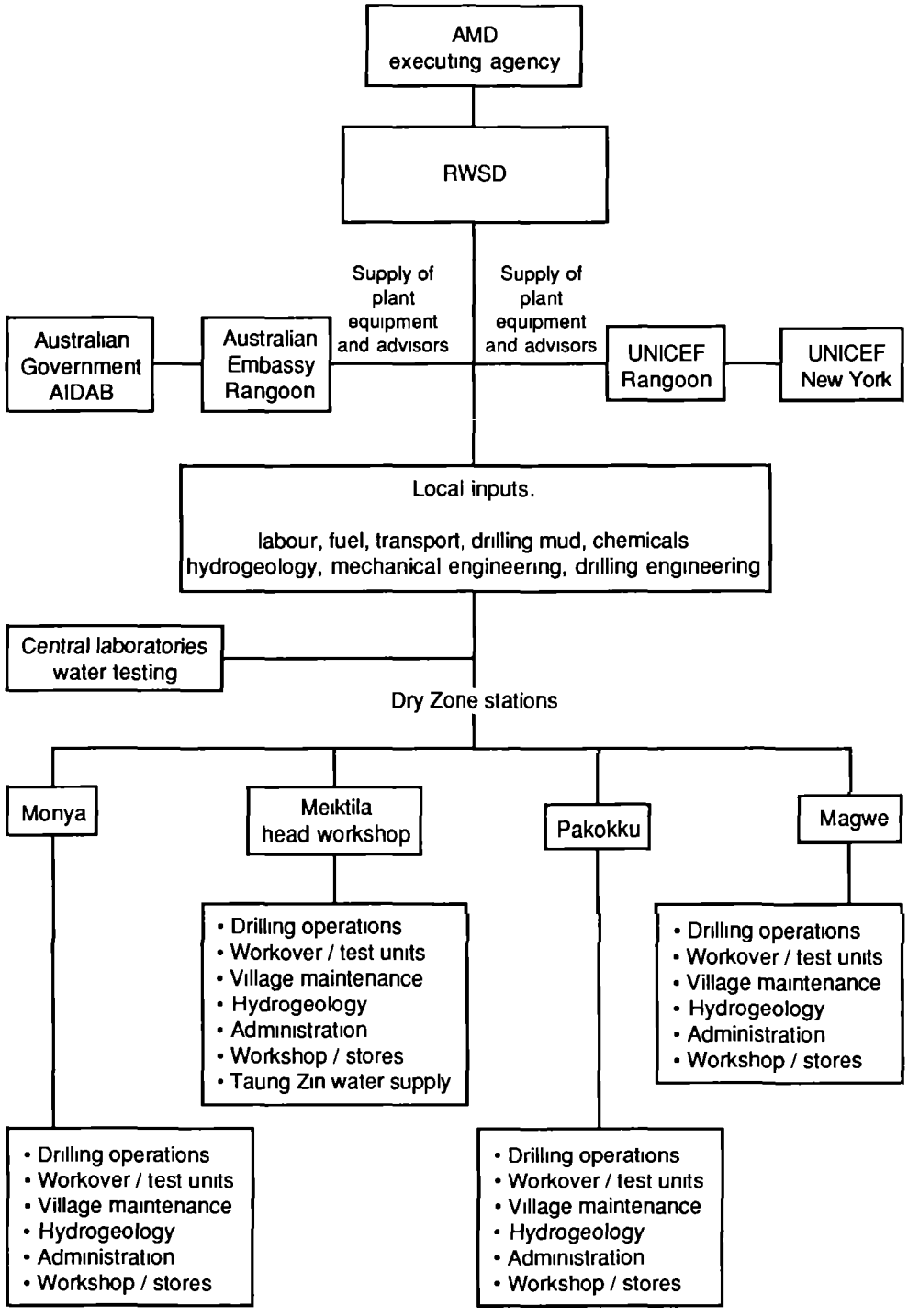
Through the Project the RWSD underwent a large increase in size and function. In October 1984 the government approved a new organisational structure and staff establishment, increasing its staff numbers from 469 to 1416.

At the commencement of the BVWSP the strength of each RWSD station was 83 staff. It was expected that project activities would more than double the staff requirements, but details of establishment and recruitment by the RWSD were not available until later in the Project. Shortages of skilled personnel were identified by UNICEF in its mid-program review as being responsible for significant shortfalls in physical targets in all activities. The implementation results which were achieved under these circumstances of reduced staff were commendable, and indicative of flexible and innovative management and the capability of RWSD to meet implementation targets.

The RWSD was also responsible for implementing the Taung Zin piped water

[1]Small villages are grouped into 'village tracts' which usually comprise 2–5 villages and share one People's Council.

Organisational chart for implementation of the Burma Village Water Supply Project



supply scheme. It was intended that RWSD should become responsible for the operation and maintenance functions for this scheme, bringing to the organisation several important functions which had not previously been performed.

The Taung Zin Water Supply Extension Scheme

In 1956–57, the Ministry of Agriculture and Forests constructed a pipeline and installed water pumps to deliver water from the Irrawaddy River to an experimental sprinkler irrigation scheme near Nyaung U. The scheme proved to be impracticable and was suspended until 1963–64 when a 24-kilometre piped water supply was installed by the Irrigation Department. The Taung Zin water supply was transferred to RWSD in 1965.

An extension to the original scheme was appraised in the 1977 BVWSP Technical Feasibility Study and work commenced in 1983–84. The extension scheme was designed to provide 119 000 villagers in 103 villages with 46 litres of treated water per person per day. Detailed civil design and equipment specification were carried out under the BVWSP.

The scope of work included:

- route survey and pipeline construction;
- an improved water intake structure on the Irrawaddy River;
- a water treatment plant;
- construction of 14 pumping stations with operators' quarters at each station;
- construction of 14 reservoirs and upgrading and roofing of four existing reservoirs and some small tanks; and
- construction of an electricity sub-station, upgrading of power lines and installation of communications and control cable between pumping stations.

Project Monitoring and Evaluation

Project monitoring and evaluation occurred in two related phases. The first was the on-going monitoring and evaluation of performance during the Project. The monitoring and evaluation system was a requirement of the MOU and had to be mutually acceptable to both governments. It was undertaken by a consortium headed by Coffey and Partners

Loading an oxcart from a correctly finished well with pumphouse and covered tank

Pty Ltd, with the Institute of Economics at the University of Rangoon as the counterpart agency for Burma.

The information collected by the Consortium was then used as an input into this evaluation.

Hypotheses and important assumptions were tested using a variety of methods. The main activities of the monitoring and evaluation Consortium included:

- a baseline socio-economic survey in 1979 of 159 villages and 7500 households;
- a follow-up survey in 1982 of the baseline sample;
- regular collection of progress indicators and socio-economic data from field visits;
- training of Institute of Economics staff on survey methodology;
- project reviews in 1980 and 1985; and
- a socio-economic survey in 1983.

The Review of the BVWSP was conducted between 6 November and 11 December 1985 with a two-week period spent in villages in the Dry Zone interviewing and examining tubewell records. The Review Team comprised seven representatives from the two governments, jointly led by a Burmese and an Australian representative. Disciplines represented on the Review Team included engineering, economics, social anthropology, project planning, management, and appropriate technology.

The objectives of the Review were to:

- assess the achievements of the Project in terms of the Project's objectives set out at the time of project design;
- assess the impact of the Project on intended beneficiaries;
- review the effectiveness of the Project on technical, economic, social, institutional and environmental grounds;
- ascertain the efficiency with which the Project was being implemented especially in terms of its cost effectiveness and ability to meet specified targets;
- recommend future directions for the Project for 1986–90; and
- comment on the proposal before the Australian Government in the context of the evaluation's recommendations.

