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FEASIBILITY OF MANUFACTURE OF AN AID HAND-OPERATED WATER PUMP IN INDONESIA

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INTRODUCTION

Recognizing the need in developing countries for a constant supply of potable water and the corollary worldwide need for a long-lasting, easily repaired, locally manufactured hand-operated water pump, the Agency for International Development (AID) began in 1966 a series of contracts with the Battelle Memorial Institute to design and laboratory test a reciprocating shallow- and deep-well pump. A final design was developed and, in late 1976, AID contracted with the Office of International Programs at the Georgia Institute of Technology to evaluate the performance and acceptability of the AID pump in comparison with other pumps used in developing countries, the feasibility of local manufacture of the AID pumps, and to adapt the AID pump designs to LDC environments.

There are obvious indications at the present time that most definitely encourage further manufacture, installation, and use of the AID pump. The AID pump can be manufactured in a developing country and offers many benefits to such a country (i.e., employment generation, spare parts availability, an easily maintained, low-cost, durable pump, and less foreign exchange demands) if adequate facilities (simple foundries, pattern makers, machine shops and skilled machinists, raw materials, etc.) are available. However, a sufficient market demand as well as the availability of adequate foundries and related facilities with acceptable prices and quality controls are matters that must be determined for each individual developing country.

The purpose of this report is to describe findings by its authors during a three-week, on-site survey of Indonesia to explain the advantages of the AID pump to AID and Indonesian government officials, to estimate local costs for manufacturing the AID pump in comparison with costs of purchasing existing locally available pumps (both locally manufactured and imported), to determine whether or not a market exists in Indonesia for the AID pump, and if capabilities exist in that country for local manufacturing to satisfy that market. Data was gathered from personal observations and from very cooperative inputs by USAID/Jakarta, the Indonesian Ministries of Industry, Health and Public Works, the World Health Organization, and CARE. Without the assistance of these organizations this report would not be possible (Appendix A contains a listing of persons and organizations contacted during the on-site survey of Indonesia).

NEED FOR A HAND-OPERATED WATER PUMP IN INDONESIA

A recent World Health Organization (WHO) publication, "World Health Statistics Report," lists estimates that show 9% of the 1970 Southeast Asia rural population had reasonable access to safe water; this percentage rose significantly to 19% in 1975. In absolute numbers, 61 million people living in rural areas had reasonable access to safe water in 1970 and the figure rose to 143 million in 1975.

During the same period of time, the above-mentioned report states that Indonesia rose from 1% of its rural population that had reasonable access to safe water in 1970 to 4% in 1975. In absolute numbers, 1 million people living in rural areas had access to safe water in 1970 and a little less than 5 million in 1975. (It is estimated from WHO statistics that some 120 million people comprise the total rural population.) These estimates are broad in nature, but they do indicate the magnitude of the need for rural water program systems.

From an AID loan proposal document entitled "Indonesia -- Rural Sanitation Manpower Development," the following is extracted:

> Approximately 83% of the population, or 110 million Indonesians, live in rural areas in an estimated 46,000 villages. The vast majority of this rural populace has to depend upon unsafe water from dug wells, rivers, canals and ponds, which are always liable to be polluted. In certain islands and coastal areas where potable water is not available, water has to be brought by boat from nearby areas producing safe water. Villages in the mountainous areas of the country use bamboo pipe to carry water from natural springs. It has been estimated that little more than 1% of the total rural population had access to a safe water supply in 1974.
>
> Not surprisingly then, water associated diseases are among the outstanding health problems facing Indonesia. Recent studies have found that the infestation of parasites spread by contaminated water to be almost 100% among all age groups in a rural population survey. Furthermore, cholera and paratyphoid and infectious hepatitis have been reported. It is also clear that diseases related to deficient water supply and a lack of sanitation are among the principal causes of mortality. It should particularly be noted that diarrhea and enteritis in children under age 2 is the leading cause of death in Indonesia.

