RURAL TECHNOLOGY AND COLLECTIVE ANALYSIS:

IMPROVING WATER SUPPLIES AND SANITATION

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WATER-RELATED HEALTH HAZARDS

World Health Organization figures indicate that in the underdeveloped countries 86 per cent of the rural population is without reasonable access to safe water and some 92 per cent is denied adequate excreta facilities (Feachem et al, 1977). While comparable estimates are not available for rich country rural populations, it is widely known that lack of provision for drinking water and sanitation at the rural peripheries of Western economies--such as in the Canadian north or the American Appalachians--has led to health hazards which mirror those of the Third World.

Feachem et al (1978) have proposed the classification of water-related diseases reproduced in Table 1. The same investigators emphasize that each transmission mechanism demands a particular preventive strategy (see Table 2).

Citing examples of water-related diseases which are found in both tropical and temperate rural regions, McGarry et al (1979) have discussed interventions designed to combat hepatitis, shigella dysentery and ascariasis (roundworm parasite). Hepatitis, spread by personal contact immediately following defecation, is prevented by improving personal hygiene through increased provision of water in the home for washing. However, transmission is also possible through drinking water, and therefore the quality of water needs to be emphasized at the same time. In contrast, the prevalence of Shigella is reduced primarily by increasing the quantity of water for improved hygiene. Water quality is of minimal importance in this case.

The eggs of the roundworm, or ascarid, develop outside the body when they are excreted with the faeces. "Transmission takes place by direct contact with faeces which have contaminated the yard and house", write McGarry et al (1979:5). "To combat ascariasis, emphasis must be laid on

Table 1

A Classification of Water-Related Diseases

Category	*Example*
1. Faecal-oral (Water-borne or water-washed)	Cholera Hepatitis
2. Water-washed	
(a) skin and eye infections	Trachoma, scabies
(b) other	Louse-borne fever
3. Water-based	
(a) penetrating skin	Schistosomiasis
(b) ingested	Guinea worm
4. Water-related insect vectors	
(a) biting near water	Sleeping sickness
(b) breeding in water	Malaria

Water-Related Diseases with Their Water Associations and Their Pathogenic Agent

Water-related disease	*Category*	*Pathogenic agent*
Amoebic dysentery	1	C
Ascariasis	1	D
Bacillary dysentery	1	A
Balantidiasis	1	C
Cholera	1	A
Diarrhoeal disease	1	H
Enterobiasis	1	D
Enteroviruses (some)	1	B
Gastro-enteritis	1	H
Giardiasis	1	C
Hepatitis (infectious)	1	B
Leptospirosis	1	E
Paratyphoid	1	A
Trichuriasis	1	D
Tularaemia	1	A
Typhoid	1	A
Infectious skin disease	2a	H
Infectious eye disease	2a	H
Louse-borne typhus	2b	G
Louse-borne relapsing fever	2b	E
Clonorchiasis	3b	D
Diphyllobothriasis	3b	D
Fasciolopsiasis	3b	D
Guinea worm	3b	D
Paragonimiasis	3b	D
Schistosomiasis	3a	D
Arboviral infections (some)	4b	B
Dengue	4b	B
Filariases	4b	D
Malaria	4b	C
Onchocerciasis	4b	D
Trypanosomiasis	4a	C
Yellow fever	4b	B

A = Bacteria E = Spirochaete
B = Virus F = Fungus
C = Protozoa G = Rickettsiae
D = Helminth H = Miscellaneous

(Source: Feachem et al, 1978)

Table 2

The Four Mechanisms of Water-Related Disease Transmission and the Preventive Strategies Appropriate to Each Mechanism

Transmission mechanism	*Preventive strategy*
Water-borne	Improve water quality Prevent casual use of other unimproved sources
Water-washed	Improve water quantity Improve water accessibility Improve hygiene
Water-based	Decrease need for water contact Control snail populations Improve quality
Water-related insect vector	Improve surface water management Destroy breeding sites of insects Decrease need to visit breeding sites

(Source: Feachem et al, 1978)

proper disposal of excreta--not water supply, apart from its being desirable for hand washing after defecation."

Efforts in the rural areas of the poor countries to redress the inequitable distribution of water and waste infrastructure have concentrated on the provision of potable water. However, the primacy among water-related health problems of the faecal-oral diseases--those transmitted by the pathogen passing out in the excreta of an infected person and then subsequently ingested--has meant sometimes spectacular failure for "water-only" projects. In recent years an increasing, yet still too small, number of providing agencies has come to view sanitation measures as essential to any programme designed to improve rural water supplies (Pacey, 1977a).

DEMOCRATIZING TECHNOLOGY CONTROL

As the inseparability of water supply and sanitation has gained currency in the last decade, so too has respect for the efficacy of appropriate technology, indigenous design and village science when applied to water and waste problems.

Goulet (1977) suggests that it is the rich-country monopoly on research and development maintained by the transnational corporations together with rich-country states, plus the use of consultant firms to link supplies with technology utilizers, which results in the adoption of inappropriate technologies by the underdeveloped nations. The condition of underdevelopment is thus intensified by the use of distant resources, large-scale production systems, and reliance on foreign capital and capital intensive technology (Canadian Hunger Foundation, 1976).