The Review Report was drafted in Burma and completed in Australia. Full details are in the report prepared for the Burmese Ministry of Agriculture and Forests and AIDAB[1].

[1]Burma Village Water Supply Project: Evaluation. Final Report, May 1986.

THE TUBEWELL COMPONENT

THE Project's activities for the tubewell component of the BVWSP embraced:

- tubewell drilling
- pump and engine installation
- maintenance program
- procurement and supply
- training and technical assistance.

Tubewell drilling

Australia undertook to supply casing and screens for the equipping of 1850 tubewells, together with drilling bits, drilling mud, geophysical loggers and other miscellaneous items.

UNICEF undertook to provide the 12 drilling rigs used during the project. Each rig comprised three vehicles mounted with either a rotary drilling rig, a water tank and cargo carrier, or a compressor and workover unit. An annual provision was made for spare parts and materials. The 12 new drilling rigs were of the mechanical rotary table type, rated for drilling to 460 metres. Two rigs arrived in May 1979, and 10 the following August.

Adequate servicing of the rigs was a significant problem: a number of units were out of service for lengthy periods because of incomplete maintenance, poor drilling mud control and improper operation of the rigs. Lack of spare parts resulted in delays in returning units to service after breakdowns. With the difficulties experienced with rotary drilling rigs, RWSD placed heavy reliance on existing water jet rigs to achieve targets. AIDAB provided parts to upgrade these rigs, but the rigs quickly ran into difficulties handling the drilling fluids being circulated. Australia subsequently provided two new drilling rigs and a variety of equipment and spare parts.

The Project achieved near target drilling rates until 1983–84. The slow down resulted from difficulties in obtaining adequate fuel supplies and lack of spare parts for the rigs. Following the delivery of additional spare parts for the rigs and the allocation of reliable fuel supplies to drilling crews in April 1984, drilling rates returned to near target levels.

Table 1 sets out BVWSP drilling performance against targets. The BVWSP maintained an average drilling rate of 471 wells per year over a six-year period, with a 90% drilling success rate. A 'successful' well was one which provided a sufficient groundwater supply. and sometimes included heavily mineralised or saline wells.

In achieving this success rate, RWSD staff overcame numerous technical problems, many relating to drilling fluid technology. Based on past experience and knowledge gained from training, RWSD is confident it can overcome drilling problems which may occur in the future.

Table 1: BVWSP tubewell drilling performance.

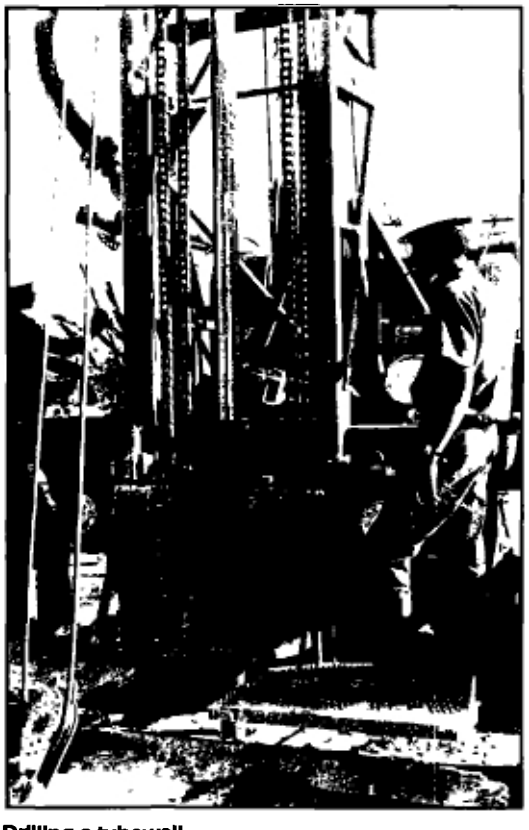
Year	Number of successful wells	% of target	Av. popn for each well
1977–78	95	95.0	525
1978–79	261	87.0	806
1979–80	393	98.3	1037
1980–81	547	99.5	1129
1981–82	600	100.0	1110
1982–83	340	97.1	1019
1983–84	229	65 4	924
1984–85	420	93.3	1125
1985 to Sep	97		555
Total:	2982	96.2	1018

The achievements of the drilling program were most satisfactory and are a tribute to the capability of the RWSD.

Pump Installation

Before 1977 about 90% of tubewells in the Dry Zone were equipped with hand pumps. The recommendation in the 1977 Technical Feasibility Report was for more efficient helical rotary pumps with diesel engines. Established procedure was for the village community to construct a pump house and a 27 000–46 000 litre holding tank prior to pump installation. Once these facilities had been completed, pump installation was carried out by RWSD crews.

Pumping units were supplied by Australia and UNICEF. Whereas Australia supplied only helical rotary pumps, UNICEF generally provided air compressor units. Air compressor pumps were cheaper and easier to maintain than helical rotary pumps; however, they can operate to a depth of only 46 metres (150 ft) and their efficiency is very low at this depth. Their low efficiency results in high operating costs, and they have a short life span. Recent UNICEF supplies have included helical rotary pumps of German origin, but their quality has not been up to the standard of those supplied by Mono (Australia).



Drilling a tubewell

Figure 2 compares actual pump installations on tubewells with annual targets. Because of the slow delivery of pumping units during the initial stages of the project, installation lagged behind drilling until late 1979. In 1979–80, and again in 1980–81, the Burmese Government undertook accelerated pump installation programs, which cleared the backlog, and pump installations exceeded targets between January and October 1981. However there were instances where holding tanks were of inferior quality or had not been built at all.

Over the period, an average of 76% of successful wells had pumps installed (Figure 2). At the end of the 1985–86 period the shortfall of pump installations to successfully drilled wells was 716. The major constraints on pump installations resulted from shortages of cement for the construction of holding tanks and pump houses, and delays in the supply of shallow well pumping equipment.

Maintenance

During the early stages of project implementation the major emphasis of the BVWSP was on procurement of inputs, well

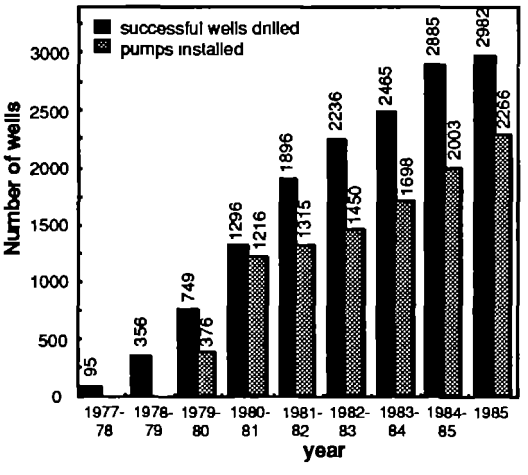


Figure 2: The cumulative number of tubewells drilled and the number of wells with installed pumps.

drilling, and pump installation using RWSD's existing capabilities. As the project matured, increased attention focused on overall project effectiveness, particularly the upkeep and maintenance of the water supply systems. By April 1982, pump breakdowns and delays in obtaining service emerged as significant problems. As the number of completed tubewells rose and the age of equipment increased, the issue of maintenance became a greater constraint.

About one third of villages reported to the monitoring teams that their pump had been out of service due to mechanical trouble. In most cases repairs were carried out by RWSD, but in 35% of cases pumps were out of use for more than 50 days. Drilling station equipment also suffered from high levels of down time while waiting for spares.