In visiting rural areas outside of Bandung and Yogyakarta there was little doubt left as to the tremendous need for water supply programs using devices such as a hand-operated water pump. With only a few small and insignificant

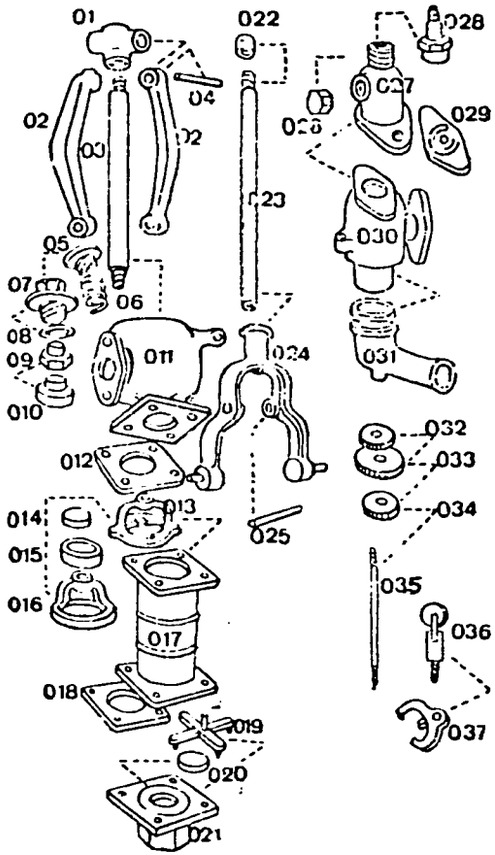
exceptions was there any evidence of attempts to provide safe water to the citizens of these areas. Rather, hundreds of examples were seen where large masses of the population depended on extremely unsanitary open wells, irrigation canals, and stagnant ponds for their daily requirements of drinking, bathing, and cooking water purposes. In each of these examples, the degree of pollution was emphasized by the sight of many people simultaneously bathing, washing clothes, washing cattle, defecating, urinating, and drawing water for domestic purposes from the same single source of supply (see Photo No. 1, 2, 3, 4 and 5 in Appendix B).

The Ministries of Industry and Health report that the need for hand-operated water pumps in Indonesia is now being only sparsely met (there is no data available as to the actual number of pumps in existence or their maintenance requirements) by imported and locally-manufactured copies of a Japanese Kawamoto Daiichi "Lucky" pump that the Georgia Institute of Technology is presently concluding a field test on in Costa Rica. However, these copies of the Japanese "Lucky" pump are not heavy-duty pumps and they will not stand up to conditions of rural life where maintenance is practically nonexistent. In fact, while the authors were inspecting existing well sites in urban Bandung, it was discovered that all locally manufactured "Lucky" pumps (commonly called the "Dragon" pump in Indonesia) observed were broken and inoperable. While the broken pumps were not disassembled and inspected, it appeared that they only needed minor repairs for replacement of worn seals and/or valves. However, spare parts were not logistically accessible and technically qualified maintenance personnel were reported to be almost nonexistent (see Photo No. 6).

It was also discovered during a visit to see foundry facilities at Ceper, a small town some 400 miles southeast of Jakarta, that the Institute of Technology - Bandung (ITB) has placed an order for approximately 420 early model AID/Battelle shallow-well pumps, funded by a Dutch international development agency. At the time of this writing, it is unknown as to what ITB is planning on doing with the pumps; however, both the Ministry of Industry and the Ministry of Health are following up on this matter to get additional details.

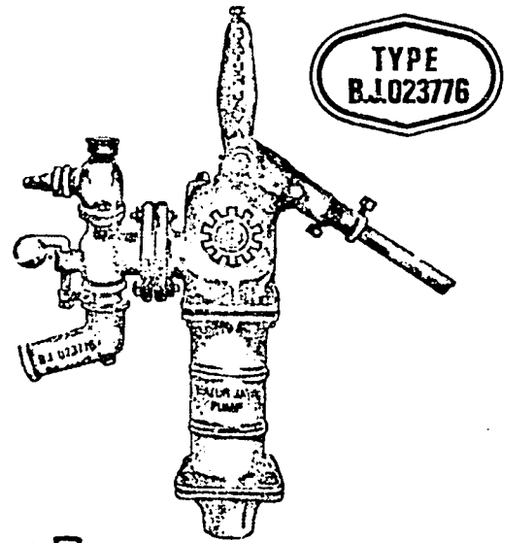
Conversations with CARE and WHO verify the previously stated conditions of a negligible supply of sanitary water for the rural and urban citizens of Indonesia. WHO is presently carrying out limited, sporadic field testing of several imported pumps (i.e., the U. S. Dempster, the U. S. Moyno, and the

