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ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

Report on Advisory mission to Thailand on accelerated local manufacture of handpumps for rural water supply

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This report was prepared by the principal mission member Mr. H.V. Krishnaswamy, a consultant engaged by ESCAP for this purpose. The opinions expressed here are entirely those of the consultant and they do not reflect the views of ESCAP-United Nations. The statistics cited in the report were obtained by the consultant through his discussions with the country representatives he met during his mission to the country.

This report is issued without formal editing.

CONTENTS

/3.4 Handpumps

1. INTRODUCTION:

1.1 Background information:

1.1.1 Almost all the developing countries in Asian and the Pacific regions, not to mention the countries of the African region, have, for decades, adopted the handpumps - both for shallow and for deepwells - as one of the facilities in their Rural Water Supply Programmes, for drinking and domestic needs of the rural millions. The importance of handpump in providing the basic necessity of drinking water for the village and rural communities, is getting the increasing attention of planners all over the world. Serious efforts have been planned by the Governments in achieving the goals of the International Drinking Water Supply and Sanitation Decade (IDWSSD) programmes. Various United Nations bodies have also been involved in IDWSSD in assisting developing countries for the achievement of these goals.

1.1.2 The Inter Agency Task Force on water for Asia and the Pacific, Bangkok, at its meetings, opined that there perhaps was a need to accelerate the manufacture of handpumps for implementing rural water supply schemes in some regional developing countries and requested ESCAP to initiate a project to assess the requirement and production capacities for handpumps in these countries and to assist and advise, if necessary, accordingly.

1.1.3 The ESCAP Secretariat responded to this request by organising a roving advisory mission to selected member countries which indicated their villingness to accept the mission to conduct a survey with emphasis on handpump manufacture and covering other points relating to handpump on procurement, quality control, installation and maintenance.

1.1.4 The mission visited Thailand, among others, from October 7, 1985 to October 11, 1985.

1.2 TERMS OF REFERENCE OF THE MISSION:

The Terms of Reference of the Mission, are attached to this report as Annex I.

/1.3 COMPOSITION

1.3 COMPOSITION OF THE MISSION:

The Mission comprised of the following member:

1. Mr. H.V. Krishnaswamy, Consultant, ESCAP, Bangkok.

1.4 PROGRAMME OF VISITS:

The Mission prepared a standard format for the collection of information during the visit to Bangkok, Thailand.

The member of the Mission was briefed on October 7, 1985 at ESCAP, before setting out on the visits.

The itinerary of the Mission was as follows:

7 October 1985	Morning	Department of Health - Rural Water Supply Division
	Afternoon	Ground Water Resources Development Division - Department of Public Works
8 October 1985	Morning	Ground Water Division - Department of Mineral Resources
	Afternoon	Accelerated Rural Development Office
9 October 1985	Morning	Visit to M/s. Muangthong Charkkol Company
	Afternoon	WHO Office
10 October 1985	Morning	Visit to M/s. Thai Pipe Industry Company
	Afternoon	Visit to handpump site at Lanna Village, 60 Km from Bangkok
11 October 1985	Morning	Wrap-up session in Rural Water Supply Division
		Visit to M/s. Kitti Charoen Industry Company

1.5 PROCEDURE ADOPTED BY THE MISSION:

At each place visited, a joint meeting was held with representatives of agencies concerned, to explain the objectives of the Mission as well as to collect relevant data. As the time of each visit was brief, the information gathering was through discussions at the joint meetings at which the agencies dealing with rural water supply programmes were represented. On the last day, a final joint meeting was held in the office of the Rural Water Supply Division, Bangkok.

/1.6 SCOPE

1.6 SCOPE OF THE MISSION:

1.6.1 In carrying out the Mission, the member concentrated on problem areas in handpump technology. These were not limited only to technical aspects of the handpump but included procurement procedures, manufacture, installation and maintenance of handpumps, all of which are inseparable links in the ultimate objective of handpumps giving continuous supply of potable drinking water to rural people. At the same time, due attention was given to any successful experience of the country which might be used to advantage by other developing countries in the region.

1.6.2 The Mission did not limit itself to the present contract of the components of the programme but used a comprehensive approach.

1.7 ACKNOWLEDGEMENTS:

1.7.1 The Mission member is sincerely grateful to all the officials who co-operated with him, answered patiently his questions and provided the required information. He also deeply appreciates all the kindness, courtesies and the warm hospitality extended to him, which made his stay in the country a delightful experience.

2. GENERAL VIEWS AND RECOMMENDATIONS:

2.1 CURRENT PRACTICE:

2.1.1 There are too many Governmental agencies who have their own programmes for providing handpumps for Rural Water Supply Schemes, involving procurement, installation and maintenance. This results in duplication of efforts, extra manpower, possibility of various agencies cross working for the same cause with overlapping responsibilities, besides extra expenditure. Different agencies have their own specifications for different handpumps and in some cases for the same type of handpumps.

2.1.2 Specification and standardisation have not been done, on a national level, for a shallow well handpump or for a deepwell handpump. This has resulted in the manufacture of many types of handpumps, with no strict control on specification of materials - both for physical and chemical properties - before or during manufacture.

2.1.3 In the manufacturers' works, quality control assurance and quality control methods are not compulsorily adopted. Jigs and fixtures are not used to the required degree. Records are not kept for rejected/accepted items. Endurance test and performance test on handpumps do not appear to be carried out.

