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**VILLAGE RURAL WATER SUPPLIES IN THE WESTERN HIGHLANDS  
PROVINCE OF PAPUA NEW GUINEA**

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**SUMMARY**

The 1980's have been declared the "International Water Supply and Sanitation Decade". The Papua New Guinea (PNG) Government has committed itself to spending K2.5 million between 1982 - 1985 on rural water supplies. The experience for such a programme in the Western Highlands is reviewed. Between 1975 and June 1981 there were 101 installations, 69 of which were inspected. Of these, 40.6% were working. Within one year 40% had broken down; after 4 years, 90% had broken down. Contributing factors to break downs were; the use of a cheap and inefficient hand pump on wells; use of plastic rather than metal pipes in reticulated water supplies; weaknesses in the design of reticulated supplies; and difficulties with regular maintenance. It is recommended that the government take steps to solve these problems before it commits itself to a significantly increased expenditure on rural water supplies.

"Sanitation and Rural Water Supply Decade". "Safe drinking water for all" is a key theme of the "Health for all by the year 2000" campaign.

From 1978-1980 the PNG Government and UNICEF spent K200,000 on the Highlands Rural Water Supply Project. From 1982-1985, K2.5 million will be spent by the PNG Government on rural water supplies. The Asian Development Bank has included K1.5 million on a rural water supply project as part of its proposed K10.1 million health development loan for six provinces.

But do rural water supplies work? And more importantly, do rural water supply schemes result in a reduced morbidity and mortality from "water related" diseases?

This paper summarises the experience of the Health Division in the Western Highlands Province in regard to the first question. It makes no attempt to answer the far more difficult second one.

**INTRODUCTION**

"Water related" diseases are a major cause of morbidity and mortality in all developing countries. Papua New Guinea is no exception. Poor sanitation, polluted drinking water, and shortages of water for washing of bodies, clothes, houses, and cooking utensils cause diarrhoea and dehydration, malnutrition, polio, intestinal worms, hepatitis, and skin diseases.

A pure, safe adequate water supply to the whole population should theoretically lead to a marked reduction in the morbidity and mortality of these diseases. The World Health Organisation has designated the 1980's as the

In 1975 an "Environmental Health Demonstration Unit" was established in Mt. Hagen. This included a small factory for producing concrete well liners and concrete pit latrine coverslabs, and for repairing hand pumps. From 1975 to December 1977, 37 village water supplies were installed. Materials costs were paid for by private individuals, village groups, missions and local Government Councils. Installation was provided free by Health Department health inspectors with free labour contributed by the villagers themselves.

The 1978 NPEP Programme approved the 3 year "Highlands Rural Water Supply Project".

Particular features of this pilot scheme were:

1. 240 demonstration rural water supplies were constructed at selected community schools, health centres, and aid-posts in the Western Highlands, Southern Highlands, Simbu and Enga Provinces. They supplied water to these institutions and demonstrated to the communities the value of a reliable, safe water supply. The "Demonstration Units" were supervised by the local institutional officer in charge who ensure that they were not misused or vandalised. He would promptly report any breakdowns to the Health Department whose staff would promptly carry out the required maintenance.
2. The water supplies were constructed by the health inspectors, with assistance from some project labourers and village volunteers under the general supervision of the project manager.
3. Maintenance was the responsibility of the health inspectors using funds provided by Provincial Governments or the National Health Department. Between July and November 1981, Western Highlands health inspectors visited as many rural water supplies as they could and completed a standard survey form designed to determined whether the supply was in use, and if not, the reasons for its breakdown.

## RESULTS

From 1975 to July 1, 1981 a total of 101 rural water supply schemes have been installed comprising 75 sanitary wells with hand pumps,

14 reticulated piped supplies, 9 storage tanks, and 3 hydraulic rams. These schemes theoretically serve an estimated population of 29,300 people. Of these, 69 (68.3%) have been surveyed. Twenty eight (40.6%) of those surveyed were found to be working, and 41 (59.4%) were not working.

The longer a scheme had been constructed, the less likely it was to be working; this ranged from 11% working of those constructed in 1977, to 60% working of those constructed in 1981 (Table 1).