SPARE PARTS



BATUR JAYA PUMP

pompa isap dan tekan



MADE IN INDONESIA
PUSAT
PEMESINAN PENGERJAAN LOGAM
BATUR JAYA

ALAMAT : BATUR CEPER KLATEN SOLO

Figure 1

NAMA² SPARE PARTS

01. T. Dragon (Head). 02. Tanganan (Double-Rod)
03. As panjang (Shaft). 04. As pendek (Pin)
05. Mur kuningan (Gland). 06 Asbes minyak.
07. Mur baut (Packing Box). 08. Ring perpact.
09. Seal (Collar-Washer).
010. Tutup mur baut (Gland Bushing).
011. Kepala (Chamber)
012. Perfact Body (Rubber Packing)
013. Rumah Klep (Upper-Plunger).
014. Karet Bandul Kecil (Valve Weight)
015. Klep mangkuk (Rubber-Cup).
016. Rumah klep (Lower Plunger)
017. Body (Cylinder-Porselain)
018. Perpact body [Rubber-Packing]
019. Rang-rang [Valve Cover]
020 Bandul Karet [Valve Weight]
021. Plendes [Valve] 022. Tutup Stang plastik / dop
023. Stang pipa 3/4". 024. Cawang
025. As pendek [Pin] 026. Tutup torong atas.
027. Torong atas [3 Way Spout Upper Body]
028. Tutup torong atas / Slang
029. Perpact lidah / Klep
030. Torong tengah [3 Way Spout Body]
031. Torong bawah [Spout]. 032. Ring plat
033. Karet torong. 034. Ring plat as torong.
035. As Torong [Change-Lever]. 036. Handel
037. Pegangan Handel [Hook].

French Vergnet pumps), but the sample size (one or two pumps each) is so small that results cannot be labeled as representative. CARE is not presently testing or installing water pumps but is in the early stages of a program that will involve water pumps later on for areas where transmigration by the federal government is being carried out.

From the foregoing, it is concluded that while actual statistical data may vary from one source to the next there is no doubt from any source that there is a definite and overwhelming need for a durable, low-cost, low-maintenance water pump such as the AID pump. The "Dragon" pump is the only pump presently being installed in Indonesia in significant quantities and this pump is not designed for multi-family heavy usage by large numbers of people, or for deep wells (which Indonesia has many of).

AID WATER PUMP MANUFACTURING CAPABILITIES IN INDONESIA

In order to determine manufacturing capabilities in Indonesia, the authors first visited the Ministry of Industry and Mr. Benito Kodijat. The Ministry of Industry was found to be most interested in having the AID pump manufactured locally and pledged its assistance by providing escorts during inspections of foundries in the Bandung and Ceper areas of Indonesia (Ceper is a small town approximately 35 miles from Yogyakarta). The Ministry of Industry also pledged its assistance, if AID should manufacture pumps in Indonesia, in the form of its providing casting patterns and technical assistance type engineers to work with local foundries if so desired by AID.

In Bandung three small-to-medium size foundries were visited that showed definite capabilities for manufacturing the AID pumps:

1. C. V. Buna Sakti Foundry and Machine Works, Jl. Suriani No. 8, Bandung, Indonesia -- This foundry was well-equipped with casting facilities (for iron, bronze, or aluminum casting), multi-speed lathes, drill presses, welding equipment, metal cutters, paint spray booths, and many assorted hand tools (see Photo No. 7). The general manager of this foundry, Mr. Akem Yuddy Pangestu, had already been discussing the possibility of locally manufacturing a water pump with the Ministry of Industry and was found to be delighted to have the opportunity to produce a pump already designed and tested. The price for the AID pump (shallow well and deep well) was quoted at between $65 and $85 for quantities of less than 50 units. For quantities of 1000 or more pumps, Mr. Pangestu felt that the unit price could be reduced to as low as $50 per pump. After inspecting samples of this foundry's present production, it appeared that the AID pump could be manufactured at C. V. Buma Sakti with some outside technical assistance. It should be noted that Mr. Pangestu volunteered to fabricate a prototype of the AID pump at no cost to AID, if necessary, to show that his foundry had the capabilities for producing a quality pump.

2. Pabrik Mesin Fa. Teha, Jl. Arjuna 29, Bandung, Indonesia -- This foundry was quite comparable to C. V. Buna Sakti in the number and types of machinery and equipment but appeared to be operating at 100% of capacity and would probably have difficulty with delivery schedules. The estimated price for the AID pump was quoted here by the chief design engineer, Mr. Yudhaka

Tanaya, at between $60 and $70 for quantities of less than 100 units. Mr. Tanaya also felt that for an order of 1000 or more pumps the price could be reduced to a unit price of approximately $50 per pump.