/2.1.4 The handpump

2.1.4 The handpump is a machine and like any other machine, requires to be kept clean and parts periodically inspected for formation of rust, loose bolts and nuts and also for replacement of missing parts in time to prevent major breakdown. At the same time the handpump is a special type of machine, unlike others in a covered machine shop, open to the rigorous of weather and subjected to rough handling and continuous use by unskilled rural folk without any trace of technical knowledge or competence. Therefore, it is all the more necessary to treat the handpump as an extraordinary machine and proper maintenance is of utmost importance. Also training programme on installation and maintenance of handpump, on a regular basis, at the level of village caretakers and supervisors and engineers, is a must. There does not appear to be any Code of Practice for installation and maintenance of handpumps - shallow well and deepwell - at the national level, applicable uniformly throughout the nation.

2.2 RECOMMENDATIONS:

After reviewing the status and the need for a more comprehensive approach on handpump technology in Thailand, the Mission recommends the following points:

2.2.1 At the moment it appears that there is not much need to accelerate the capabilities of manufacturing handpumps, as the manufacturers have indicated that their production capacities are much higher than the present demand as well as the projected demand, under the Master Plan, for 1985-1991.

2.2.2 The Government should consider and identify one Central Agency, for the entire Country, to be responsible for procurement, installation, maintenance and training programmes for shallow well handpump and deepwell handpumps for Rural Water Supply Schemes.

2.2.3 Design changes in some of the parts of existing models of shallow well and deepwell handpumps, should be considered and effected, to reduce the incidence of break down of handpumps at site.

2.2.4 Standardisation of one or two hand pumps for shallow well and deepwell use, should be brought about, detailed specifications should be drawn for materials giving physical and chemical properties, and for manufacturing process giving tolerances, quality assurance manuals and quality control requirements.

/2.2.5 The quality

2.2.5 The quality control should be more vigorously pursued and insisted upon at the manufacturers' shops.

2.2.6 There is a need for the preparation, at national level, of Codes of Practice for installation and maintenance of shallow well and deepwell handpumps, giving step-by-step procedures with diagrammatic sketches.

2.2.7 Standardised handpump training programmes for persons at various levels who are involved in the implementation of handpump schemes, should be periodically conducted.

3. REPORT ON THAILAND:

3.1 GENERAL INFORMATION:

3.1.1 About the country: Thailand is situated in the central part of the Indo-China peninsula of Southeast Asia, with an area of 514,000 Sq.Km. Geographically, the country is divided into four regions: Central, Northern, Northeastern and Southern. These regions have their own distinctive economic, social and cultural characteristics. In general, the terrain is flat, with scattered hills in the south and southeast, and higher mountains in the north. Rainfall in Thailand is generally good and beneficial to agriculture, with the annual mean of 1550 mm, except for certain portions in the Central, Western and Southern Regions where rainfall is comparatively less but substantial. Relative humidity in Thailand varies between 72.2 to 80.5 per cent.

The geological formations of Thailand can be classified into two groups: porous rocks and jointed rocks. These two rock types constitute the most important aquifers of the country. Thailand is a country with a severe flooding problem for more than four months a year.

/3.1.2 GENERAL

3.1.2 GENERAL HABITS AND PREFERENCES OF LOCAL PEOPLE IN RESPECT OF UTILISATION OF WATER FOR DRINKING AND OTHER DOMESTIC PURPOSES:

3.1.2.1 The approximate percentage usage of water by the local people from the most preferred sources for drinking and domestic use, in wet and dry seasons, region-wise, is given below:

Region:	For drinking		For other domestic use:	
	Wet season	Dry season	Wet season	Dry season
North	*RW - 44.4%	SW - 51.7%	SW - 51.4%	SW - 51.4%
	SW - 23.8%	DW - 21.9%	DW - 19.1%	P/C 14.7%
	DW - 6.1%			DW - 4.9%
Northeast	RW - 72.3%	SW - 51.3%	RW - 29.9%	SW - 0
	SW - 6.8%	P/C 22.9%	SW - 27.7%	Buying 48.7%
	DW - 0	DW 8.1%	DW - 0.5%	DW - 33.3%
Central	RW - 73%	SW - 43%	SW - 32.6%	SW - 44.2%
	SW - 4.3%	DW - 8%	P/C 13.8%	P/C 28.2%
	DW - 1.2%	P/C 29.6%	DW - 6.2%	DW - 11.9%
South	SW - 83%	SW - 92%	SW - 88.6%	SW - 81.8%
	RW - 4.5%	P/C 8%	RW - 5.7%	P/C 14.8%
	DW - 0	DW - 0	DW - 0	DW - 0

* RW means Rain Water; SW means shallow well; DW means deep well; P/C means Pond/Canal.

3.1.2.2 From the above, it can be surmised that for drinking water, in wet season, the most preferred source is rain water in Northern, Northeastern and Central regions, whereas in South, the shallow well is extensively used in all the regions. However, for domestic use, the shallow well is very popular in all the regions, throughout the year, except for northeast region, where they buy water in dry season.

/3.1.2.3 The deepwell

3.1.2.3 The deepwell source for drinking is hardly used in wet season, but in dry season it is used to an extent, in northern region, for a lesser extent in north eastern and central regions. For domestic needs of water, in dry season, deepwell source is used considerably in north eastern region and to a lesser extent in central region. In wet season, the northern region use deepwell source to a certain extent and hardly in any other region. In southern region, deepwell tapping is not a source of supply of water either for drinking or for domestic use, in both the seasons.