Out of this kind of "macro" critique and the dismal record of conventional technology transfer in the post-war international development era, has emerged an appropriate technology approach to rural water and

wastes. The use of hand-dug wells (Watt and Wood, 1977) and village maintenance of handpumps (Pacey, 1977b; Darrow and Pam, 1976; McJunkin, 1977) have received much attention in recent years. Cairncross and Feachem (1978) have outlined methods for building a variety of water supplies--including rain water collection; boreholes and tubewells; the processes of storage, filtration and disinfection; dams; bamboo and metal pipes and house connections—to serve small communities.

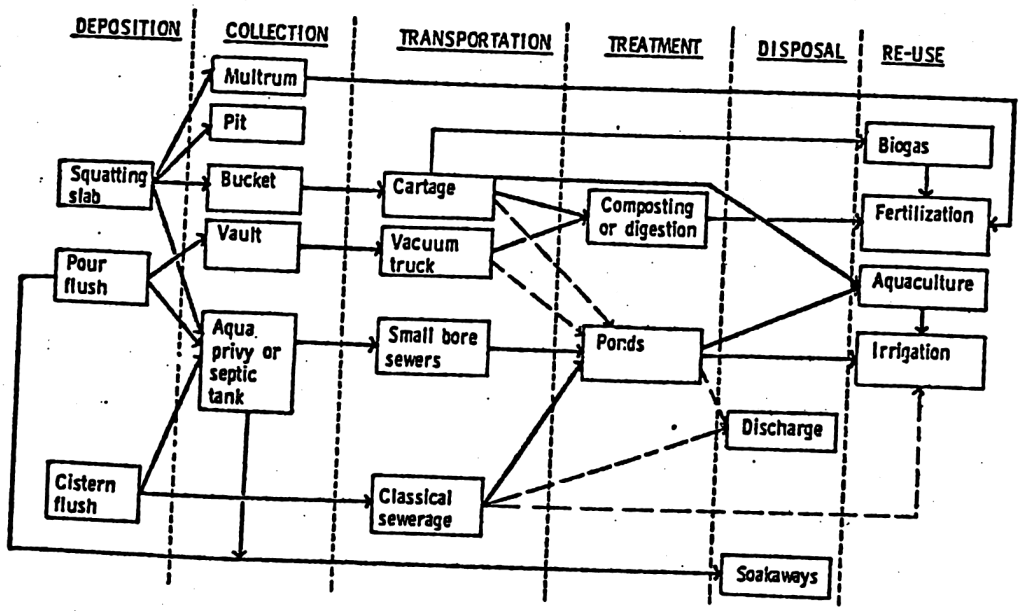
Appropriate technologies for rural sanitation have also found increasing support of late. Perhaps the most comprehensive study has been produced by Rybczynski et al (1978) who assess technical evidence of such low cost sanitation options as on-site collection and treatment (pit latrines, composting privies, septic tanks and aqua privies); collection and off-site treatment (cartage, water-borne methods, ponds, composting and aquatic weeds); reuse (irrigation, aquaculture, algae, fertilization and biogas); greywater and water saving devices. Feachem and Cairncross (1978) provide construction details for a range of excreta disposal systems appropriate to small communities. The stages of these systems are presented in Figure 1. Water-borne sewerage has been criticized for its inappropriateness environmentally and in terms of cost ineffectiveness by Van der Ryn (1978) and McGarry (1977).

Such approaches commonly promote technical control at the village level and the reduction of dependence on external resources and skills. That villagers are in fact capable of choosing the technologies most appropriate to their particular environments has been underscored in a number of parallel, and related, development debates. Whyte (1976), for example, has advocated a user-choice philosophy in rural water improvements, arguing the legitimacy and accuracy of environmental perception by local residents. A recent meeting of the People's Science Movement in India saw the call for "stimulating the technological creativity of the masses

Figure 1

ELEMENTS OF EXCRETA DISPOSAL SYSTEMS

(Source: Feachem and Cairncross, 1978)



and enhancing their capacity to create technology", in the recognition that technology is a tool in the political struggle of the exploited masses against their exploiters (Rahman, 1978:5). Even more recently, Chambers (1979) has put forth the case that the neglect by development agents of indigenous technical knowledge is "a straightforward form of inefficiency". In the same publication (Chambers, 1979), Richards argues that Third World farmers maintain a comparative advantage in certain areas of technical expertise and Howes points out that rural people regularly conduct their own experiments from which they derive practical, direct benefits.

This literature, then, describes a strong--yet still subordinate--direction within the rural development field to democratize the control of water and waste technologies. The requirement of meaningful community involvement in such participatory approaches has, in part, forced even the most conventional aid organizations to re-examine the "social side" of water supply and sanitation improvements.

THE POTENTIAL FOR COLLECTIVE ANALYSIS

The result has been a pronounced increase in attention to the dynamics of self-help, village organization and the social impact of water and waste improvements. Howell's (1977) important critical study of rural water and self-help in Kenya, Ethiopia, the Sudan and Tanzania outlines the potential for village participation in the planning, design, construction, materials, finance, celebrations and operation and maintenance of water supply improvements. The World Health Organization and Unicef are collaborating on a special study of community participation in water supply and waste disposal programmes. The effects of village organizations, such as Water Committees and Water Boards, on rural water supply maintenance and operation have been investigated in detail by Feachem et al (1978). The Canadian

International Development Agency is more frequently commissioning studies on the socio-economic impact of its rural water efforts (e.g., Norwood and Hughes, 1979). The World Bank has recently sponsored an in-depth case study analysis of the socio-cultural aspects of Latin American water and waste projects, and has designed a general model for community participation in water supply and sanitation programmes (Elmendorf and Buckles, 1978).