3. Celco Technical Industry, Ltd., 43A Jl. Jendral Gatot Subroto, Bandung, Indonesia -- This foundry appeared to be especially capable of manufacturing the AID pump and the manager, Mr. Tano Tjakrasasmita, quoted a price of $55 for orders of 50 pumps or less. Mr. Tjkrasasmita did not want to estimate a price for 1,000 or more pumps per order until he had more detailed cost information but felt sure that the price could be brought down below $50 per pump for such a sizeable order. Mr. Tjakrasasmita further agreed to also make prototypes of the AID pump prior to a production run and would continue to make prototypes until all interested parties (AID, Ministry of Industry, Ministry of Health, etc.) agreed that his quality was acceptable. Also Technical Industry, Ltd., had essentially the same equipment as the previously discussed foundries (casting facilities for iron, brass, and aluminum products, multi-speed lathes, drill presses, welding equipment, metal cutters, paint spray booths, assorted hand tools, etc.), but its cast products appeared to be more complicated and of a higher quality than C. V. Buna Sakti or Pabrik Mesin Fa. Teha (the castings appeared to be smoother and did not contain as many voids and inclusions). Lastly, the management of this company was impressive with its technical knowledge of foundry operations and seemed to be genuinely interested in manufacturing the AID pump because of its feeling that there was an apparent need for such a product in Indonesia.

In Ceper, an interesting and unique situation was experienced. Ceper is a small village-type town composed of hundreds of family-owned and operated foundries that have formed a cooperative machine shop facility for finishing operations (see Photo No. 8, 9, 10 and 11). After viewing casting operations and inspecting the work of these family-size foundries, there is little doubt that the AID pump could be manufactured in Ceper with some outside technical assistance. This opinion is reinforced by the fact that the Ministry of Industry's Metal Industries Development Centre (MIDC) is presently working with these foundries to establish standards that will reduce variations in tolerances and has pledged further assistance if AID should choose to locally manufacture the AID pump, or any other pump, in Indonesia (see Photo No. 12).

More specifically, the Ceper foundries were located in each family's backyard with a small cupola and a covered area where molds and castings were made. In the cooperative machine shop, horizontal and vertical millers, several different sized lathes, grinders, sanders, precision drilling equipment, and other machinery necessary for finishing castings were found. Personnel working in the machine shop also appeared to be highly skilled and productive in their assigned tasks.

The most surprising thing about the Ceper foundries and their cooperative machine shop was that they were in the beginning stages of producing approximately 420 early model AID/Battelle shallow-well pumps for the Institute of Technolcgy - Bandung at a price that is expected to be about $70 (the final price will depend on more accurate cost estimates that are still being calculated). As mentioned earlier, both the Ministry of Industry and the Ministry of Health are following up on this matter to get additional details.

Retail shops were visited in the Bandung area to see how widely distributed the "Dragon" pumps could be found and at what price. The "Dragon" pumps were readily available at a price varying from $15 to $25, depending on the manufacturer (many of which were from the hundreds of Ceper family-owned foundries) and there were imported pumps of the same design from Taiwan for $39. These pumps were not of a sturdy nature, had especially thin cylinder walls, and the Ministry of Industry has reported that they last no more than two years before being discarded for a replacement pump. In addition, these pumps are for shallow wells and single-family use, rather than multi-family village use and are not suitable for deep wells.

CONCLUSIONS AND RECOMMENDATIONS

There are three distinct conclusions that can be reached from the previously mentioned observations:

1. The AID pump can be manufactured in Indonesia at an acceptable level of quality at any of the foundries and machine shops visited.

2. The AID pump can be manufactured in Indonesia at a reasonable cost to the purchaser of between $50 and $75.

3. The need for both urban and rural potable water supply programs involving cost-effective hand pumps such as the AID pump is overwhelming in Indonesia.

From the above, it is reasonable to suggest that a program be carried out by AID in Indonesia that would allow several foundries to manufacture a limited number of AID pumps and then have the locally manufactured pumps tested in rural areas under actual field conditions. Such a program has the support of USAID/Indonesia and the Ministries of Industry and Health because of the pressing need for potable water supply systems in Indonesia. Such a program would also positively impact on the employment level of Indonesia industry, effect a more favorable balance of trade, make spare parts more available (as opposed to using imported pumps and spare parts that require a long purchasing lead time), and would provide a locally manufactured pump now unavailable that is easily maintained, low in cost, and designed for durability. Further, the locally manufactured "Dragon" pumps now available in Indonesia (the only type pump available on the local market) are basically for shallow wells (25 feet or less in depth) and there is a great need for a locally manufactured deep-well pump, such as the AID pump, that can withstand the stress associated with lifting water from depths of greater than 20-25 feet (neglecting friction, stress on working components of a pump increases as the depth of a well increases).