3.2 RURAL WATER SUPPLY SCHEMES:

3.2.1 GENERAL:

3.2.1.1 The provision of clean water to rural areas in Thailand, was initiated in 1964. In the following year the cabinet appointed an Executive Committee consisting of the members from various departments with responsibilities for planning and execution of the National Rural Water Supply Programme. A target of the programme was then set up to implement a plan to supply clean water to local inhabitants in some 50,000 villages throughout the Country, by employing several means including (1) Rain water collection tanks, (2) Shallow dug wells and jet wells fitted with handpumps, (3) small diameter wells fitted with handpumps, (4) Deep wells fitted with handpumps, (5) Piped water supply, (6) Standard ponds, (7) Improvement of existing ponds, and (8) Dikes and reservoirs.

3.2.1.2 It was estimated that, by the end of 1983, about 15 per cent of the rural population of Thailand had been served by adequate (meaning water supply throughout the year) and safe water sources, although approximately 84.9 per cent of the entire rural population already had access to adequate water sources (Regionwise north 94.5%, northeast 85.2%; Central 75.2% and South 83.7%). Of the existing rural water supply facilities (with respect to shallow wells, deep wells, piped water supplies and surface water sources) only around 75% were adequate. Of these adequate sources, roughly 75% were considered un-safe sources (for example surface water and shallow wells without handpump or covers). Piped water supplies, deepwell and shallow wells with handpumps and covers were

/considered as

considered as safe sources, and facilities of this sort comprised only 27% of the adequate sources.

3.2.1.3 The Royal Thai Government, in response to the International Drinking Water Supply and Sanitation Decade (IDWSSD) of the United Nations had declared The Thailand Decade (1981-1991) with the same objectives as that of IDWSSD. The target aims at providing drinking water to 95 per cent of the rural population by 1991.

3.2.2 PROCUREMENT OF HANDPUMPS BY GOVERNMENT AGENCIES:

3.2.2.1 A network of some 16 Royal Thai Government (RTG) agencies have been actively taking part in the provision of Rural Water Supply Service in Thailand. These agencies independently plan, implement and monitor their own programmes. Of the 16 agencies, twelve are responsible for the provision of water supply for drinking and domestic consumption. However, the following five agencies among them are directly involved in providing shallow wells and deepwells for rural water supply schemes.

RTG Agency:	Shallow well	Deepwell
A) Ministry of Interior (MOI)		
1) Department of Local Administration (DOLA)	✓	
2) Department of Public Works (DPW)		✓
3) Department of Accelerated Rural Development (DARD)	✓	✓
B) Ministry of Public Health (MOPH)		
4) Department of Health - Rural Water Supply Division (RWSD)	✓	✓
C) Ministry of Industry (MI):		
5) Department of Mineral Resources (DMR)		✓

/3.2.2.2 There are

3.2.2.2 There are also other agencies involved in the provision of clean water for the rural areas, but their inputs are comparatively small.

3.2.2.3 Handpumps utilised by the various agencies are of different prototypes. The prototype of handpumps which are widely used include: The Mineral Resources Department (MRD) handpump; Public Works Department (PWD) handpump, Health Department handpump (KORAT handpump), Accelerated Rural Development Department (ARDD) handpump; and Local Administrative Department (LAD) handpump. The MRD handpump and the PWD handpump are the same prototype, being DEMPSTER Model, whereas the handpump generally used by Health Department, ARDD and LAD, is the KORAT type.

3.2.2.4 About 55,000 deepwell handpumps have been installed so far all over the country by the Government agencies mentioned earlier.

3.2.2.5 The handpumps are also bought directly by private agencies and villagers from the manufacturers for which no statistics, in respect of number of handpumps installed, appear to be available.

3.2.3 FUTURE PLANS INVOLVING HANDPUMPS FOR RURAL WATER SUPPLY SCHEMES:

3.2.3.1 A Master Plan has been prepared for the years 1985-1991 which ensures provision of water supply facilities in the rural areas. The estimated number of water supply systems to be constructed with shallow well handpumps and deepwell handpumps, in the different regions of Thailand are described below:

Region:	Shallow well handpumps:		Deepwell handpumps:	
	Per year	Total for 7 years upto 1991	Per year	Total for 7 years upto 1991
North	682	4,774	405	2,835
Northeastern	1,487	10,409	945	6,615
Central	641	4,487	1,336	9,352
South	769	5,383	429	3,003
Whole Kingdom	3,579	25,053	3,115	21,805

/3.2.3.2 The other

3.2.3.2 The other types of facilities for supply of water for rural areas envisaged for the years 1985-1991, apart from shallow well and deepwell handpumps, include the following:

Type of facility	No. of Units:
- Rain water jars 1 Cum	376,788
- Rain water jars 2 Cum	4,011,000
- Spring catchment system	63
- Small scale piped water supply system	1,316
- Village piped water supply system: Slow sand filter	77
- Village piped water supply system: Rapid sand filter	21
- Small scale rain water supply system	6,650

3.2.3.3 From the above, it will be observed that for Thailand, the most popular facility for supplying water for rural areas, is rain water jars.