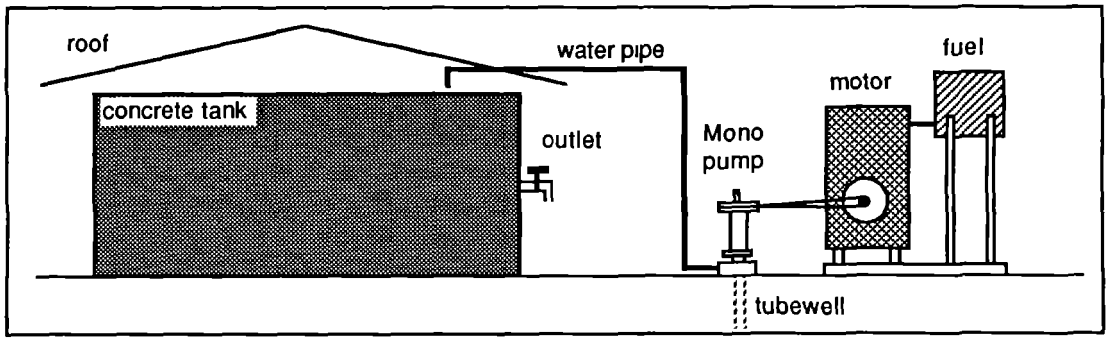
The Review Team found that drilling station workshops had an average of five pump motors in for repair at any one time, with a number of other unserviceable units in store awaiting repair. The predominant repair was for replacement of bearings and valves. Mechanics at the stations suggested that the quality of oil villagers were obtaining and the irregular usage patterns of the wells were major contributors to the condition of the motors. Clogged filters and strainers no doubt also played a part: a spot check of fuel and oil filters issued at Magwe Store during the review revealed that the maximum replacement of oil filters was around 20% of the manufacturer's specification, and 33% of the manufacturer's specification for fuel filters.

Upgrading RWSD's maintenance capability did not receive a high priority during initial project design, but as the BVWSP evolved, increasing attention was given to maintenance. Since the RWSD initially was concerned primarily with construction activities, an increasing maintenance load from the project required the introduction of new procedures and skills. The evolution of the BVWSP into more mature phases of implementation meant that a different type of support was required, including a need for human resource development, and institution strengthening to cope with new demands and functions.

From November 1982 a series of evaluations of the effectiveness of the BVWSP maintenance program resulted in the appointment of an Australian mechanical and maintenance adviser to assist RWSD mechanics to establish and implement a scheduled routine maintenance program and upgrade RWSD workshops. Since October 1984, RWSD has begun implementing a Work Plan to carry out systematic and effective repair and maintenance of tubewells and pumps at drilling station workshops, local Agriculture Tractor Stations, and the AMD workshop at Meiktila.

There have been delays in implementing the Work Plan due to the rapid growth and restructuring of the RWSD. Its success depends on the efficiency of the RWSD, on expanding training facilities for mechanics, and on the the continuing availability of spare parts.

The Review Team believes that Australia should support the work plan beyond the Project completion date. This support should be in the form of improving the AMD/RWSD proposals rather than introducing new items.



A scheme for the layout of a properly installed tubewell and water storage tank

Procurement and Supply

During the early stages of the project some delays in the delivery of Australian supplied equipment and materials were reported. On occasions inadequate supply documentation by the Department of Administrative Services resulted in delays in Customs at Rangoon resulting in demurrage charges. The delays were ultimately overcome.

A significant achievement for the Australian procurement program was the degree of standardisation which was achieved. Over a six-year period, Australia supplied a standard range of pumps and engines which were selected, and in some cases designed specifically for BVWSP conditions. Moreover, Australian supplied vehicles were standardised to the maximum extent possible. In contrast, equipment supplied through UNICEF was subject to international competitive bidding, which resulted in different suppliers for each contract. The outcome was a diverse range of equipment types and difficulties for RWSD in maintaining a suitable range of spares. All spare parts for pumps, motors, heavy equipment and workshop tools were provided by Australia or UNICEF.

There were proposals for changes in the stores procedures in the RWSD. For example, a change in the current ledger system of stores control was suggested, but this would have necessitated a change in the AMD stores audit procedures which could not easily be accommodated within the Burmese system.

There was awareness in RWSD management that improvements were possible, but not likely until other factors outside the control of the Project were adjusted. Nevertheless, the close control of the AMD/RWSD stores system has ensured that virtually all project supplies were available for their intended use.

There is a continuing Australian commitment to provide spare parts for the Project for up to 20 years. One of the lessons from this Project is that an initial commitment to hardware supply is of little value to the recipient unless a long-term commitment to the provision of spare parts is given beyond the life of the Project. Burma may purchase spare parts directly from Australia within the lifetime of the equipment provided by Australia. Opportunities for trade links in spare parts therefore need to be explored.

Burma has begun producing diesel engines and conceivably will ultimately produce pumps. It is recommended therefore that any commitment to the provision of spare parts be reviewed every two years to allow for these growth factors to be taken into consideration.

Training and Technical Assistance

The 1977 Technical Feasibility Report emphasised that the Burmese agencies possessed a high level of competence with respect to the technology currently employed, and it was recommended that the new Project should be based on technology compatible with this capability. It was considered that, apart from limited operator training on new types of equipment, there were few training needs under the BVWSP and that these were in the area of on-the-job training by specialist advisers. However, the Technical Feasibility Study concluded that the RWSD needed assistance in a number of areas where they were understaffed or were not familiar with newer methods and technologies. Possible areas of Australian assistance were seen as a drilling engineer to assist with Australian-supplied rigs, and an automotive engineer. The MOU for the project specified a Project Adviser, an experienced engineer, who would visit Burma and the Project site as and when required, and a resident hydrogeologist. Nevertheless, as the project matured, increased attention was given to training activities, and Australia has agreed to fund training fellowships and to provide additional Australian personnel to enable expansion of on-the-job training. UNICEF planned to provide a drilling engineer and a hydrogeologist.

In November 1978, RWSD proposed a series of nine training courses for their personnel to prepare them for BVWSP activities and for three of these sought Australian involvement. Coffey and Partners ran training programs to improve installation and maintenance practices used at RWSD Drilling Stations, and a number of other short courses were conducted by Australian Project personnel. These

training activities were attended by large numbers of RWSD technical staff and village pump operators.

The resident Australian hydrogeologist for the Project provided on-the-job training to assist RWSD personnel with the establishment of a comprehensive groundwater data collection system based on geological regions. This appears to have been done by less structured on-the-job training.

The manufacturers of Australian-supplied equipment (Mono pumps and Petters engines) provided field instruction and training courses in installation and maintenance of the equipment. A review of the program in 1984 found that pump installation foremen developed high levels of skill and retained this learning over several years. Future major equipment supplies should include similar training courses.

A number of RWSD staff came to Australia on Project fellowships. There were problems with English language proficiency and inappropriate study programs, but practical work experience training programs were considered a success and further awards were offered.

The majority of training activities of the BVWSP were at the AMD Training Centre at Meiktila. A total of 2434 personnel were trained in 16 courses from 1982 to 1985, including four-month training programs for groups of 35 trainee drillers. Because a shortage of skilled training officers was a constraint, an expanded program was provided to allow the instruction of AMD/RWSD recruits in a wider range of trades.

Technical assistance was provided throughout the Project. Table 2 summarises the Australian staffing inputs for technical assistance. The 37 personnel provided assistance over a wide range of activities for periods ranging from five days to over four years.

There were clearly contradictions between the organisational structure, the manner in which developments took place, and the philosophy underlying the Project. The philosophy assumed that the capacity and capability existed within the RWSD to implement the Project with minimal assistance. The development of the capacity and capability of RWSD to perform its function could not be measured objectively. Nevertheless, the RWSD implemented the Project successfully, and within budget, though two years behind schedule.

In the early years of the BVWSP, there were no clearly defined responsibilities for training between UNICEF and AIDAB, and training activities were frequently provided according to needs perceived by expatriate personnel. Technical training was sometimes identified as a convenient 'solution' for problems which were in fact related to more fundamental management and procedural shortcomings. There was no institutional base in RWSD for training, so that expatriate personnel were used in a direct training role rather than to train trainers. This situation improved as the AMD Training Centre at Meiktila was provided with a permanent establishment of trainers.