Such a program as described above would also be extremely beneficial to USAID/Indonesia in the development of an upcoming program entitled "Indonesia -- Rural Sanitation Manpower Development" and designed to train sanitarians and sanitary technologists in the delivery of environmental sanitation facilities to the rural population of Indonesia. The training of these sanitarians and

sanitary technologists will include the "installation and maintenance of hand pumped wells." By carrying out a pilot program in Indonesia to test the capabilities of local pump manufacturers, there would be a mechanism available that would allow the trainees to participate in on-site activities involving the various working components of a hand-operated water pump, the preparation of well structures to support water pumps and to seal out surface water contamination, disinfection of contaminated water, and pump installation and maintenance techniques. After these trainees have completed their formal education, they will have practical experience and will be familiar with various hand pumps that are available for their use when they are later assigned to rural areas on job assignments.

More specifically, it is suggested that AID sponsor a program that will involve the following elements:

1. The purchase of at least 60 hand pumps (perhaps 10 "Dragon" pumps, 20 shallow-well AID pumps, 10 U.S.-manufactured Moyno pumps, and 20 deep-well AID pumps).

2. The provision of technical assistance to manufacturers producing test pumps.

3. The bacteriological and chemical analysis of all waters where the test pumps are to be installed, both prior to, and after, pump installation.

4. The preparation of well structures that will seal out contaminated surface waters.

5. The installation of test pumps (30 deep-well and 30 shallow-well pumps).

6. Field monitoring of AID pump performance for a one-year period.

If such a program should become a reality, there would be no problem in selecting an area for location of the field test pumps. The pumps could be located in many urban or rural areas and still serve a dire need of supplying potable water to Indonesian citizens. However, to the fullest extent possible and practical, sites should be selected which are in close proximity to each other to allow efficient use of travel funds and project personnel. Expected high usage of the pumps should be a factor in site selection. Existing sites with broken, inoperable pumps should also be given priority consideration so that site preparation would be kept to a minimum.

The program proposed herein should include the gathering of more specific cost/benefit and marketing information than was possible during a three-week visit to Indonesia. Initial per unit costs of purchasing suggested test pumps are known ($50-$75 for AID pumps, $15-$25 for "Dragon" pumps, and $400 for Moyno pumps), but long-term, overall costs are unknown. For instance, is it more cost effective to initially pay $75 for an AID pump that might last 10 years with minimal maintenance, $25 for a "Dragon" pump that will have to be replaced every one-to-two years, or $400 for a Moyno pump that should last 15 to 20 years with practically no maintenance?

Benefits of each pump should be measured. It is certain that local manufacture has many advantages, either through production of the AID pump or the "Dragon" pump, such as in-country employment generation, spare parts availability and contribution to a positive balance of trade. In addition, the AID pump offers additional benefits of being durable enough for multi-family use, low in maintenance requirements, simple and easy to manufacture, and flexible enough for shallow or deep wells (the "Dragon" pump is for shallow wells only). The Moyno pump is U. S. manufactured but has components that might be adaptable to local manufacture, can be used in shallow or deep wells, and is also durable enough for multi-family use.

Lastly, precise marketing information on supply and demand for water pumps is scarce in Indonesia and needs to be gathered, documented, and analyzed. Available general information and on-site observations definitely indicate that there is an overwhelming need that is not being satisfied for either urban or rural potable water supply programs involving cost-effective hand pumps such as the AID pump. However, specific data is not available, for instance, on the number of pumps actually installed in rural areas of Indonesia, how many of these pumps are operational, or what the maintenance requirements are for these pumps.

Appendix A

PERSONNEL AND ORGANIZATIONS CONTACTED IN INDONESIA

PERSONNEL AND ORGANIZATIONS CONTACTED IN INDONESIA

1. Dr. Charles B. Green, Chief
   Education and Human Resources Division
   U.S. Agency for International Development
   American Embassy
   Jl. Merdeka Selatan 3-5
   Jakarta Pusat, Indonesia

2. Phillip E. Smart
   Public Health Adviser
   U.S. Agency for International Development
   American Embassy
   Jl. Merdeka Selatan 3-5
   Jakarta Pusat, Indonesia

3. William H. Littlewood
   Science and Technology Advisor
   U.S. Agency for International Development
   American Embassy
   Jl. Merdeka Selatan 3-5
   Jakarta Pusat, Indonesia