3.2.3.4 The implementation plan for the rural water supply programme will be from 1985 to 1991. In addition to the construction of new safe water sources such as shallow well, deepwell spring catchment system, small scale piped water supply system, slow sand filter, rapid sand filter and small scale rain water system, it is also proposed to rehabilitate and upgrade existing facilities, to supplement the availability of clean water in the rural areas. The estimated number of existing facilities for upgrading, in the different regions of Thailand between 1985 and 1991, is 78,183 shallow wells and 37,135 deepwells. Similarly, the estimated number of existing facilities for rehabilitation in the same period throughout Thailand is 1,546 deepwells. These schemes would involve replacement of defective handpumps wherever required. It can safely be assumed that about 20 per cent would need replacement of complete handpumps. This calls for an additional requirement of about 24,000 (20 per cent of 78,183 plus 37,135 plus 1,546 is 23,373 or about 24,000) handpumps, in a period of 7 years from 1985.

/3.2.3.5 It will be

3.2.3.5 It will be seen from the above that the Master Plan for the 7 year period 1985-1991, would approximately require 46,858 (25,053 plus 21,805) handpumps under new constructions and about 24,000 handpumps under upgradation and rehabilitation schemes. This means, on an average, about 10,000 handpumps per year are required to meet the Government target of providing water supply to cover 95 per cent of the rural population.

3.3 HANDPUMPS USED IN THAILAND:

Handpumps are used in rural water supply programmes of Thailand both for shallow well and deepwell constructions.

3.3.1 SHALLOW WELL HANDPUMP:

3.3.1.1 At present, locally made 'Lucky Pump' or 'A-1 Pump' are mostly used as hand operated shallow well lift pump. The pumps are of cast-iron body. The use of these shallow well pumps is limited to conditions where the ground water table during pumping is within 7 metres. The Lucky Pump derived its design originally from Kawamoto of Japan.

3.3.1.2 The Lucky Pumps and PVC pumps for shallow wells are mostly purchased and installed by private agencies/ villagers. The statistics with regard to the number of pumps installed in the country, were not available.

3.3.2 DEEPWELL HANDPUMPS:

3.3.2.1 At present, there are mainly three types of deepwell handpumps used in Thailand:

- the modified Dempster handpump
- the conventional Korat handpump (6084-1)
- the modified Korat handpump (608-C)

The major differences in these pumps are only in the upper part (body) portion, whereas the principle is same in the lower parts.

/3.3.2.2 KORAT HANDPUMPS:

3.3.2.2 KORAT HANDPUMP:

This handpump has gone through a series of improvements and the latest model 608C incorporating chain instead of a gear as in 608-Al, on the basis of India Mark II deepwell handpump, has come to be accepted as a better performing, cost saving pump than 608-Al model. The Korat 608 pump has had changes as:

608 type with bushing and steel handle;
608-A type with bearings (in lieu of bushings) and steel handle;
608-Al type with bearings and wooden handle;
608-C type with bearings, chain (instead of gear) and galvanised iron pipe handle.

The experiments are, on hand, introducing a water tank, again, on the lines of India Mark II handpump, called 608C.T.

It has been observed that 608-C handpump is better in performance and in price than 608-Al pump. Some of the statistics are given below:

		Korat 608-Al:	Korat 608-C:
1)	Stroke length	4"	6"
2)	Diameter of cylinder	3"	3"
3)	Operating strokes (times)	37	20
4)	Discharge of water litre/stroke	0.541	0.936
5)	Number of parts	89	86
6)	Price U.S. Dollars	150	130
7)	Maintenance cost U.S. Dollars	50	30

3.3.2.3 Another type of deepwell handpump being developed and monitored is PVC handpunp. The purpose of developing a PVC handpump is to reduce the cost of construction of deepwell and the maintenance cost. While the number of parts in a PVC deepwell handpump is 46, and the cost 80 US Dollars approximately, the development is still on hand and, therefore, the suitability of PVC handpump for rural areas has to be watched under extensive field trials for sturdiness and dependability.

3.4 HANDPUMP MANUFACTURING FACILITIES IN THAILAND:

3.4.1 There are number of private owned companies manufacturing handpumps of different types in Thailand. It was given to understand that in Bangkok alone there exist about 20 to 30 manufacturers of handpumps. The major manufacturers are:

- M/s. Muang Thong Charkkol
- M/s. Koolworset
- M/s. Wichian Karchang
- M/s. Kitti Chariorn

The Mission visited the factories of M/s. Muang Thong Charkkol and M/s. Kitti Chariorn.

3.4.2 Muang Thong Charkkol manufactures both Dempster and Korat type deepwell handpumps. Their capacity is about 15,000 handpumps a year. But, due to paucity of orders, they produce, on an average, 10,000 pumps annually. Their clients include Governmental agencies as well as private buyers. They have exported KORAT 608 pumps to Indonesia. Handpump is one of the many cast-iron items produced by the Company. The Mission was given to understand that the orders received from the Governmental agencies as well as private buyers fall short of the Company's capacity to produce pumps.

3.4.3 KITTI Chariorn manufactures shallow well handpumps of types 'Lucky Pump' and 'Al pump'. They also make handpumps No. 75 and 90, the difference being in the cylinder diameter. They manufacture motorised pumps also. The Company can produce about 12,000 handpumps a year, but make only about 10,000 a year because of lack of orders. They do not have a foundry and buy cast iron parts of pumps from the market.

3.4.4 The capacity of the above two Companies, visited by the Mission, is about 27,000 handpumps a year. There were not any ready statistics to give the combined capacity of all the manufacturers of handpumps throughout Thailand. However, it can be safely and conservatively assumed that about 50,000 handpumps per year would be the total capacity of all factories.