These and similar studies provide substantial support for the argument that collective analysis for action can maximize the chances of long-lasting, self-sustaining water supply and sanitation improvements in rural settings. Consider the following cases:

- In northern Ghana, illiterate subsistence farmers are trained as handpump caretakers. In addition to identifying and repairing pump breakdowns, these caretakers also work with the local Water Committees to analyze unhygienic water use practices by villagers and initiate relevant educational events. This project employs extension motorists who train the caretakers. Appendix A reproduces a health and water checklist to be used by the extension motorist, and illustrates the detailed technical nature of pump-site maintenance (Jackson, 1978).
- A community attitude survey, carried out jointly by citizens and extension agents, and whose results were published in the local newspaper, was an important factor in convincing the municipal government of Williams, Arizona, to raise funds for an improved water and sewerage system (Davie et al, 1974).
- A general assembly of village leaders and family heads is required to begin the legal groundwork for a village Water Board prior to the installation of a new piped water system in rural Paraguay. Learning materials--print, slides and posters--on the technical and health aspects of the new system are developed for adults and children (Cardenas, 1978).

- Residents in Jogjakarta, Java provided U.S.$10,000 worth of free labour in installing bamboo and metal pipes to transport water from a spring across two large hills into the villages. The system was designed co-operatively by village leaders with a group of local university graduates, and has been maintained by the villagers on a user-fee basis for several years now (Asian Action, 1976).

While these cases are illustrative of the potential for collective analysis in water and waste programmes, it was never their intention to focus critically, in detail, on the process of collective analysis itself. Furthermore, there does not exist in the circulated documentation of these cases sufficient data to allow others to carry out such an assessment. It is useful, therefore, to turn to a case for which somewhat more information is available.

A NORTHERN ONTARIO EXAMPLE

The Royal Commission on the Northern Environment (Hartt, 1978:215-217) recently heard testimony from residents of Ontario north of 50 degrees parallel, indicating that in the region's remote settlements, "usually it is only the medical and teaching facilities which have running water, bath and toilet facilities". The Nishnawbe--the Cree and Ojibway people of the area--typically haul water by hand from lakes and rivers and use pit latrines for excreta disposal.

The early work of the Participatory Research Project in one such community, Big Trout Lake, has been described elsewhere (Jackson and McKay, 1978). The essential problem, defined by the Band Council which represents the 600 Reserve residents, involves the participatory assessment by the Band of the most appropriate technology options for waste disposal and water supply. The people of Big Trout Lake disapproved of a government sponsored plan to install a sewerage system in their community. The people

did not want the effluent from a proposed sewage lagoon to flow into the lake, which is their major drinking water source. Furthermore, only government buildings and a minority of non-native homes would be connected to the sewer, whose cost is now estimated in excess of 1 million dollars. Subsequent analysis by specialists hired by the Band revealed the further inappropriateness of the sewer in terms of high maintenance costs, technical inadequacy of the proposed extended aeration plant and inordinately high initial and operating costs relative to other technology alternatives.

McGarry et al (1979) have outlined several of the most appropriate technology options for Big Trout Lake as a result of community dialogues and technical research. These technologies include repairing existing handpumps, collecting rainwater, and hauling drinking water by truck as well as improving existing latrines, pumping non-native septic tanks and carting sewage away by truck. These technologies provide for a democratized access to services across the community, lower initial and operating costs, and are compatible with the environment and the culture of the community.

At one recent point in the process of the community's assessment of these options, a group of Big Trout Lake women were brought together by a local woman in a meeting completely independent of the Band's consultants from the south and entirely on a volunteer basis. Thirteen women of a variety of ages attended, representing all the geographic areas of Big Trout Lake, including the main residential area on the island and the three more recently settled areas on the mainland.

The organizer of the meeting had reviewed and made both written and diagrammatic summaries of a very complex, technical report on the options, produced by the Band's professional consultants. She verbally presented the major recommendations of the report to the group of women for their evaluation. The meeting, opened by an Indian prayer, was conducted entirely in Nishnawbe, and was of about 3 hours duration. Minutes of the meeting

were produced in English for the benefit of the Band's consultants.

The improvements to the native latrines as recommended by the consultants are presented in Figure 2. The group agreed that the improved outhouse,[1] with vent pipe, seat with lid and banked log crib, should be the first method to be tried. They suggested that each household take responsibility for building their latrine structure and that perhaps students could be employed to build the cribs and install the seats and vents.

It was remarked by the group that the outhouse with liner attached to the house "will benefit the elderly as they cannot always do their own digging and building due to age and illnesses." The women suggested that new house designs should be made that would include, on one end of the house, an attached outhouse with a liner, a small porch area and a private washing area. Later, the women spent the last hour of the meeting drawing floor plans which incorporated this innovation, among others, into existing and new house designs.