4. Tatang Soeriaatmadja
   Office Manager and Program Assistant
   Science and Technology Office
   U.S. Agency for International Development
   American Embassy
   Jl. Merdeka Selatan 3-5
   Jakarta Pusat, Indonesia

5. Ir. D. Soepardi Haroen Al Rasjid
   Jl. Gegerkalong Girang
   Kompl. Dept. Perindustrian
   No. 55D
   Bandung, Indonesia

6. Ir. Benito Kodijat
   Special Assistant
   Ministry of Industry
   Jl. Kebon Sirih 36
   Jakarta, Indonesia

7. Dipl. Ing. Hamzah Yunuzir
   Assisten 11 Proyek Bipik
   Jalan Perdatam V/7
   Komplek Perindustrian
   Pancoran - Jakarta Selatan, Indonesia

8. A. Kartahardja, Director
   U.N. Regional Housing Centre
   Dep. P.U.T.L./Ministry of P.W.E.P.
   Jl. Tamansari 84
   Bandung, Indonesia

9. Ir. Afandi Dachlan
Kepala Proyek
Departemen Perindustrian
Jl. Gunung Batu 3
Bandung, Indonesia

10. (Ms.) Pat Phillips
Program Coordinator
CARE
Jl. Kiyai Maja 65
Kebayoran Baru, Jakarta, Indonesia

11. Maman Abdul Rochman
Metallurgical Engineer
Metal Industries Development Centre (MIDC)
Jl. Sangkuriang No. 12
Bandung, Indonesia

12. Ir. Suprapto
Direktorat Jendral
Industri Logan & Mesin
Jl. Gajah Mada No. 8
Jakarta, Indonesia

13. Abd. Syatari S.H.
STMA
Jl. Kusumanegara No. 1
Yogyakarta, Indonesia

14. Krt. Subanar
Kakanwil Dept. Perindustrian
D.I. Yogyakarta
Jl. Kusumanegara 3
Yogyakarta, Indonesia

15. Tano Tjakrasasmita
Director
Celco Technical Industry, Ltd.
43A Jl. Jendral Gatot Subroto
Bandung, Indonesia

16. Ir. Yudhaka Tanaya
Chief Designer
Pabrik Mesin Fa. Teha
Jl. Arjuna 29
Bandung, Indonesia

17. Akem Yuddy Pangestu
General Manager
C.V. Buma Sakti Foundry and Machinery Works
Jl. Suriani No. 8
Bandung, Indonesia

18. Oerip Mursyidi
Manager
Batur Jaya
Koperasi Pusat Pemesinan Pengerjaan Logan
Batur - Ceper
Klaten - Solo
Indonesia

19. Humberto Sanchez
WHO Sanitary Engineer
World Health Organization
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Jakarta, Indonesia

20. Dr. Bana Kartasasmita
DTC-TOOL Project Leader
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Indonesia

21. Dr. Ir. Saswinadi Sasmojo
Deputy Director
Development Technology Center
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P. O. Box 276, Bandung
Indonesia

22. Ir. Hans de Iongh
Engineer
Development Technology Center
Institute of Technology - Bandung
P. O. Box 276, Gandung
Indonesia

23. Dr. Widodo
Ministry of Health
Jakarta, Indonesia

Appendix B

PICTORIAL MONOGRAPH OF SURVEY OF INDONESIA

Photo No. 1 -- A stagnant pond of water located in the Wonosari County of the Yogyakarta Region of Java where the same, single source of water must satisfy all water requirements for the community.

Photo No. 2 -- A polluted stream within the city limits of Jakarta that serves urban poor with water for bathing, drinking, cooking, and human bodily function disposal.

Photo No. 3 -- An open well unprotected from contaminated surface or ground water.