/3.4.5 M/s. Thai

3.4.5 M/s. Thai Pipe Industry was also visited by the Mission. The Company manufactures PVC products and includes PVC pipes for casing pipes, riser main pipes, screen pipes, used in Rural Water Supply Schemes. PVC pipes upto 400 mm are made here. Their annual capacity is 10,000 M.T. of PVC products.

3.5 HANDPUMP REQUIREMENT VERSUS MANUFACTURING CAPACITY IN THAILAND:

3.5.1 The shallow well and deepwell handpump requirements, as envisaged in the Master Plan for Thailand and as detailed in 3.2.3.5 above is about 10,000 numbers per year, commencing from 1985. The capacity currently available with handpump manufacturers in the country, as detailed in 3.4.4 is about 50,000 numbers per year. The conclusion, therefore, is that the capacity adequately exists with the present manufacturers for production of handpumps to meet the present and future requirements of the Government of Thailand, as well as private buyers.

3.5.2 As PVC deepwell handpump is still under development and is in trial stage and as the capacity for the manufacture of PVC pumps have not been fully developed, the use of PVC handpumps has been excluded in the above assessment.

3.6 PRESENT PRACTICE AND SITUATION IN VARIOUS LINKAGES OF HANDPUMP TECHNOLOGY FROM DESIGN, PROCUREMENT, MANUFACTURE UPTO MAINTENANCE:

3.6.1 The shallow well handpump generally used is 'Lucky Pump' or 'Pump A1'. For the deepwell purposes, the handpumps commonly used are Dempster and Modified Korat types. All these pumps are indigenously manufactured.

3.6.2 Each of the several Government agencies who is involved in the procurement of handpumps for Rural Water Supply Schemes, has developed its own standard design for handpumps for installation.

/3.6.2 The frequent

3.6.3. The frequent breakdown of handpumps is one of the reasons for the villagers not to rely on deepwell as their regular water source for drinking and domestic needs. Another reason for the villagers not to use the handpumps, is the poor quality of water from deep well containing iron, manganese and mineral salts. Villagers prefer the deepwell source when the quality and yield of water is good, which generally prevails in Central region.

3.6.4 In the handpump manufacturers shops visited by the Mission, the following observations were made:

- Little attention to quality control
- No records are kept to show the rejected/ accepted components
- Jigs and fixtures are not generally used
- Checking of physical or chemical properties of raw materials are not done.

3.6.5 The installation and maintenance of rural water supply facilities have been the responsibility of the respective constructing RTG agencies. But most of these agencies do not have the required manpower support and this results in many handpumps remaining unrepaired.

3.6.6 The breakdown of handpumps at site were attributed to the following main reasons:

3.6.6.1 Korat Commercial Pumps:

- failure of threads of the gear connecting rod
- breakage of handle

3.6.6.2 Korat Modified Pumps:

- breakage of handle
- grease cup missing

3.6.6.3 Dempster Pump:

- breakage of fulcrum links
- disconnection of round bar and flat bar due to failure of threads
- fulcrum fork breaking
- pump shaking even under gentle operation

/3.6.6.4 Lucky

3.6.6.4 Lucky Pump:

- breaking of valve spindle
- stainless steel sleeve tearing
- cracking of pump body
- rubber seal wearing
- failure of threads of connecting rods.

3.6.6.5 The below ground components of most of the pumps were failing due to:

- leakage of foot valve
- leakage of pump cylinder

3.6.7 Most frequently used spare parts were:

- spring activated foot valve for Korat and Lucky pumps
- pump bodies (barrel) for Lucky pumps
- fulcrum links for Dempster pumps

3.6.8 The Mission was given to understand that, at any given time, it is estimated that 15 per cent handpumps are out of operation for some reason or other.

3.6.9 Public health aspects:

Public health in Thailand is generally satisfactory, with a death rate of 5.0 per thousand population and a life expectancy of 60.8 years for males and 64.8 years for females. However, a large number of people suffer from health problems related to poor sanitation and inadequate water supply. Water and food-borne diseases, specifically gastro intestinal infections and parasitic diseases affect about one-third of the entire population every year. From 1978 to 1981, it is reported, that about 40 per cent of all reported cases were attributed to water-borne and water-related diseases. It was estimated that, by the end of 1983, only about 15 per cent of the rural population of Thailand had been served by adequate and safe water sources, although approximately 85 per cent of the entire rural population already had access to adequate water sources. The Mission was informed during discussions that each handpump is installed with a platform built around it for cleanliness.

3.7 TECHNOLOGY ITEM SUITABLE FOR INTER-COUNTRY CO-OPERATION:

The ground water division of the department of Mineral Resources (DMR) has extensive experience of over 30 years, in ground water exploration to search for water by resistivity and seismic methods. It would be advantageous for other developing countries in the region to react with Thailand Royal Government to get the experience in the theoretical knowledge and case-study interpretation of the scanning for the ground water, about which DMR has wide and rich experience.

4. RECOMMENDATIONS:

The comments and recommendations this Mission is making, is based on what the Mission is able to observe and discuss with different agencies involved in procurement and production of handpumps, during the short visit. Therefore, the recommendation is based not on any in-depth study of the handpump production or other activities connected with handpumps.

The Mission makes the following recommendations:

4.1 SPECIFICATION OF SHALLOW WELL AND DEEPWELL HANDPUMPS:

4.1.1 The specifications are not well defined and are vague. No tolerances have been shown in the component description in the drawings of the handpumps. These are absolutely necessary if any quality control scheme is to be thought of.