Throughout the meeting, the broader contextual issues surfaced. The need to clean up the lake, polluted badly by non-natives and native people, and the government's inability to provide native people with adequate water and waste infrastructure, were critically assessed. Why had things come to this? They discussed in some detail the historical and structural reasons for the water and waste problems of Big Trout Lake, even going back as far as the signing of the Treaty in the early 1900's. One woman remarked that "during the signing of the treaties the government stated that it would stop asisting Indians when the rivers stopped flowing and

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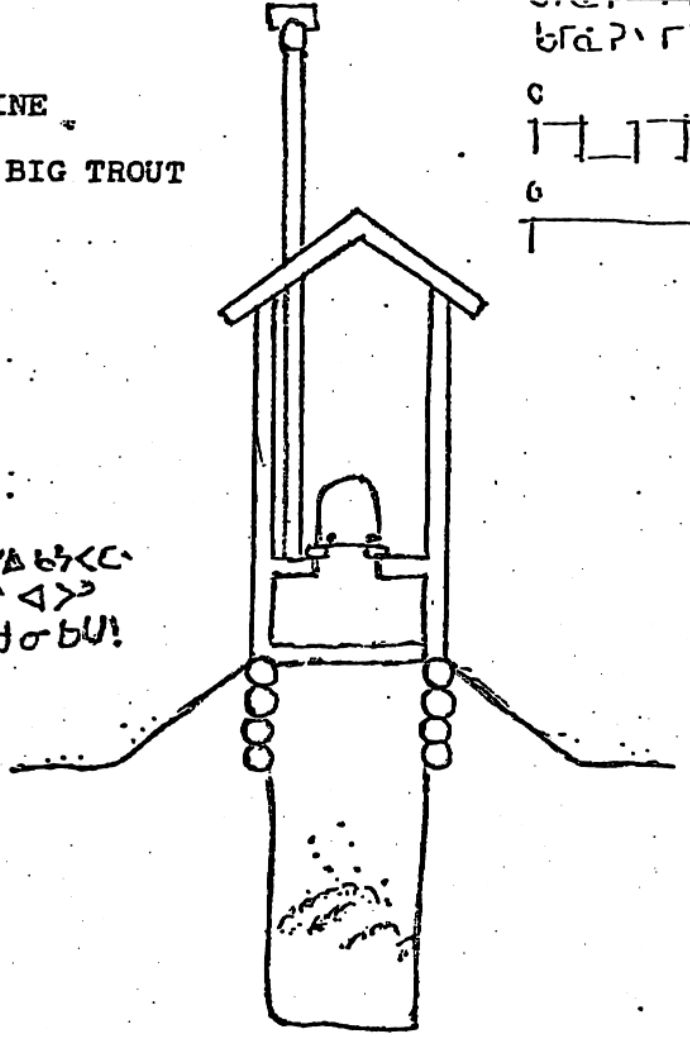
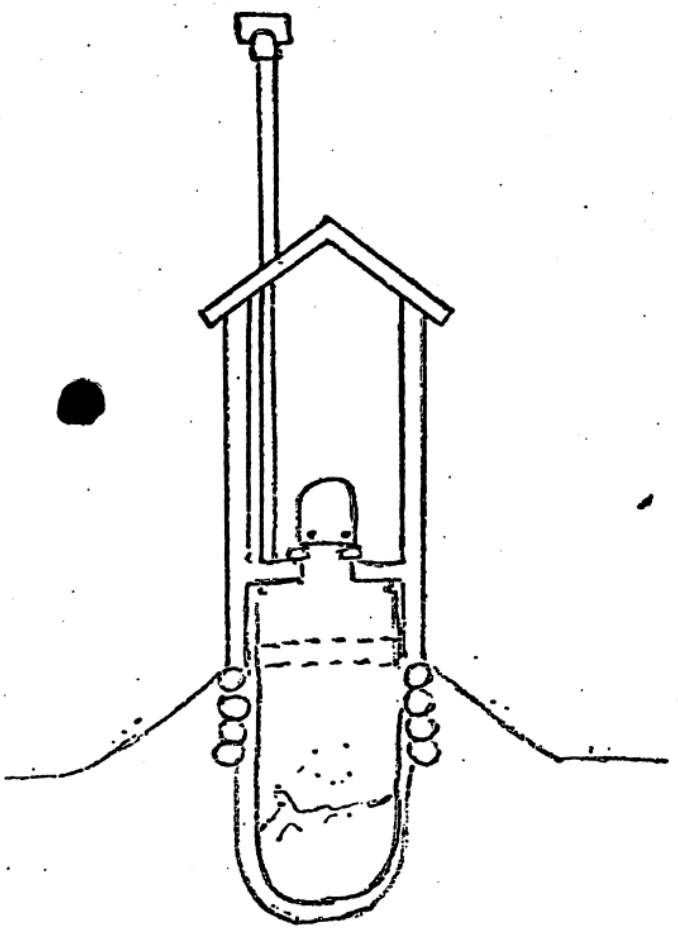
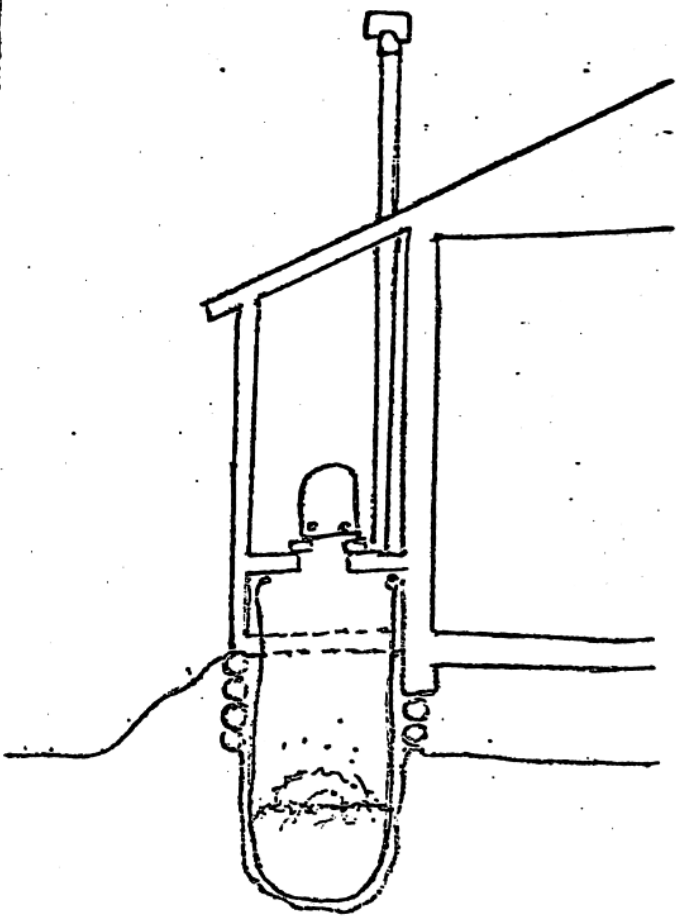
[1] One of the health hazards in the community had been found to be caused by spring run-off of faecal wastes from overflowing, ill-constructed latrines. This material would contaminate the shoreline areas of the lake, used by many for collecting drinking water.