More recently, training and technical assistance were directed at strengthening the RWSD, and the need for a carefully designed training program was identified. Australian advisers became more concerned with establishing improved procedures within the RWSD, and on-the-job training was provided to assist the effective utilisation of these procedures.

RWSD acquired a high degree of expertise in several areas, notably hydrogeology. The

Table 2: Australian staffing inputs for the BVWSP tubewell component until 30 June 1985.

Program	Personnel	Months
Tubewell—long term (3–51 months)	5	106.5
Tubewell—short term (5 days–1 month)	10	8.0
Monitoring and evaluation (10 days–6 weeks)	13	6.5
Company representatives (2-6 weeks)	9	9.0
Totals:	37	130 0

Division was aware of the importance of keeping abreast of changing technology, and favoured gaining experience overseas. It identified several specific areas where technical assistance and training were required (e.g. pneumatic drilling techniques). Such training, whether in Burma or overseas, had institutional support only where the training need was identified within the framework of Burmese policy, resources and values, and where training was perceived by those to be trained as being of some value.

Financial Performance

Construction Costs

At the time of the Feasibility Study in 1977, the cost of the tubewell component of the project in terms of foreign exchange was estimated at $A19.5 million for 1700 wells. After several revisions and two 12-month extensions, total project costs to Australia were estimated at $A37.7 million. Actual costs are set out in Table 3. Total Australian costs for the whole project were a little under the agreed $37.7 million.

The tubewell component remained well within cost estimates. The 1850 tubewells had cost $A32.3 million at the end of 1985–86. A population of 1.94 million people was covered at an average Australian installation cost of $A15 075 and a cost per head to Australia of $A14.34 or $A71.72 per household. It was estimated that use of tubewells by nearby villages could bring the population served to 3.5 million. On this basis, foreign exchange cost per head was $A5.60. In comparison with the 1977 estimates for 1700 wells, the financial performance of the tubewell component was very creditable. When adjusted for Australian inflation rates over the period, the financial performance in terms of the 1977 estimates was even better. The completed tubewell cost of $A15 075 (current prices) is 15% less than the 1977 estimates when adjusted for inflation.

Both the consultants and RWSD must share the credit for this financial performance. RWSD ensured that the materials supplied were used in accordance with the MOU, the degree of wastage was minimal and the physical targets were met.

The local costs on the tubewell project were substantial. Total costs for the 1850 tubewells are shown in Figure 3. The Burmese Government contribution was estimated at K41 million.

Table 3: Australian costs for the tubewell component of the BVWSP.

Year[a]	Current year prices ($A,000)	Australian consumer price index[b]	1977 constant prices ($A,000)
1977	146.9	70.1	146 9
1978	96.5	76.7	88.2
1979	2 981.1	83.0	2 517.8
1980	4 331.1	91.4	3 321.8
1981	5 265.4	100.0	3 691.0
1982	3 620.9	110.4	2 299.1
1983	4 952.6	123.1	2 820.3
1984	3 651 6	131 6	1 699.5
1985	3 962.4	137.2	1 241.1
1986[c]	3 290.0	142.0	457.4
Total	32 298.5		18 256.4

Notes:
a. Australian financial years ending June 30.
b. Consumer Price Index at June 30 each year.
c. 1986 figures are budgeted estimates.

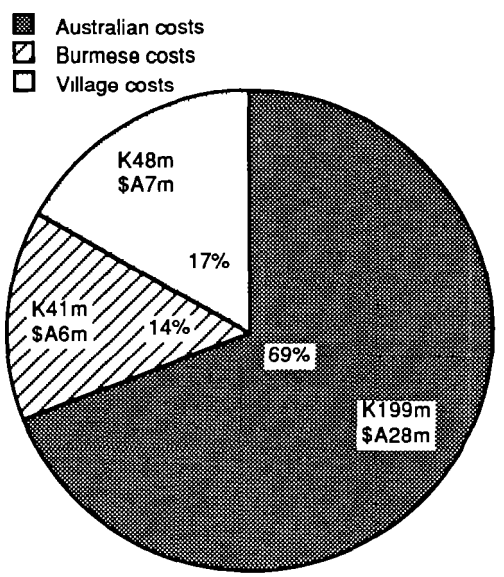


Figure 3: The contributions of the funding organisations to the costs of the tubewells.

The villages contributed to the construction of tubewells in several ways: labour for drilling activities; tank and pumphouse construction; and cost of drilling.

There was a range of preparation activities, and drilling time varied considerably. Assuming some organisational work, an average drilling and preparation time of 15 days and a wage rate of K7.00 per day, the average village contribution for labour for drilling activities was estimated at K2000 ($A286) per tubewell.

Costs for tank and pumphouse construction varied widely and an average cost per village was estimated at K16000 ($A860). This estimate included a component of non-cash costs such as donated labour.

The methods of mobilising the resources for the village contribution to the tank and pumphouse were extremely variable, and provide clear evidence of the autonomy of village decision making. The ability to pay for these facilities was a necessary condition for selection for a tubewell. It is not known how many villages did not receive tubewells because they could or did not wish to pay for the tank and pumphouse.

A decision has been made by the Burmese authorities to transfer the operation and control of tubewells to Village Cooperatives at a cost (to the village) of $A12 per metre (K26.50 per foot) of well drilled. The costs depended on the depth of well, but villages would pay an average of K7800 ($A1100) per tubewell. The initial understanding of the project given to villagers during the consultative process did not include this cost. This would raise the total cost to each village for construction of a tubewell to an estimated K25 800 ($A3686) or K125 per household of five.

The implications of Cooperative takeover were no doubt quite disturbing to villagers. The issue of who manages the tubewell requires further consideration by the Burmese Authorities. It is possible that if villages have to pay for the drilling of a tubewell where water is scarce, the aquifer deep, and populations small, it may be beyond the means of the village to have a tubewell. The transfer of management responsibilities of tubewells to cooperative societies under the existing policy has ramifications for the continued acceptance and success of the project. The Review Team considered that the idea of charging villages again, in addition to their already substantial contribution, was inadvisable. It is recommended that this decision be reviewed.

In July 1985, 17% of tubewells were not being operated. Reasons for this included diesel fuel shortages, water quality, distance from village and the fact that July is the period of lowest demand for tubewell water.

Operating Costs

Village control of a tubewell means that each village is responsible for its operating costs. These costs include: fuel (diesel and oil), pump operator, water donated to village institutions (up to 20% of consumption), and maintenance.

Fuel is the major cost. There are no data available on direct costs to villages for fuel to operate pumps but an estimate of tubewell efficiency was made and is set out in Table 4. An average of 68 litres of diesel fuel was required to pump 9000 litres of water. Diesel cost between K1 (government price) and K6 (open market price) per litre. The volume of water pumped varied enormously. The cost of pumping water is quite variable, according to the depth of the well, the type of underground aquifer, the condition of the well, screen and pump, and the pump type (helical or

Table 4: Tubewell performance for a sample of 34 tubewells

	Average	Range
Well depth (metres)	148	19–352
Volume (litres/hour)	15 470	6 825–27 300
Fuel consumption (litres/hour)	2.13	1.37–4.55
Fuel (litres/1000 litres of water)	0.15	0.05–0.33

compressor). Nevertheless, for most villages, the capital and operating costs were such that it would require only a relatively small level of net benefits to the village to make the investment in the well and the recurrent operating costs worthwhile.

Village Water Charges

There was considerable variation in the charges and the methods of charging for water. Some villages aimed only to cover costs, others made a small surplus to use for village social projects, while for some (especially those with high-yielding wells in water deficient areas) the well was seen as a village commercial activity. A few villages made a loss which was subsidised from other village activities. Charges were by volume (average: K0.61 per barrel; range: K0.25 to K1), or on a levy basis (average: K4 per month per household; range: K1 to K15). Some villages charged higher prices to outsiders.