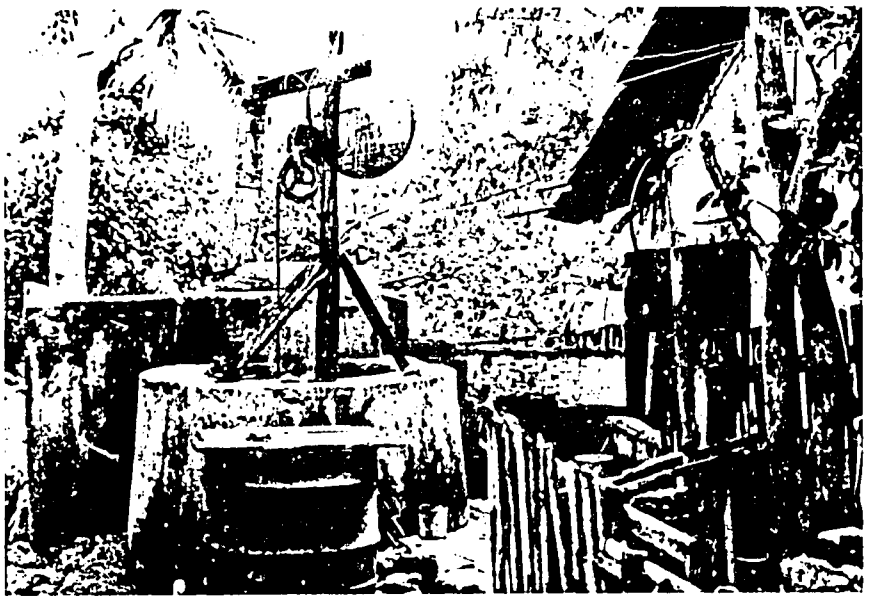

Photo No. 4 -- An open well unprotected from contaminated surface or ground water.

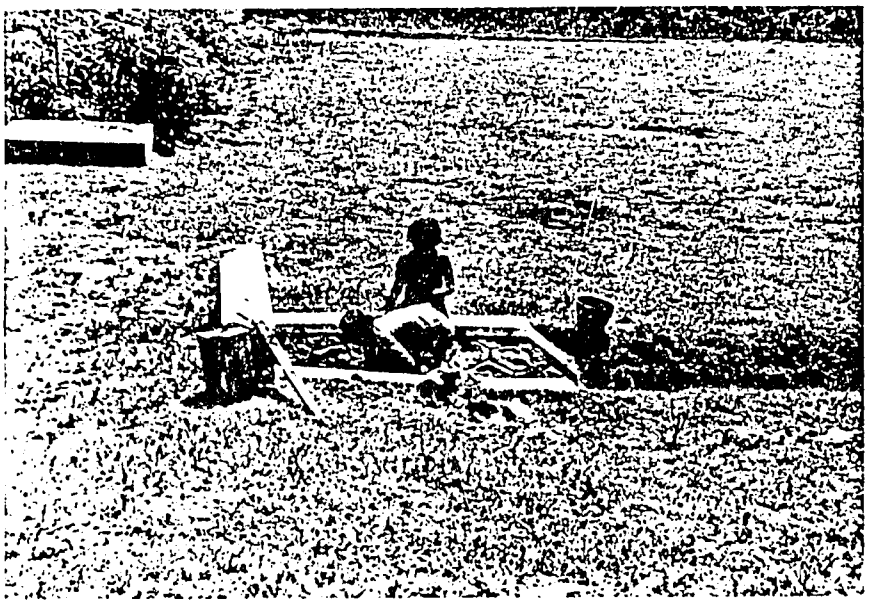

Photo No. 5 -- An irrigation ditch used for bathing, washing clothes, and domestic purposes (drinking and cooking).

Photo No. 6 -- A broken "Dragon" pump in urban Bandung where no maintenance facilities are available. The alternative to repairing the pump is to purchase a new pump and discard the old pump.

Photo No. 7 -- C. V. Buna Sakti Foundry and Machine Works, Bandung, Indonesia.

Photo No. 8 -- A family owned-and-operated foundry at Ceper.