Figure 2

RECOMMENDED LATRINE IMPROVEMENTS FOR BIG TROUT LAKE







the sun stopped shining, and nature hasn't come to that yet."

Later, responding to the suggestion that the 8 inoperable local handpumps in Big Trout Lake be repaired and maintained by local persons, the women agreed. However, they went further, suggesting that the number of pumps be doubled to reduce the distance for those who collect the water--mostly women and children. The group was also worried about the pumps being frozen, even though the consultants had suggested housing the pumps in wooden structures. "you'd still need heat," argued the women. They went on to suggest heating the pumps via an extension wire plugged into a nearby house, by a wood stove or a gas powered pump.

The group dealt in detail with many other technologies, including the trucked water and sewage system. The point here is that on two basic technologies--latrines and pumps--the women analyzed together the advantages and risks of each and generated their own very technically sound assessment and courses of action. It was obvious that these women, whose knowledge of water use in the community was sophisticated and complex, were the true experts.

In comparison with their southern "expert counterparts", they proved even more competent. In a separate meeting during the same week in the south, the Band's consultants--including a sanitary engineer, a chemical limnologist and an adult educator--generated many of the very same suggestions, criticisms and ideas for action as the women's group. And the women's group, in fact, generated a wider variety of modifications to the technologies. What participatory research claims in theory is startling for a professional to witness in practice. Yet the women who went to this meeting are not at all surprised at their own abilities to analyze and act together, to become their own experts.

POLITICAL ISSUES IN COLLECTIVE ANALYSIS FOR WATER AND SANITATION IMPROVEMENTS

Experiences in Big Trout Lake and elsewhere have demonstrated the centrality of politics in the process of collective analysis for rural water and waste improvements.

Who the improvements will benefit and who decides what the improvements will be are fundamental issues in every instance. Collective analysis may be blocked by a number of factors related to rural class structure. Unlike lower class residents, rural leaders may possess sufficient time, energy, sources of information, capital and linkages with outside agents to initiate and follow through on meetings. Village discussions may also be held strictly in the language of the dominant local faction, further consolidating elite power.

That the state is never a neutral force in technology transfer has been made clear by Goulet (1977), Eaton (1973) and others. The capitalist state works closely with the private sector to serve both the purposes of 1) the accumulation of capital and 2) the legitimization of existing social relations (O'Connor, 1973). In a fascinating current example, we find that the major Canadian handpump manufacturer, Monarch Co. Ltd. of Winnipeg, Manitoba, supplies the handpumps to both Big Trout Lake and the Upper Region Water Supply Project in Ghana detailed in Jackson (1978). The "Monarch Connection" is facilitated through two state agencies, the Department of Indian Affairs and Northern Development (DIAND) in the case of Big Trout Lake and the Canadian International Development Agency (CIDA) in the case of northern Ghana. In both instances, "go-betweens"--state employees who have worked in private sector consulting firms, or vice versa--appear to facilitate the technology penetration into the margins. Private markets are developed at low cost to the supplier, and the profits flow freely back to Winnipeg.

The state may, however, block collective analysis at the village-level by means other than defining the supplier, and thus the technology itself. Other available methods include:

- not giving technical data to the communities involved;
- negotiating for projects with only certain fractions of local elites;
- "buying off" consultants with promises of future contracts;
- delaying funds;
- creating a policy of funding only preferred technologies;
- promoting the use of large-scale, capital intensive projects by offering greater subsidies on these than on more appropriate technologies;
- subordinating within a project the social to the technical, as defined by seniority, staff size and budget.