Benefits

The economic appraisal of projects such as the Burma Village Water Supply Project has problems typical of projects where the objective was improvements in health and welfare, rather than a specified output which could be valued. Identifying the impact of a specific intervention (the water supply) is very difficult, and was made more difficult by Project implementation corresponding with a period of sharply rising Dry Zone incomes, and the considerable extension of health facilities and health education at the village level.

Actual or potential benefit flows are not possible to quantify in a project of this nature without very detailed research. However, if the project has acceptable rates of return over a range of probable benefits, then it is highly likely to be providing an acceptable economic rate of return, even though exact level of benefits is unknown.

The review team examined all available survey data on Dry Zone rural incomes, and estimated an average household income of K3000, or K600 per head. Figure 4 indicates the economic rates of return calculated under varying assumptions regarding benefits per head for people directly served and shadow prices of foreign exchange. It is noteworthy that even at a high shadow price of foreign exchange, the tubewell project returns are quite favourable. The range of benefits per head of K20 to K80 represents a range of 3% to 12% of estimated incomes. The 1977 Technical Feasibility Study assumed a benefit flow equal to 10% of incomes in estimating the rate of return at 20%. The actual returns might be higher than calculated since the population benefited by the wells is much larger than the population directly serviced.

The flow of benefits will not be uniform over the Project. Improvements in health education, general education and incomes are all occurring in the area, and these will undoubtedly increase project benefits over the years of tubewell operation. If benefits rise strongly in the future, rates of return will increase.

One very important criterion of perceived benefits of water supply is the extent to which beneficiaries are prepared to pay for the water. It is clear from the continued operation of the tubewells that villages are willing to pay for the facility. But this willingness is understandably much greater in the very dry periods when the cost of collecting water from other sources is much higher, in terms of time and opportunities forgone, than in the wet season. Assuming a water charge of K1 per barrel and water use of 45 litres per head per day, a five member household would pay K356 per year. This is around 10% of average

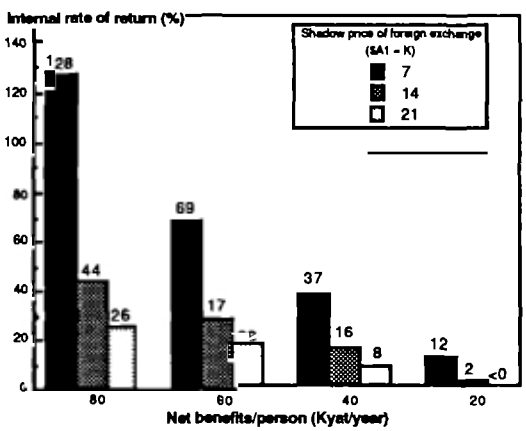


Figure 4: Estimates of the economic rates of return for the tubewell component.

household incomes: it is highly unlikely that a household at that income level would be prepared to pay for water when cheaper sources are available.

They might, however, be more prepared to pay more for tubewell water for drinking. Three per cent of the total water requirement is used for drinking. If tubewell water were considered 'safer' than water from other sources, it would be rational to use it.

One important benefit of the tubewells is the availability of water for livestock. In the very dry season, villagers have often had to move livestock to distant water sources. The availability of a secure source, even if at some cost, enables villagers to keep more livestock.

Project Effectiveness

The original Project objective was to provide villages with a year-round supply of safe drinking water from tubewells. This section reviews the effectiveness of the Project in meeting this objective.

Volume of Water Provided

The project attempted to achieve a yield of 45 litres per capita per day. Villages surveyed indicated that around 46% of tubewells in the dry season and 10% in the wet season pumped water for sufficient hours to provide this volume. Cost of pumping was the most common reason given (14%) for not pumping all year round. Field visits during the project gave a more accurate picture of engine operating hours, since engine log books were often available. The data in Figure 5 indicate that about 23% of tubewells provided the targeted water supply in the dry season and about 4% in the wet season. This is roughly half of what was claimed in survey interviews.

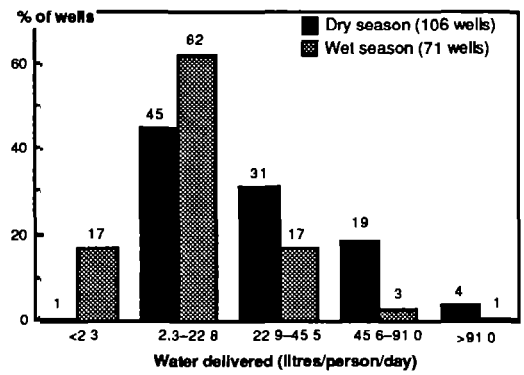


Figure 5: Tubewell water pumped each day for selected Dry Zone villages in both the wet and dry

From interviews with villagers and examination of pump operation records at the villages included in the Review, it appeared that there had been no increase in the quantity of water drawn from all sources since the above figures were compiled. Villagers appeared to be making the same number of trips to their water sources as they did prior to the existence of the tubewell. The tubewell cut down the time taken to reach the water source during the extreme dry season because it was closer than some of the more distant perennial sources traditionally used by villagers.

An aspect of water quantity which was not determined was the capacity of the various aquifers used by tubewell systems. It is thought that in most instances aquifers are capable of providing a lifetime yield which matches their current output. Work is currently under way to test this assertion.

Quality and Preference

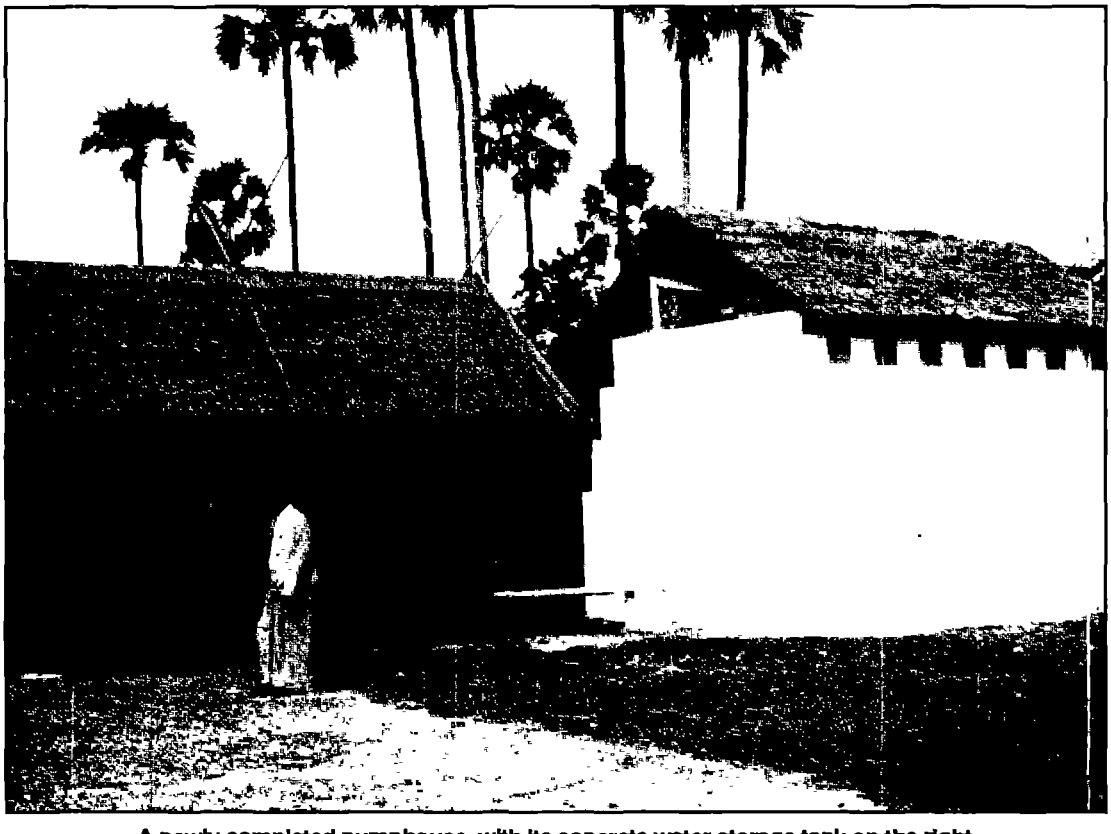
Water sampled during tubewell construction was tested for salinity only. Tubewell water was believed to be free of bacteriological contaminants and therefore was not tested for this at construction. Whilst there are many opportunities for water contamination at storage tanks, during transport and at storage containers in the house, the Burmese villagers appear to have a strategy to select water of various qualities for various functions, but their classification is based more on turbidity, colour and taste than on bacteriological quality. Complete chemical analysis done on some tubewell samples found that a high proportion of them contained a number of chemicals which were much greater than the WHO's highest desirable level, but generally within the WHO maximum permissible limit for consumption. Some wells, although delivering water, were found to be saline. These were still regarded as 'successful' since the water could still be used for washing or animals.