4.1.2 The pump head of the deepwell handpump has too many moving parts which result in higher failure rate.

4.2 DESIGN OF HANDPUMP:

4.2.1 KORAT PUMP:

- 4mm thick solid drawn brass tube could be considered for use as cylinder body.
- Presence of spring in check valve is not a good feature. This should be redesigned along with bottom cap.
- Cup washers could be made from nitrile rubber, to have a better service life.

/4.2.2 DEMPSTER

4.2.2 DEMPSTER HANDPUMP:

- Grades for cast iron parts have not been mentioned in the drawings. Unless graded castings are used, there would be immense problems. Proper grades which offer higher elongation should be selected. Malleable iron would be suitable.

- The handle, fulcrum link, top body should be of malleable iron.

- Piston seals should be out of nitrile rubber instead of leather.

- Cold drawn steel of minimum 13 per cent elongation should be used for flat and round bars, to prevent failure at threads. Sudden change in section is also not desirable.

4.2.3 It is recommended that one or two design for each shallow well and deepwell handpumps, for the country, should be developed for adoption, to avoid many existing problems like non-availability of spare parts, too many handpumps in use, non-interchangeability of parts, etc. This will also reduce the down-time when a handpump breaks down, and quicken maintenance.

4.3 STANDARDISATION AND SPECIFICATIONS:

4.3.1 Standardisation of one or two handpumps each for shallow well and deepwell use, should be brought about, and detailed specifications should be drawn for materials giving physical and chemical properties, and for manufacturing process giving tolerances in dimensions.

4.4 PROCUREMENT:

4.4.1 One Central Government Agency should be made responsible for the central planning, procurement, distribution, installation and maintenance of shallow wells and deepwell handpumps, for Rural Water Supply Programmes, for the entire country, instead of a number of agencies existing as at present, which results in overlapping and duplication of efforts leading to extra time and extra manpower and to lack of proper co-ordination among the agencies involved. In some countries, the Rural Water Supply Division is the implementing agency responsible for implementing Rural Water Supply Schemes.

/4.5 The Mission

4.5 The Mission recommends the following points to be particularly looked into during the manufacture of handpumps:

4.5.1 The manufacturer should have a separate quality control wing with personnel exclusively manning this wing, independent of production personnel, and answerable directly to the Chief Executive. This department must maintain complete documentary records separately for accepted/rejected parts, and should be responsible for checking and ensuring quality standards from raw material stage right upto final assembly of handpumps. Buyer should insist on manufacturers to prepare quality assurance manuals and quality control procedures during manufacture and inspection which should also cover documentation procedures. Required checking gauges and measuring instruments should be used by the manufacturer.

4.5.2 The manufacturer should be insisted upon by the buyer to use the jigs and fixtures at the manufacturers' shops, in order not only to increase the production rate but make it possible to use less skilled labour, to improve dimensional accuracy, to improve assembly and for interchangeability of parts.

4.5.3 The chemical composition of pig iron used for casting will be within an acceptable range to facilitate good casting. The recommended chemical composition is:

- Carbon : 3.2 per cent to 3.5 per cent
- Silicon : 2.1 per cent to 2.3 per cent
- Manganese : 0.6 per cent to 0.9 per cent
- Phosphorus : 0.2 per cent maximum

High phosphorus content can cause brittleness and has low resistance to impact which can cause breakage, and is difficult to machine resulting rougher cylinder wall and poorer tolerances. Therefore, phosphorus content is especially critical. A periodic chemical analysis of the pig iron should be provided by the supplier and verified by chemical analyser before the pig iron is accepted.

/4.5.4 Foundry

4.5.4 Foundry coke should also be purchased to specifications. The recommended specification is:

		Weight by per cent:
- Fixed carbon	:	88.0 minimum
- Volatile matter	:	1.0 minimum
- Ash content	:	12.0 maximum
- Sulphur content	:	1.0 maximum

The caloric content should average 2500 million BTU per short ton. Coke should be covered in storage and protected from moisture.

4.5.5 Brinel Hardness of the casting should be from 179 to 229 BHN. The tensile strength of the casting produced should be 14 tons per square inch (24 kg per Sq.mm.)

4.5.6 The type, size and distribution of graphite flakes and the structure of the matrix shall be as per table below:

Grade 14 Type I: Size 3-5.
Distribution and Micro Structure: A, lamellar/pearlite.
Ferrite, if present, shall not exceed 10 per cent.

4.5.7 The manufacturer of castings shall issue test certificates with every batch of their supply and also test bars for tensile, transverse and impact tests. The test certificate shall indicate:

- Delivery challan and date
- Purchase order number and quantity
- Part number and description
- Heat number/batch number, quantity per heat, heatwise chemical composition, tensile, hardness, transverse values on representative samples. The hardness values should indicate the number of samples checked from each heat/batch and the location of hardness testing
- Micro-structure report
- Identification for each heat/batch.

/4.5.8 Final

4.5.8 Final inspection details to be looked into on the castings are:

- Visual inspection
- Dimensional checks
- Casting defects like blow holes, cracks, rough castings
- Hardness
- Chemical composition
- Tensile strength
- Transverse and impact tests

4.5.9 It should be ensured that the valve seats must be smoothly finished and without blemish. The fabrication of valve assembly parts should be done with care for satisfactory operation. It should be ensured that the cast iron cylinder inside wall (in which the plunger operates) smoothness should be almost that of extruded brass cylinder, This increases life for cup washers.