This latter device is perhaps the most insidious and deserves special mention. There is now a greater chance of such a method being employed in very sophisticated ways in the context of the increased attention to the "social" aspects of water and wastes. There is already some evidence in, for example, the World Bank's "methodology for introduction and adoption of appropriate technologies in sanitation" (see Figure 3) to indicate that the social aspects--though acknowledged as important--remain subordinate to the technical and financial aspects of rural water and waste developments. The activity labels are laudible and the sequence of decisions not unreasonable. However, little is said with regard to power: what interests on the various committees and in the multitude of meetings retain power, through position, wealth, influence, and number of committee votes. The process of community participation is fundamentally a political process whose input/output equations directly mirror the internal class structure of a village in interaction with external class

Figure 3

METHODOLOGY FOR INTRODUCTION AND ADOPTION OF APPROPRIATE TECHNOLOGIES IN SANITATION

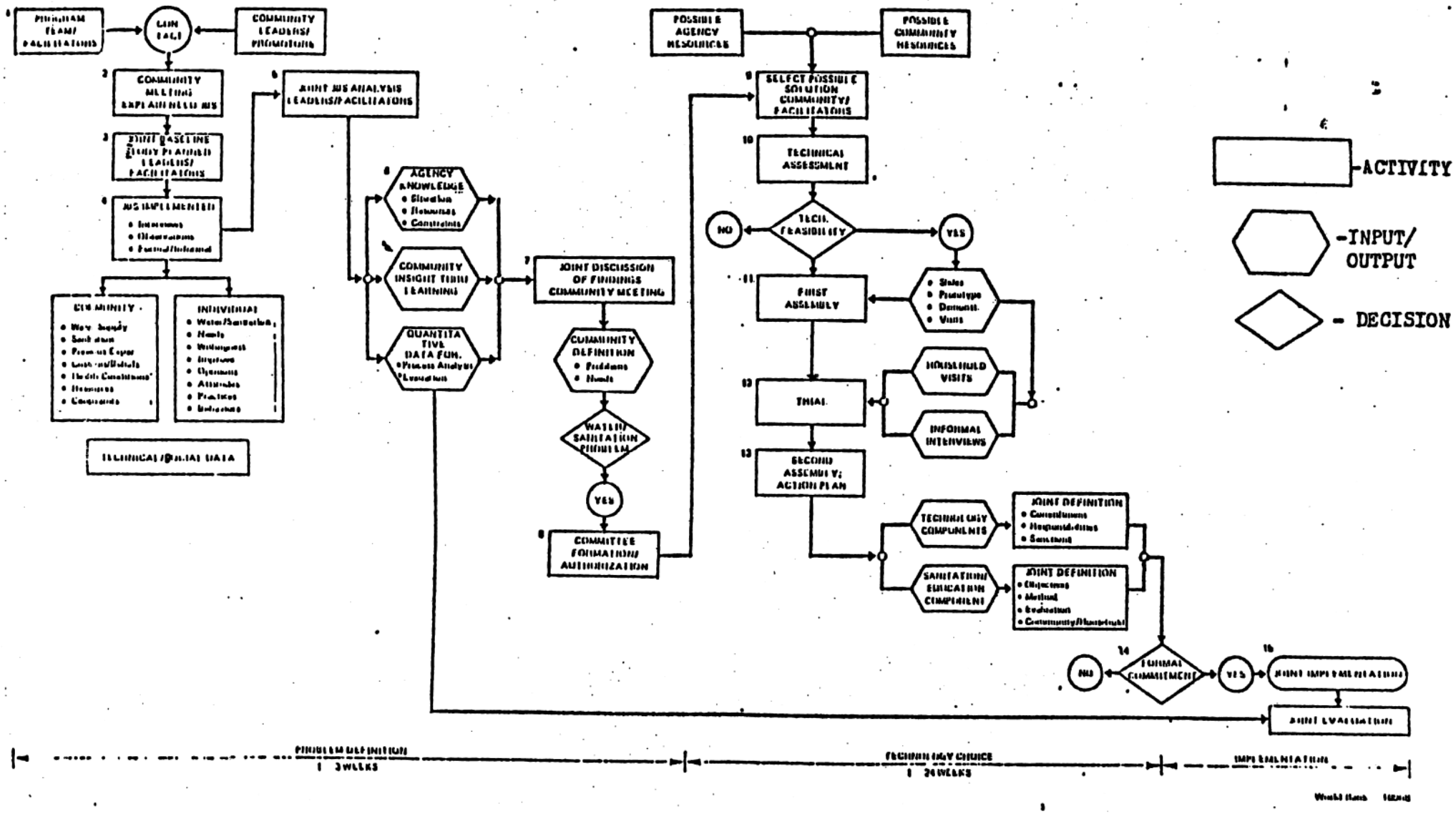


DIAGRAM 1

(Source: Elmendorf and Buckles, 1978)

fractions.