The goals of the project assumed that village committees would operate the tubewells year round to provide 45 litres of water per person per day. This assumption was only partially valid. Overall, people continued to use traditional water sources in the wet season when water was more or less fully sufficient. In the dry season, when there was insufficient water and as the traditional water sources progressively dried up, villagers used tubewell water. Whether this pattern was due to preference or because tubewell water costs money is debatable. What is evident is that people in the Dry Zone fully realise the hardships connected with water scarcity. Over time, they have developed a strategy for coping with water scarcity, one component of which involves developing new water sources, so that they have the security of several sources at any one time. Tubewell water is regarded as another source which fits in with existing water supply systems. What distinguishes it from other sources is that it never 'dries up'. This is considered the primary benefit, and thus tubewell water is used mostly in the dry season when other sources are dry, low yielding, contaminated or distant.

The Review and other related studies indicate that on the basis of their needs (including taste) villagers make a series of careful decisions about water: which water source to use and for what purposes, how to protect sources, how much water to use, and how to draw, transport and store water. In other words, they make evaluative judgments about their water sources in terms of perceived quality. Tubewell water is a choice in the scheme of things.

Access

The review team found that the village organisation ensured that tubewell water was accessible to all members of the community. This is reflected in the range of charging systems employed: in some villages the very poor are exempt from paying for water; in others the very old not only are not charged, but community members take turns in fetching their water. Problems of access could arise if



A newly completed pumphouse, with its concrete water storage tank on the right

the tubewell was located in an institution in or near the village, or where a tubewell located in one village was intended to service a number of villages scattered within the vicinity.

One study found that, over the period 1979 to 1982, the distance to primary source of water decreased. Moreover, people without a tubewell travelled significantly greater distances for water than did those with a tubewell (650 and 380 metres, respectively). This, however, reveals very little about user behaviour, since distance is not the only factor determining villagers' choice of water source.

Number of Beneficiaries

RWSD estimated that the population directly served by the 1850 tubewells under the BVWSP was 1944000 or an average of 1051 per well. Additional people were served in a number of ways: some wells supply health centres and schools which draw people from a wider area; some villages sell water to neighbouring villages. Thus the tubewell in many instances is also a village commercial enterprise. The Project has therefore benefited a far wider group than those directly served.

In terms of providing improved water supplies the BVWSP was successful. Before 1977, only 9.2% of the rural population of the Dry Zone had improved water supplies. By 1982, this had increased to 31.8% and was 37.6% by 1986. RWSD intends to continue its activities in the Dry Zone to achieve the Decade target of providing a safe, secure water supply to 50% of the population by 1990.

One Dry Zone Division achieved the Decade target with a coverage of 54.2%. The actual rural coverage for both Dry and Outer Dry Zones requires clarification but evidence suggests the Outer Dry Zone is lagging. With this in mind and the fact that UNICEF is already emphasising the Outer Dry Zone, there may be a shift in emphasis in RWSD/AMD necessitating a resource shift in future planning periods.

It is evident that the Project was partly effective: it did reach intended beneficiaries but not as planned. For reasons convincing to them, villagers integrated tubewell water into their existing system of water use habits and practices. This apparent contradiction between what was planned and what occurred was not due to lack of education or ignorance on the part of the villagers; rather it was a case of differences in information and its assessment.

Monitoring and Evaluation

The emphasis of the monitoring and evaluation was more on evaluation of project impact than on monitoring project inputs and outputs.

The monitoring and evaluation approach involved very broad and detailed surveys supported by field studies by the consortium. This was a common approach for project evaluation studies at the time. However, problems with processing data were encountered from the outset, and only a small amount of data was analysed in detail and after a considerable time lapse.

Since the design of this Project's monitoring and evaluation component, studies have shifted towards smaller, more tightly defined surveys with more timely results. The monitoring and evaluation exercise thus provided little of immediate use to the Project and its management, but it did provide a broad body of data which helped put the Project in context. The consortium thus partly achieved its objective of developing capacity for project monitoring and evaluation in a Burmese counterpart organisation, but in a rather restricted sense: it created a capacity for carrying out broad surveys.

Future project monitoring and evaluation may be better done through RWSD and the Department of Medical Research, perhaps with some technical assistance. The capacity and inclination for record-keeping are well developed down to village level and a useful first priority would be to bring together and analyse the government and village data already available.

TAUNG ZIN WATER SUPPLY

Construction

The Taung Zin Water Supply Extension Scheme commenced construction in 1983–84 and was targeted for completion in 1987–88, with RWSD responsible for its implementation. The Construction Corporation and the Electric Power Corporation also were involved. RWSD was responsible for controlling and monitoring the work and providing materials.

RWSD activities covering work undertaken up to the end of November 1985 included:

- pipe alignment, survey and line clearing survey for a total of 26.6 km (39% of the total survey work);
- pipe laying of 21.5 km (31% of total work);
- pressure testing, with 50% of the work being complete at the time of the review, and the remainder in progress;
- laying communication cable—cable had been laid and backfilled along the 24 km length of the old pipeline, and 8 km of the new line (57% of total work); and
- checking, repair and replacement of old pipeline (completed).

The Construction Corporation was involved in construction of reservoirs, pump houses and pump operators' quarters which were in varying stages of completion; largely complete in the case of pump houses and living quarters.

The Electric Power Corporation was responsible for construction of a mains electricity supply along the pipeline. It was scheduled to be completed in 1985–86, although problems with installation of power poles delayed completion.

There were numerous constraints on the completion of this scheme. They included:

- pipeline alignment—the original line survey had to be altered causing delays in pipe-laying activities;
- reservoir sites—sites had to be moved due to unsuitable soil types;
- delays in pressure testing (which occurs before backfilling can take place) permitted supporting sand to be blown or washed away; and
- the availability of materials at different times caused variations to work programs for the completion of targets at Taung Zin.

A major constraint on the Taung Zin Project was the design of the treatment plant. It was originally designed in Australia and proved to be the cause of some problems which could have been avoided had it been designed in Burma. It is questionable whether such a plant was warranted so early in the project, or whether the total system should have been made operational and the treatment works added at a later date. The treatment plant design required techniques and skills not used before by RWSD. An expert should have been involved in the design and construction of the treatment plant in Burma, from the start of the Project.

Technology Transfer

The complexity of the Taung Zin Piped Water Scheme and the complicated procurement requirements required considerable technical assistance. New technology was introduced to RWSD, and short-term Australian advisers

were provided to assist with technology transfer. Seventeen personnel were involved for periods of around one week to three months, but accurate details of time spent by assistance personnel on the Taung Zin Scheme are not available.