4.5.10 Plunger rods should be from mild steel rods and not from flats.

4.5.11 Tolerances should be minimized at all pinned connections not only to prevent excessive wear at those points but to reduce wear and damage to other parts that may result from poor alignment and wobbling.

4.6 The Mission recommends the following points to be noted for installation and maintenance of handpumps:

4.6.1 A Code of Practice for installation and maintenance of standardised shallow well and deepwell handpumps should be prepared, at the national level, giving step by step procedures with diagrammatic sketches. Proper formats should be maintained giving statistical data of installation and maintenance of each handpump. This information is crucially important not only from statistical point but to get feed back information for research for continually improving the design aspects and standards of handpumps.

/4.6.2 Lack of

4.6.2 Lack of feed back from maintenance to engineering and procurement personnel, inadequate record keeping, little analysis - for example - of the most common failures - all these factors dwarf the research and development of handpumps. The recommended maintenance information manual is given in Annex II - Sheets 1 to 8.

4.6.3 Proper storage of pumps and components is a must. Proper painting, protection of machined portions against rust and protection of leather against mildew are necessary.

4.7 The Mission recommends the following points to be noted for training programmes on handpumps.

4.7.1 The training programmes for installation and maintenance of handpumps should be regularly conducted by the agency responsible for the implementation of the Rural Water Supply Schemes. The programmes should broadly cover:

- Education of local people on the importance of handpump in their day-to-day life
- Training in actual pump installation and dismantling in the field with step-by-step procedures. This is an excellent means of 'on-site' training
- Instructing in how the hand pump works, the more common causes of failures, and their corrections
- Importance of public health in the construction of platforms and maintaining clean surroundings around the pump

4.7.2 The training should make available the samples of handpumps used locally, with tools to dismantle and reassemble them. A collection of broken or worn out parts is also useful for demonstration purposes.

4.7.3 The training should be imparted to the village caretaker as well as to the local supervisors and engineers of the Government agency who is responsible for installation and maintenance of handpumps.

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ANNEX I

Advisory mission on accelerated local manufacture of hand pumps for rural water supply

TERMS OF REFERENCE

The mission will carry out its activities within the framework of the following terms of reference:

(a) To visit selected countries and, within each country, to visit the relevant hand pump manufacturing facilities as recommended by the concerned national government agency. The duration of the visit in each country shall be between five and seven days inclusive of international travel involved.

(b) To carry out detailed discussion with concerned government agencies and with the management of each manufacturing facility visited about overall national hand pump requirements (both short - and medium-term) and the existing production capability both at the national level and at the level of the individual plants visited by the mission. Also to discuss the nature and extent of production problems both nationally and at the specific plant level.

(c) At each manufacturing facility visited, to discuss any problems related to technical, management and manufacturing processes. Also, to discuss plans and potential for plant upgrading, increased production and improved quality including financial implications.

(d) To recommend appropriate changes for improvements in technical, management and manufacturing methods and in quality control.

(e) To recommend appropriate measures to increase production of hand pumps and spare parts.

(f) To recommend appropriate measures to improve occupational health, and also safety features in each manufacturing facility visited.

/(g) To identify

(g) To identify elements and scope for appropriate technology transfer and for technical co-operation among developing countries in the region.

(h) To prepare a consolidated report for each country visited with specific recommendations for each plant visited. The report should be prepared within one month of completion of the visits.

****

ANNEX II

WATER SUPPLY - INFORMATION CHARTS ON HANDPUMPS

RECOMMENDED MAINTENANCE INFORMATION MANUAL

FORM 1 : WELL AND PUMP CHART

(A) REFERENCE:

A1. Identification Code [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]
State District Serial No.

A2. Water Point Location
(a) Taluk _____ (b) Village _____

A3. Form completed by _____ (b) Date _____

A4. Form checked by _____ Date _____

(B) WELL CONSTRUCTION :

B1. Well Type : Drilled / Dug

B2. Static Water Level : (a) Below G.L. _____
(b) Date _____

B3. Yield of well _____ Litres/minute

B4. Depth of well _____ Metres

B5. Remarks : _____

_____

Sheet 2

(C) WATER QUALITY:

(a) Conductivity _____

(b) pH _____

(c) Total solids _____

(d) Total iron _____

(e) Chloride _____

(f) Sulphates _____

(g) Salinity _____

(h) Any other information _____

(D) PLATFORM CONSTRUCTIONS:

D1. Attach sketch

D2. Position of end of handle from operation level

(a) Top of stroke _____ mm

(b) Bottom of stroke _____ mm

D3. Drainage _____

D4. Remarks _____

_____

_____

Sheet 3

(E) PUMP

E1. Manufacturer ..... Pump Description .....

E2. Installation (a) Date .....
(b) Time taken .....
(c) Installed by:
(Agency)

E3. Dimensions:

	Material	Diameter	Unit length	No. of length
(a) Rising main				
(b) Rods				
(c) Cylinder				

E4. Placement of cylinder
(from G.L.) ..... m.

E5. Pump lever ratio .....

E6. (a) Max stroke ..... mm.

(b) Max swept volume..... litres

E7. Seal Material .....

E8. Any problem encountered during or immediately after installation ?

Yes No

Specify .....

.....

Sheet 4

E9. Observed faults of
Pump (Manufacturing defects) .....

E10. Remarks .....

.....