Similar dynamics are operable in the use of visual materials for collective analysis in water and sanitation efforts. Reports of such visual materials are frequently found in the literature. Ghanaian pump caretakers, for example, indicate a broken part by an "X" on a drawing of a pump, reproduced here as Figure 4. The potential of this procedure for promoting literacy training is currently under investigation (Jackson, 1978). A Panamanian handbook on how to build a latrine out of local materials employs legendary native symbols and modern construction diagrams in its visuals (Ministry of Education, 1978). Recently, a study of Nepal villagers' perceptions demonstrated the ineffectiveness of pictures or photos of water-related health problems which are not accompanied by explanation and discussion (National Development Service, 1977). Figure 5 presents an example from the study.

However, there is little evidence of cases where rural people themselves have created visual representations of their chosen technologies or current practices. Who produces the visuals materials is a political question of great importance. The current literature also tends to ignore the further question of the extent to which political struggle becomes itself the analytic focus in the creation and assessment by villagers of visuals on waterand wastes.

A final political issue relates to the role of the professional researcher or educator. The foregoing suggests that among the terms of reference for the professional engaged in village efforts towards collective analysis for water and sanitation improvements, the following tasks are important:

IF A FAULT OCCURS ON

(1) YOUR HANDPUMP, INDICATE IT BY PLACING AN X ON THE BROKEN PART.

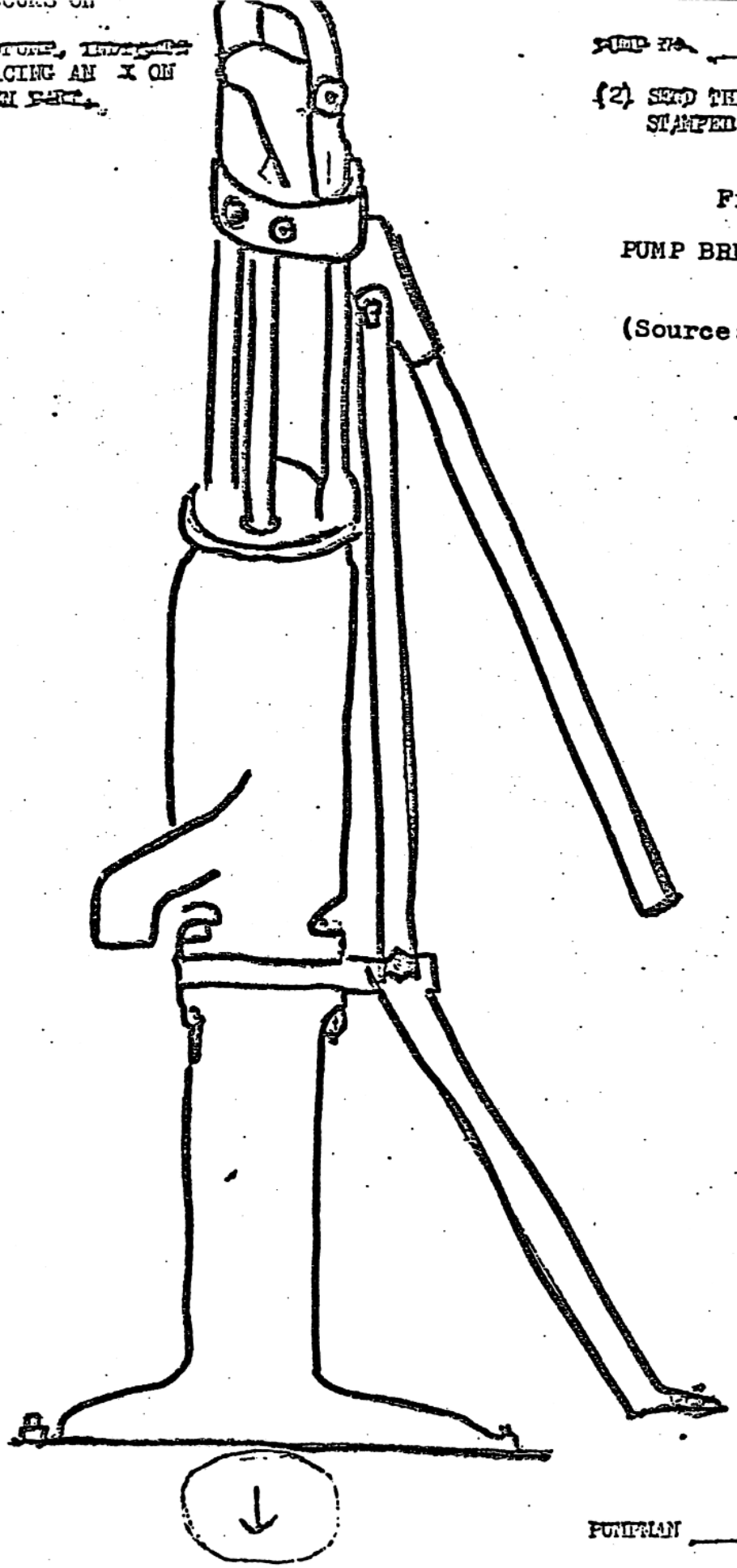
PUMP NO. _____

(2) SEND THIS FORM IN THE STAMPED ENVELOPE PROVIDED

Figure 4

PUMP BREAKDOWN REPORT

(Source: Jackson, 1978)



FAULT IS BELOW GROUND LEVEL

FOR COMMENTS, USE OTHER SIDE OF THIS PAPER.