It appeared that the successful transfer of technology and skills required additional Australian inputs especially in water treatment techniques and civil engineering.

Financial Performance

Costs

At the time of the Feasibility Study, estimated foreign exchange capital cost for the Taung Zin Scheme was $A1.6 million (K11.7 million) over four years from 1978–79 to 1982-83. An estimated 80000 people were to be served at a foreign exchange cost per head of $A20.55.

The scheme went through a number of revisions which resulted in large cost overruns for both the Australian and Burmese governments. Cost details for Australia are set out in Table 5. Project redesign and extension, the inclusion of equipment for electrification and other changes, resulted in an estimated cost to the Australian Government of $A5 million. Total Taung Zin Project costs rose to an estimated expenditure of K66.6 ($A9.5) million by the end of 1985–86. It is estimated that by the time the Project is finished the total cost may be $A6.3 million in foreign exchange, plus K80 million or more in local costs. After adjustment for inflation, the cost overrun for Australia was $A1.1 million at 1977 prices, an overrun of 69% on original estimates.

Table 5. Australian costs of the Taung Zin Component of the BVWSP.

Year[a]	Current year prices ($A'000)	Australian consumer price index[b]	1977 constant prices ($A'000)
1982	357.7	110.4	238 6
1983	1475.1	123.1	840.0
1984	1448.9	131 6	771.8
1985	511.8	137.2	261.5
1986[c]	1210.0	142.0	597.3
Total	5021.4		2709.1

Notes:
a. Australian financial years ending June 30.
b Consumer Price Index at June 30 each year.
c. 1986 figures are budgeted estimates

The Australian cost per person supplied with water was $A58 in 1985. This is 68% higher per head than original estimates, allowing both for inflation and an additional population served in Nyaung U township. This is expensive when compared with the cost for the tubewell component of $A14 per head; however, the costs were similar to those of urban water supplies in Burma. There are some mitigating factors such as the longer life of the project compared with tubewells if appropriately operated and maintained and the additional benefit of rural electrification.

Benefits

Figure 6 indicates the economic rates of return calculated under varying assumptions regarding benefit per head and shadow prices of foreign exchange. This should be compared with Figure 4 which shows (on a different scale) returns for the tubewell component.

The project returns are very low. This is a cause for concern, and although the Review Team recognised that the Scheme was a learning process for both Burma and

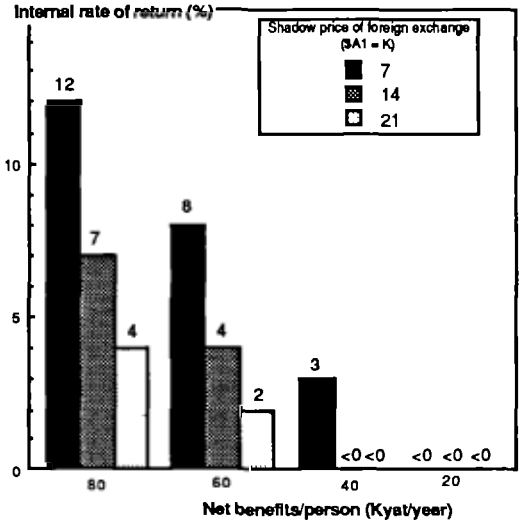


Figure 6: Estimates of the economic rate of return of the Taung Zin Piped Water Supply Scheme.

Australia, the high cost in relation to the population served has implications for any future piped supplies of treated water to rural populations. The low returns bear out the statement in the earlier documents on the Scheme that it can be justified only on social grounds.

Assuming an increase in benefit flows over time in the areas of health, education and incomes, the above rates of return will increase. For Taung Zin, the increases still are unlikely to bring returns to within acceptable ranges.

Laying pipeline for the Taung Zin Water Supply Extension Scheme

IMPACT

THE impact of a project such as the BVWSP is difficult to quantify. No really satisfactory method exists of evaluating health benefits without long term data on health and economic variables in the villages. So many factors influence health that it is difficult to identify the impact of a specific intervention (in this case a water supply). In rural Burma, other factors that influence health, such as education, incomes, housing and health programs, were all improving significantly, and the impact of the improved water supply was difficult to isolate. Nevertheless, the effects on four factors are assessed here:

- health;
- productivity;
- women and water, and
- institutions.

Health

A goal of the Project was to reduce the prevalence of water-related diseases in villages served by the project. This goal assumed that villagers would improve domestic and personal hygiene, increase the quantity of water they consumed, and change their attitudes and behaviour on the introduction of technically improved facilities. However, international experience has shown that the improvement of water alone is unlikely to result in reduction in disease without other support programs in health education and improved sanitation facilities. Provision of water is an essential but not sufficient ingredient for achieving improvement in health.

The village surveys conducted by the Institute of Economics showed that there was little difference in health indicators between villages with and without tubewells. Consequently, it was concluded that the village water supply project had not had any significant impact on health. However, the Review concluded that if villagers continue to use tubewell water on a regular basis and in sufficient quantity, and if support programs on sanitation and health education continue to be provided, there is a strong likelihood that the Project goal will be achieved.

Productivity

The review found that villagers with access to a tubewell spent 28% less time carrying water in the dry season and 17% less in the wet season than villagers without a tubewell. Thus the provision of a tubewell resulted in significant reductions in the time needed for water collection, and a corresponding reduction in drudgery.

A reduction in the water collection journey will have a development impact only if the time savings are utilised for increased production.

Productivity in this context is difficult to measure. There was no significant difference between villages with and without tubewells in numbers of livestock or agricultural production. But individual claims of increased productivity were numerous. They included more time to spend in the fields or doing pottery and weaving, and increased production of crops. These claims do not indicate increased productivity across all sections of the community. The very poor seemed to have fewer employment opportunities, and were probably limited to labouring for other villagers for additional income.

Villagers had a clear perception of the benefits

they expected to receive from the Project. The primary benefit was access to a secure source of water, dependable in the extreme dry period. Tubewells meant that villagers did not spend hours (sometimes up to 12 hours) waiting for water to seep into a drying well, and they did not have to travel increasing distances as village wells and ponds dried up. The increased security will probably allow greater numbers of livestock to be kept.

There is ample evidence that the villagers in the Dry Zone were quick to adopt new economic opportunities, so that any opportunities to use time savings in productive employment were likely to be taken up.

Women and Water

Over the past decade rural water supply projects have placed increasing emphasis on women as a target beneficiary group. There has been an increasing recognition that since women manage and distribute domestic water and are responsible for child care and socialisation, they are a logical target group for water supply projects whose objectives include improvements in health.

In the Dry Zone, domestic water is managed by women, although the carrying of water is done by women, men, and children. In addition, in their capacity as socialisers, women greatly influence the behaviour, attitudes and practices of other family members to water, personal hygiene and disease. Therefore the opinions and needs of women have a bearing on the ultimate goal of the water supply project: improved health.

There is no evidence to suggest that women as a group were consulted at any level of the Project planning and implementation stages. Given the central role of women in matters relating to water use and socialisation, it was an oversight not to have involved women in project planning.

Institutions

The institutional impact of the BVWSP as perceived by RWSD can be categorised as organisational, managerial, or technological and conceptual.

Organisational

RWSD expanded institutionally to meet the requirements of the project from the initial establishment of 469 to 1416 personnel. The influx of drilling and related equipment, auxiliary support, and mechanical units all improved the capacity and capability of RWSD. The range of training programs, technical assistance and printed information improved its capacity even further.

Organisational complications are likely since many of the new functions of the Department relating to the Project commenced only recently. They are yet to be tested, especially the routine maintenance arrangement with Tractor Stations. Time is required to test the approach and procedures which will suffer initial problems, and it is uncertain how effective the organisation will be.