(F) HABITAT :

F1. Approximate population
of village/Habitat :

F2. No. of House holds :

F3. Source of water supply in
the area:

(a) Drilled Well/Dug well
with hand pumps :

(b) Taps

(c) Power pumps :

F4. Estimated population
using this pump :

F5. Village pump caretaker(s) Yes No

F6. Remarks .....

.....

Sheet 5

FORM 2 - SITE INSPECTION

State | District | Serial No.

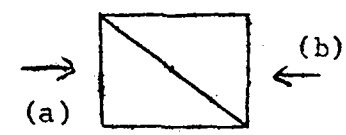
Form completed by:.....

Date	Static water level	Well depth	Performance*	Volumetric efficiency**	Condition of		Preventive Maintenance (Details)	Cause for Break down	Repairs carried out
					Pump	Surroundings			

* No. of strokes to give 12 litres rate of pumping. Rate of pumping:

** Actual discharge in litres in 40 strokes ÷ 12.66 (a) 40 strokes per minute

(b) 60 strokes per minute



Sheet 6

FORM 3 REPAIR AND MAINTENANCE REPORT

A. Reference :

A1. Identification code: [ ][ ] [ ] [ ][ ][ ][ ][ ][ ]
State District Serial No.

A2. Form completed by ..... A3 form checked by .....

Date .....

B. Sequence of Events :

B1. Reason for intervention : Breakdown [ ]

Poor performance [ ]

Scheduled maintenance [ ]

B2. Nature of failure .....

.....

B3. Dates (a) Failure occurred .....(b) Failure reported.....
(c) Failure inspected.....(d) Repair completed.....

B4. Failure reported (a) By whom .....(b) To whom.....

B5. Failure inspected (a) By whom .....(b) Action taken .....

Sheet 7

C. Repair (Specify on site or in workshop)

C1. Description of Repair

C2. Parts replaced(Description and Qty.)

C3. Tools used for repairs (specify standard and special tools)

C4. Time taken to do repairs (man hours)

C5. Repair carried out by

(a) Engineer/Supervisor .....nos.

(b) Skilled man power .....nos.

(c) Unskilled .....nos.

C6. Assistance from Villager: Yes/No

If Yes specify type of assistance .....

C7. Type of vehicle used .....

C8. Total distance travelled
by vehicle for completing repairs .....

C9. Description of corroded, worn, damaged or broken parts
(add sketch or photograph if necessary) .....
.....
.....

C10. Remarks .....
.....
.....

Sheet 8

A. REFERENCE

A1. Identification code 

A2. Form completed by:..... Date:.....

A3. Form checked by: ..... Date:.....

A4. Date of Repair .....

B. MAINTENANCE COST :

B1. Cost of part replaced (as reported in Form 3, C2)

Qty.	Part replaced (from form 3, C2)	Unit cost	Total Cost
	Total cost of parts		

B2. Transportation cost: .....

B3. Direct labour charges.....

B4. Indirect cost (overheads).....

B5. Total cost (B1.+B2.+B3.+B4.).....

ANNEX III

BANGKOK

PERSONS MET

I. FROM THE GOVERNMENT OF THAILAND:

1) Mr. Chetpan Karn-Kaew, Director, Rural Water Supply Division, Department of Health
2) Mrs. Devarugsa Kruerklai, Public Health Administrative Officer, Rural Water Supply Division
3) Mr. Charuchandr Praphorn, Sanitary Specialist, Public Health Department
4) Mr. Sudhi Kornkamonphurk, Deep Well Drilling and Development Division, Public Works Department, Ministry of Interior
5) Mr. Phaisan Lorphensri, Public Works Department, Ministry of Interior
6) Mr. Manas Sarngeimsuk, Civil Engineer, Rural Water Supply Division
7) Mr. Jade Julawong, Hydrogeologist, Ground Water Division, Department of Mineral Resources, Ministry of Industry
8) Mr. Tanong Tanohavalit, Mechanical Engineer, Department of Mineral Resources, Ministry of Industry
9) Mr. Sumeth Chittrayanont, Geologist, Department of Mineral Resources, Ministry of Industry
10) Mr. Naravudthi Deesuwan, Ground Water Development Section, Field Operation Division
11) Mr. Vanchai Noichan, Equipment Control Division, Accelerated Rural Development Department, Ministry of Interior
12) Mr. Weera Pothiruk, Chief of Engineering Planning Section, Planning and Projects Division, Accelerated Rural Development Department

/II. HANDPUMP

II. HANDPUMP MANUFACTURERS:

1) Mr. Suphot Hantrapong, Assistant Managing Director, M/s. Muangthong Charkkol Company
2) Mr. Thongwut Kittiyarn, M/s. Kitti Chariorn Company
3) Mr. Vichai Dulyavit, Production Manager, M/s. Thai Pipe Industry Company
4) Mr. Suphet Hantrapong, Assistant Managing Director, M/s. Muangthong Charkkol Company

III. UNITED NATIONS ORGANISATIONS:

1) ESCAP Natural Resources Division : a) Mr. A.S. Manalac, Officer-in-Charge
   b) Mr. Azm Fazlul Hoque, Economic Affairs Officer
   c) Mr. Nafis Ahmad, Regional Advisor on Water Resources
2) ESCAP - Mr. Moeljono Partosoedarso, Chief, ECDC-TCDC Services
3) UNDP/Consultant - Mr. George T. Finlinson, Water Resources Planning Consultant
4) Dr. Han Tun, WHO Liaison Officer with ESCAP
5) Mr. Alan Gibbs, WHO Consultant.

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