PUMPMAN _____

VILLAGE _____

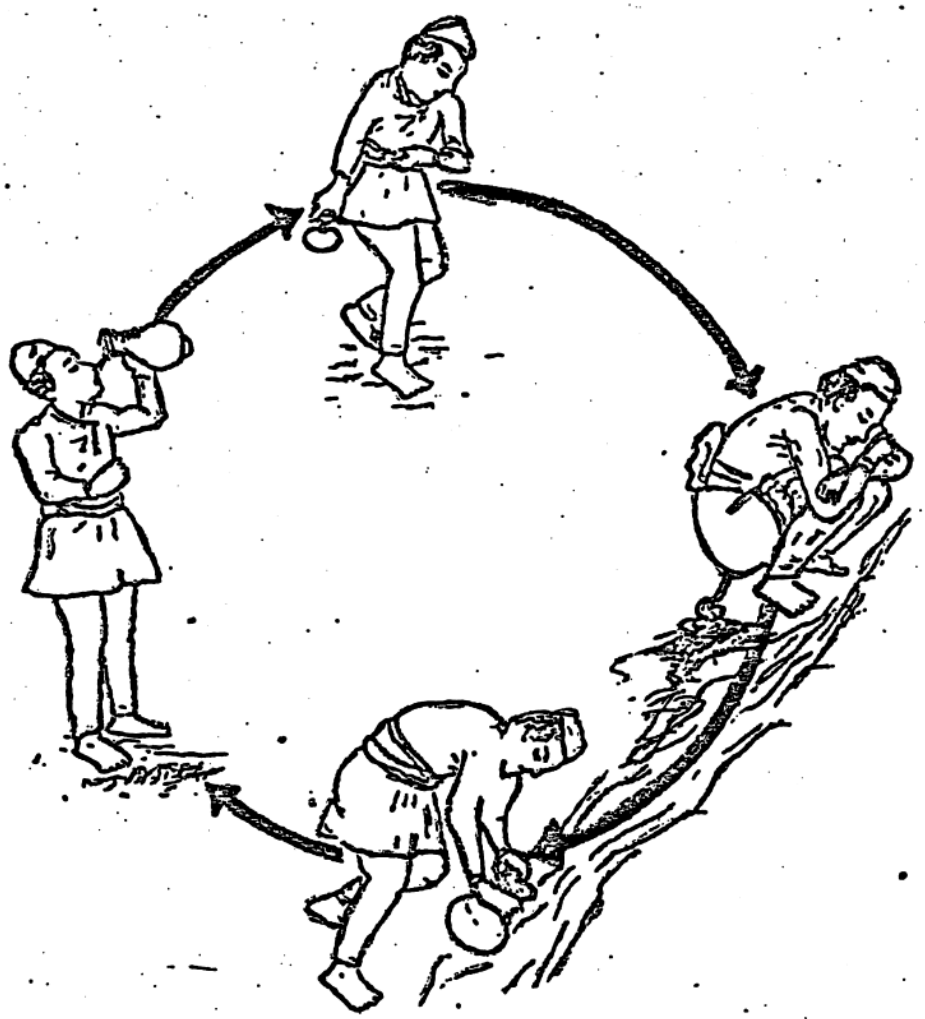
SECTION _____

Figure 5

EVALUATING WATER AND HEALTH VISUALS IN NEPAL

(Source: National Development Service, 1977)

For example, this picture was intended to convey the idea that people who drink polluted water are likely to get diarrhoea.



It was shown to 89 villagers, and only one of them understood the message behind the picture.

- to accurately and completely assimilate the design, installation, maintenance, costing, and social and health risks, of each particular technologies under study. In addition to competence in the technology of learning or research, then, the professional must be thoroughly familiar with the water and waste technologies in question.
- to translate this information in an understandable, problematized way to the broadest population of the community for their assessment through cyclical dialogue.
- to provide linkages between the community and specialist networks in such fields as engineering, architecture, limnology and public health. It is desirable, however, that contacts in these networks be predisposed to appropriate technology and local self-determination in rural development.
- to reflect and act as a partisan, a militant, on behalf of the community in <u>external</u> relations with the state and private sector.
- to reflect and act as a partisan on behalf of the lower classes in the <u>internal</u> relations of the community. What makes this latter activity so problemmatic is that, as opposed to the case of the former task, the professional is not likely to take his/her strategic direction from the local political elite. Thus internal alliances with the lower classes are independent political acts and leave the professional in a vulnerable position.
- ultimately, to <u>leave,</u> with the proviso that the professional's departure is thoroughly prepared. This means assuring that a means of technology struggle is left in the hands of the people; that perhaps local specialists are trained; or that new professionals with refined technical skills are brought in to work on more specialized problems.

What of the benefits of this work to the professional? Our experience is that, almost by definition, the professional knows how to take care of his or her own professional interests. Consulting fees, salaries, or honoraria constitute one benefit sector. However, in some cases almost equally important are the "data" generated by the villagers in their efforts at collective analysis. This labour may be efficiently appropriated by professionals for use in journal articles and presentation at conferences. Access to such data for the purposes of appropriation may be rightly seen as a form of payment to the professional, and may in the long run cost a local community less than under conventional money payment conditions. However, the more complex issue is whether or not the professional is able to further the political struggle of the local people with whom he is allied through the process of data appropriation. The possibility seems to exist.

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