The type of water supply construction appeared to be important in regard to the length of time it functioned effectively (Table 2.).

Hydraulic rams were the least successful installation (none working); water tanks the most successful (83% working). The health inspectors conducting the survey were asked to give an opinion why the systems were not working. Reasons given were "wear and tear", vandalism and faulty design and construction (Table 3.). More than one reason was often given for a single case. The mechanical breakdown of mechanical pumps was frequently attributed to "wear and tear", and the breakdown of reticulated schemes to "errors in design and construction."

In those cases where missions or private persons contributed toward the cost, water supplies appeared to work better than when

TABLE 1: WATER SUPPLY SCHEMES - YEAR OF CONSTRUCTION

YEAR OF CONSTRUCTION	NUMBER SURVEYED	NUMBER WORKING	% WORKING	NUMBER NOT WORKING	% NOT WORKING
1975-1977	9	1	11%	8	89%
1978	15	6	40%	9	60%
1979	17	7	41%	10	59%
1980	14	6	43%	8	57%
1981	10	6	60%	4	40%
NOT STATED	4	22	50%	2	50%

TABLE 2: RURAL WATER SUPPLIES - TYPE OF CONSTRUCTION

TYPE OF CONSTRUCTION	NUMBER	WORKING	% WORKING	NOT WORKING	% NOT WORKING
Water Tank	6	5	83%	1	17%
Reticulated Supply	9	4	44%	5	56%
Sanitary Well	51	19	37%	32	63%
Hydraulic Ram	3	0	0%	3	100%
<b>TOTAL</b>	<b>69</b>	<b>28</b>	<b>41%</b>	<b>41</b>	<b>59%</b>

TABLE 3: REASON FOR INSTALLATION NOT WORKING

TYPE OF INSTALLATION	NUMBER NOT WORKING	DESIGN OR ERECTION FAULT	VANDALISM	WEAR AND TEAR
Water Tank	1	1	0	0
Hydraulic Ram	3	2	3	3
Reticulated Supply	5	4	5	1
Sanitary Well	32	2	9	24
	<b>41</b>	<b>9</b>	<b>17</b>	<b>28</b>

TABLE 4: RURAL WATER SUPPLY - SPONSOR OF PROJECT

CONSTRUCTION PAID FOR BY	TOTAL	WORKING	% WORKING	NOT WORKING	% NOT WORKING
Private, Mission	15	10	67%	5	33%
H.R.W. S.* Project	46	18	39%	28	61%
Provincial Government	4	0	0%	4	100%
Local Government Council	4	0	0%	4	100%
	<b>69</b>	<b>28</b>	<b>41%</b>	<b>41</b>	<b>59%</b>

\* Highland Rural Water Supply.

the schemes had been fully paid for by the "Project" or Local Government Councils (Table 4).

However it should also be noted that the mission or eight private schemes surveyed were constructed during 1981, and that most

of the Local Government Council schemes had been constructed before 1978.

#### DISCUSSION

The success of any Rural Water Supply Project can be measured by several parameters.

As far as "completion of work" is concerned, the Western Highlands Province project has been very successful. 80% of the planned installations for the 1978 - 80 period were completed within schedule despite delays caused by bad weather, bad roads, late delivery of supplies and so on.

As a public relations exercise it has also been very successful. Since 1975, the health inspectors have installed 23 private schemes, and there is a waiting list of almost 50. They cannot keep up with the demand. Reticulated water supplies in particular but also village wells are seen as status symbols, so that Local Government Councils and individual leaders frequently demand that they are installed in their area.

However it is questionable when 40% of schemes are not working within a year of installation and 90% are not working after 4 years if the Project can be deemed to be successful.

These results are probably as good as can be expected and other provinces will probably fare worse. A senior and very experienced expatriate health inspector spent a year designing the Project in the Western Highlands. Because it was the first province, the Project was generously supplied with materials from UNICEF, funds from the NPEP Programme and transport to visit construction sites. The road network in the Western Highlands is comparatively very good, and intra-provincial communications are easy. Community interest in water supplies is high. Most importantly, the province was able to recruit an experienced National Health Inspector to be project manager; and the Provincial Health has a staff of five enthusiastic health inspectors who are particularly interested in rural water supplies.