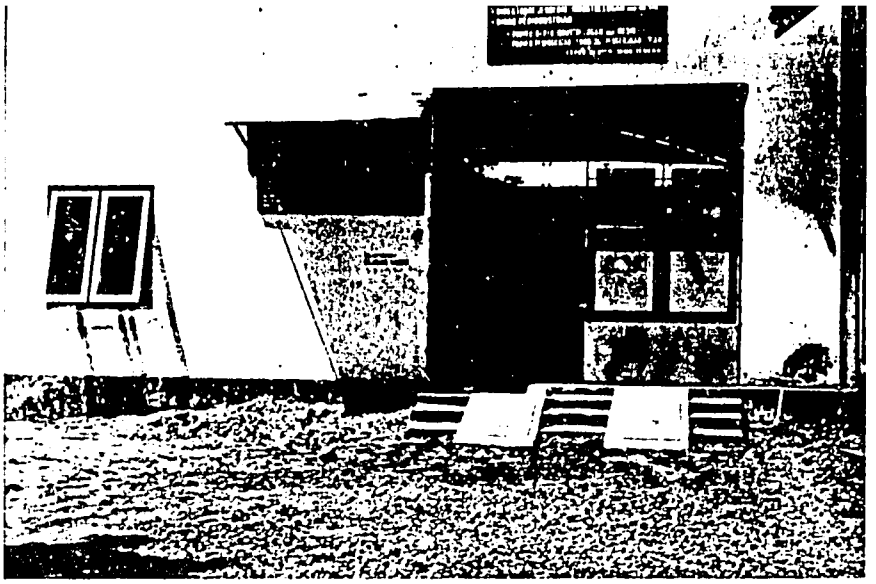

Photo No. 9 -- Batur Jaya, a cooperative machine shop facility for finishing operations required by the family-owned and operated foundries at Ceper.

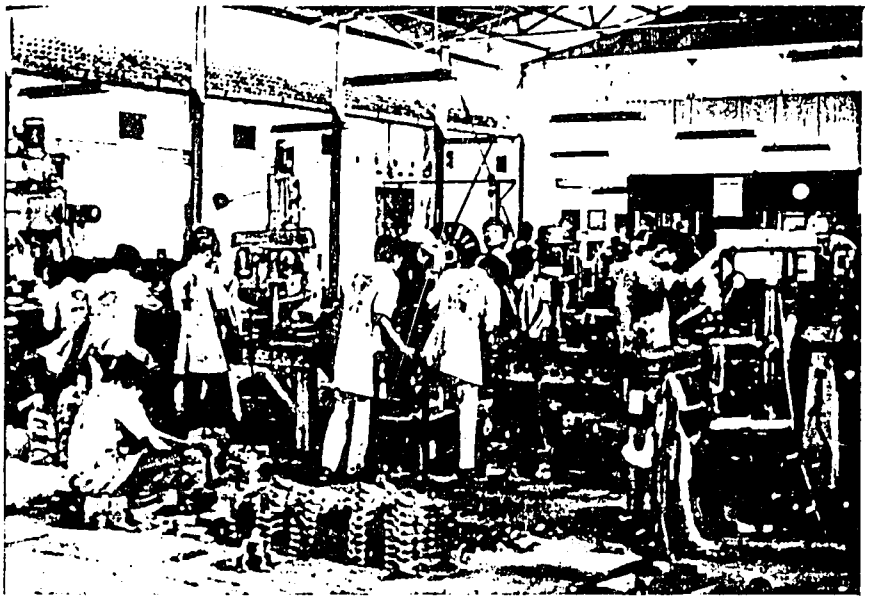

Photo No. 10 -- Batur Jaya. In this and the following photo "Dragon" shallow-well pumps are being machined and assembled.

Photo No. 11 -- Batur Jaya. The manager's salary for this cooperative machine shop is paid by the Indonesian Ministry of Industry.

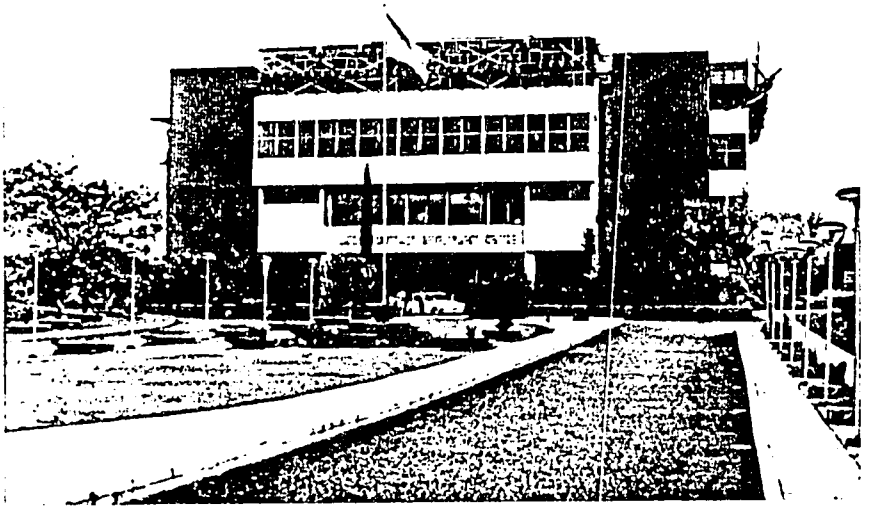

Photo No. 12 -- The Indonesian Ministry of Industries "Metal Industries Development Centre," located at Bandung, Indonesia. This centre (MIDC) has complete facilities for making castings, patterns, performing finishing operations, stress analysis, and high quality welding.