Managerial

Expanding RWSD human resource needs resulted in the development of managerial skills in numerous areas. They include making decisions at the national level, organising community involvement, taking responsibilities, sharing hard work,

Women collecting water from a completed tank

supervising construction, and manpower planning and management.

RWSD also gained experience in cooperating and coordinating with related agencies in the network of national planning, monitoring and evaluation of water supply programs.

Technological and conceptual

Throughout the Project, RWSD established a high standard and operational knowledge in updated water supply technology, except in hydrogeological research and exploration conducted within the Project. This resulted in RWSD being accepted as a reliable reference and resource centre for the groundwater industry.

Technology transfer was successful over a wide range of skills. New areas of knowledge relating to exploitation of groundwater resources were opened up to the RWSD as a result of the Project, notably water quality evaluation and controls.

With the benefit of hindsight, it is clear that the Project stretched the financial, personnel and technical resources of RWSD and caused that Department to make many internal adjustments, including a reorganisation involving a large increase in personnel. A commendable aspect of the Burmese reaction to this stretching of resources was the way in which the adjustments were carried out with perseverance and in accord with Burmese economic, technical and cultural value systems. Experts need to be more aware of the technical and managerial value system which governs technical activity in Burma, and RWSD in particular.

Burma also has a remarkable resource in the planning, administrative and management capability of its villages. Their close involvement in projects of this nature is crucial to their success, and even if sometimes this slows down overall implementation, its benefits often far outweigh the slower performance. Villages had a very significant role in the implementation of the Project, and their need to mobilise resources and construct the tank and pumphouse within the context of competing demands for money and labour should be recognised.

OVERVIEW AND RECOMMENDATIONS

THE Review concluded that the tubewell component of the Project was successful in several areas:

- It achieved its physical targets and within budget.
- The economic rate of return was within a range acceptable for this type of Project.
- The users considered the Project a success, and valued the security associated with improved water supply, although they did not use the supply in the way anticipated by the objectives of the Project.
- An impressive and effective infrastructure was developed at institutional and village levels for the installation, management, and ongoing maintenance of the water supply system.

However, the Taung Zin Piped Water Supply Scheme had problems. They included considerable cost overruns, and unacceptably low economic returns which bore out statements in planning documents that the Scheme could be justified only on humanitarian grounds. Problems occurred with technical, operational and maintenance functions which were new to the RWSD. Some of the problems were attributed to an absence of detailed appraisal of the scheme before its implementation, and the design of the scheme in Australia. One clear lesson was the danger of conducting technical design activity outside of the host country.

The high cost for the population served in this component of the Project has implications for future piped supplies of treated water to rural populations. The complexity of the Scheme and past experience warrants continuation of tight management of future activity if further cost overruns are to be avoided

The Australian Government should consider the Scheme as a separate project for management purposes. Accordingly, the Scheme should be taken out of the BVWSP and costed and monitored separately. The Taung Zin Piped Water Supply Scheme requires reappraisal and, if warranted, a future assistance program for this Scheme should be designed.

In Burma, the appropriate approach to development cooperation is one which enhances existing capabilities. At the project level this generally implies 'standing back' from the project, providing assistance when and where it is required.

The need for Australian technical assistance must be identified and managed by RWSD, with the technical expert providing appropriate expertise for technology transfer. There are obligations commensurate with such an approach. For example, RWSD must be forthcoming where technical assistance is required, and Australia must be in a position to provide technically and socially acceptable technical assistance.

A need implicit in the technical cooperation theme is for a coordinator in a wide range of areas. These areas are largely determined by identified gaps in AMD's organisation. Such areas include:

- economics
- corporate planning
- support of staff development
- support of training initiatives.

The coordinator must avoid a steering approach. A flexible management structure is necessary which reacts to developments and 'reins in' if problems occur.

Further Development Assistance

The Village Water Supply Project; Dry Zone, Extended Program is a proposal currently before the Australian Government for development assistance. The objective of the proposal is to extend the provision of safe water sources from 38% to at least 50% of the rural population of Burma by the end of 1990. Proposed activities for 1987–90 are:

- the construction of a further 1750 tubewells;
- piped water supply construction; and
- rehabilitation of 1800 existing tubewells.

Total foreign exchange costs are estimated at $A37.5 million. This contribution includes tubewell and drilling equipment and spares, and consultancy costs.

The Review recommends that the three activities be appraised separately and critically. The appraisal needs to address issues involving:

- further development of institutional confidence and infrastructure;
- sustainability of the technology involved;
- appropriateness of the technology involved;
- clarification of the technical cooperation approach;
- assessment of rehabilitation required; and
- separate design and costing of piped water schemes.

In 1986 a team was sent to appraise Australia's possible future assistance to the Burma Village Water Supply Project. A large project extension was recommended. However, budget constraints and restrictions on fuel availability in Burma prevented implementation of the main components of the recommended program.

APPENDIX 1: THE INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE

The current IDWSSD (1980–90) arose from a Global survey conducted by WHO during the previous decade (1970–80). It revealed that, in 1970, 13% of the rural population and 72% of the urban population of the third world had access to safe drinking water. At the close of the first Decade 29% of the third world rural population had safe drinking water and 13% had sanitation.

As a result of this survey two vital health targets were set by the WHO:

- to assure access by all people to 'decent' health care by the end of the Decade; and
- to provide access to safe drinking water and hygienic disposal of wastes for all people by the end of the century.

The second target led to the creation of the second IDWSSD which is part of WHO's Global Program for Health for All by the Year 2000.

At the international level the approach to achieving the Decade's objectives stressed international technical cooperation with developing countries to achieve their national goals, and encouraged external financing for national Decade programs.

The IDWSSD has provided the impetus for a number of water and sanitation programs throughout the developing world. The BVWSP is one such project assisted by the Australian Government as a contribution towards the goals of the Decade.

Burma has pledged full support for the objectives of the Decade. It has stressed the need for both technical and financial assistance from international organisations, developed countries, and developing countries to fulfil the goals of the Decade.

APPENDIX 2: ACRONYMS AND ABBREVIATIONS

AIDAB	Australian International Development Assistance Bureau
AMD	Agricultural Mechanisation Department
BVWSP	Burma Village Water Supply Project
CC	Construction Corporation
EPC	Electric Power Corporation
IDWSSD	International Drinking Water Supply and Sanitation Decade
K	Kyat (Burmese currency unit)
M&E	Monitoring and Evaluation Consortium of the BVWSP
MOU	Memorandum of Understanding
PHP	People's Health Plan
RWSD	Rural Water Supply Division
UNICEF	United Nations International Children's Emergency Fund
WHO	United Nations World Health Organization

WATER FOR THE VILLAGERS

The Burma Village Water Supply Project

With its expertise in its own arid areas, Australia is in a good position to assist the Burmese in developing water resources in their arid zone. This Project involves both the drilling of wells within villages, and the piping of water from rivers. While there has been success with this Project, planned extensions will further assure water supplies to these Burmese villages.

...out the authors:

...Kywe is an engineer with the World Health Organization.

...Maung is the Director of the Rural Water Supply Division of ... ...rests, Burma.

...e Thein is a hydrogeologist with UNICEF.

...Maung is the Deputy Director of the Rural Water Supply Divi... ...ture and Forests, Burma.

...rry Shaw is a consultant to the Project.

...on Staples worked for the Australian International Development A...

...scha Teckle works for the Australian International Development A...

...ruce Walker is a consultant to the Project.

...tralia's bilateral development assistance program ...sists of over 400 projects in more than 30 countries. ...t bilateral assistance is concentrated in the South Pacific region, including Papua New Guinea, and South ...st Asia, but also includes other regions of Asia, Africa, ...e Middle East.

9 780644 081009

R88/20 850 Cat. No. 88 0939 2