Most installations have been sanitary wells. These have been a failure because of the very poor quality of the handpump used. The hand-pumps (Japanese made cast iron) break down after 2 or 3 months use. Spare parts are unobtainable. Since the same part always tends to break down it is not possible to utilise some broken pumps to obtain spare parts to repair others. The authors have repeatedly tried over the last years to find an alternative handpump that is more reliable, but so far without success.

A number of wells had been vandalised and this nearly always involved the handpump. It is likely that many of these were vandalised in frustration after the pump had broken down. If a reliable pump could be used vandalism may become less of a problem. Until a reliable pump can be purchased, the wisdom of installing large numbers of new wells is to be questioned.

Reticulated water supplies have suffered from design and maintenance problems. Typically a small concrete and rock weir is constructed on a small permanent stream. A pipe feeds by gravity to one or two galvanised iron storage tanks, and then feeds by pipe, which may be a mile long, to a number of faucets. In order to save costs most pipe used is PVC plastic. Pipes are laid in shallow trenches, and may be exposed over areas of bare rock or very steeply sloping land. It has been found that the PVC pipe is easily cracked or broken wherever it is exposed. Some breakages are accidental, but most appear to be deliberate. The Highland streams contain a large amount of sediment and the small dams tend to silt up after a year or more. All dams have been built with a flushing system so that the silt can be easily removed, but this never appears to have been used. The filter on the pipe inlet from the dam had been removed on 4 occasions perhaps because it had become clogged. As a result, the pipes had become hopelessly clogged with silt and gravel, and the system could only be repaired by digging up all the pipes and starting again. A lesser problem has been due to lack of experience in designing reticulated supplies so that water flows have not been properly calculated. Often in those schemes with multiple faucets, only one tap could be used at a time. When the tap at the bottom of the hill is turned on, there was no flow in those higher up hill. A better result could be obtained if more money could be spent at the outset, using metal pipes in all exposed areas, and if the health inspectors could regularly visit each dam in order to flush it.

Hydraulic rams have been totally unsuccessful. The problems have been principally a badly designed ram and high levels of grit in the water which caused excessive wear. Inexperience in the installation of these systems by the health inspectors may also have been a con-

tributing factor.

Community interest in Rural Water Supplies has been very encouraging. Village people have been very willing to provide money to help pay for installations, and they have readily volunteered free labour. Surprisingly, they have tended not to report to the Health Division when the supply has broken down. Even health workers living next to a broken pump have not reported it when they visit the Provincial Health Office on other business. The Health Division has been aware of the need for regular maintenance and limited funds have been provided for that purpose. However, it is impossible to regularly visit all 101 installations some of which are very inaccessible. The maintenance system relies on broken installations being reported. Perhaps local villagers could be trained to maintain their own pumps. But there does not seem to be an immediate solution to the problem of maintenance.

In view of the unsuccessful outcome of the pilot scheme in the Western Highlands (despite the enthusiasm of the staff involved and the relatively unlimited supply of equipment and funds) it is questionable whether it is wise to expand the water supply scheme rapidly in order to cover the whole country. As is usual for Health Improvement programmes in Papua New Guinea, the problems have not been due to a shortage of money but to inadequate technology and a shortage of skilled manpower.

### RECOMMENDATIONS

Before the Government commits itself to a

large increase in expenditure on rural water supply schemes it should:

1. Review the performance of all previously installed schemes and determine whether they are functioning.
2. Give priority to the procurement or development of a handpump which will require minimal maintenance. Even if the cost is high, it is better to have fewer installations that work than many which do not.
3. Investigate alternative means of maintenance — either by training villagers to do their own maintenance, or by setting up adequately staffed and financed maintenance teams within the Provincial Health Divisions.
4. Investigate whether the provision of rural water supplies has any measurable impact on morbidity or mortality.

While "pure and plentiful water supplies for all in 1980's is a catchy slogan and eminently socially desirable, it is questionable whether, at this state, it is technically feasible. Unless care is taken, instead of the 1980's being remembered as "the water supply and sanitation decade" it may be remembered as "the decade of broken wells, smashed pipes and wasted money".

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