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The Impact of Participation on Sustainability: An Analysis of the Malawi Rural Piped Scheme Program

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Summary. — The Malawi rural piped scheme program exemplified the participatory approach to rural drinking water supply. Today, between three and 26 years after completion, the smallest schemes, and the newest one, are performing well, but about half the schemes are performing poorly, and a third of these are functioning abysmally. Two implementation decisions would have improved performance, namely cash contributions from consumers, and the construction of smaller schemes. The participatory approach sets up community organizations capable of managing very small rural piped gravity schemes, but it does not address the need of larger schemes for support from a competent external agency. © 2000 Elsevier Science Ltd. All rights reserved

Key words — Africa, Malawi, infrastructure, water supply, participation, sustainable development

1. INTRODUCTION

For several decades, donors and governments have used participatory strategies in all kinds of poverty alleviation programs, in the belief that participation is the most effective means both to deliver and sustain benefits to the poor. Many such programs have now been completed for some time, presenting an opportunity to study the long-run impact of participation on sustainability.

Nowhere is research into this issue more relevant than for rural water supply. The emerging consensus on how better to deliver rural water supplies in the future assumes that communities will play an even bigger role than in the past, based on the belief that local organizations and institutions are best able to construct and maintain the supplies. Thus, the new approach to rural water supply rests on the same assumption about participation and sustainability that has long characterized so many poverty alleviation programs.

This article will explore the assumption about the link between participation and sustainability by presenting findings from a study of operation and maintenance on rural water supplies that were constructed under a program widely praised for its exemplary approach to community participation.

2. BACKGROUND

During the 1970s, most major donors committed themselves to providing rural social services that would have the direct and immediate effect of reducing poverty. Governments and donors had the responsibility to provide these services, so the thinking went, both on humanitarian grounds and as a means to improve the productivity of the poor and thus raise their incomes (International Labor Organization, 1977; Streeten, 1979; Streeten & Burki, 1978). Drinking water constituted one

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such service, which gained special prominence when the United Nations declared 1981–90 as the International Drinking Water Supply and Sanitation Decade. The United Nations estimated that by 1988 external agencies were spending US$ *4.5 billion a year* on improved water supplies (United Nations, 1990, p. 13).

The basic human needs strategy, as originally conceptualized, did not survive the economic crises of the 1980s. Donors perceived that governments simply could not afford to supply subsidized social services; beneficiaries would have to shoulder a significant portion of the costs. At the same time, research indicated that only public investment in education and health care seemed to have a cost-effective impact on productivity and incomes, which further undermined any economic rationale for subsidizing water projects (World Bank, 1990, pp. 74–89; World Bank, 1993b, p. 93).

As a result, thinking about the role which governments and donors should play in *providing* better drinking water supplies changed dramatically. Instead of financing and constructing as many *schemes as possible*, governments and donors should create an environment in which communities and the private sector could take on this role (Briscoe & de Ferranti, 1988). Two key principles in particular embodied the new perspective. One was "management at the lowest appropriate level," which meant that communities and local government should manage their own supplies if at all possible. The second principle was "treating water as an economic good," implying that people would get the kind of water services for which they were willing and able to pay, rather than government attempting to provide a minimum service level to everybody. The strategy came to be called "the demand responsive approach" because of this second principle.

While ideas about the role of governments and donors in rural water supply have done an about-face over the past 20 years, thinking about the community's role has shown surprising consistency. Under a demand responsive approach, users must pay for most of the cost of services, decide on the type of improvement, and take responsibility for maintaining the services (Briscoe & de Ferranti, 1988, p. 9). But similar descriptions of the community's role have been given since the beginning of the Decade and even before. By the start of the Decade, a rather extensive literature already existed on why and how to increase community participation in all phases of rural water supply (Miller, 1979; Saunders & Warford, 1976; White, 1981; van Wijk-Sijbesma, 1979, 1981). The World Bank and USAID were already taking steps to transform the precepts of community participation into policy and policy recommendations (Dworkin, 1982, pp. 17, 25–27; World Bank, 1980, pp. 5, 28–29, 35).

The original arguments for increasing community participation in rural water supply projects stemmed in large part from the basic *needs strategy*. From the beginning, participation was touted as a necessary strategy in implementing poverty alleviation programs. In fact, when the US Congress mandated USAID to pursue basic human needs in 1973, the legislators also directed the agency to promote bottom-up development and the participation of the poor. Getting beneficiaries involved would lower costs, better target people's needs, incorporate local knowledge, *ensure that* benefits were equitably distributed, and create grassroots capacity to undertake other development projects and to maintain benefits, particularly in the case of physical infrastructure (Uphoff, Cohen & Goldsmith, 1979). Decentralization and strengthening local organizations were related aspects of bringing power and responsibility down to the community (Esman & Uphoff, 1984; Uphoff & Esman, 1974). Arguments and strategies for increasing community participation in rural water supplies were to large extent a by-product of this larger *trend*.

The dramatic change in community participation in rural water supply over the past two decades lies not so much in what has been proposed as in what has been done. By the mid-1980s, most donors formally supported the idea of community *participation in rural* water supply, but few had included it in their programs, and even fewer had positive experiences with it (McCommon, Warner & Yohalen, 1990, pp. 6–7). The forms of community participation that were included often amounted to little more than demanding unpaid labor from the users, and even this so-called self-help component might be scrapped if the construction pace slowed as a consequence. But project designers and implementers continued to experiment with means to give users more responsibilities and genuine control in all phases of the projects.

Projects in Tanzania illustrate this evolution quite well. Projects begun in the early 1970s had

little to no community participation, to the extent that one donor even paid the villagers to provide unskilled labor. As these same projects went into new phases, however limited forms of participation were introduced (Therkildsen, 1988: pp. 81, 99–100). New projects designed and initiated in the early 1980s incorporated even more extensive community participation, and these elements grew over the life of the projects (Kleemeier, 1995, pp. 12, 14, 15–16; Smedt, Shordt, Ikumi & Ngubya, 1997, pp. 17–20; Therkildsen, 1988, pp. 113–114, 144–145).

Gradually a kind of standard model for participatory implementation evolved. By the late 1980s, a well-regarded participatory rural water supply project would include many, but rarely all, the elements in this ideal typical model. Table 1 lists the key features in this model, but even this long list is far from exhaustive, and new elements continue to be developed all the time. For instance, some *projects now require communities to complete* a rather elaborate application process in hope of weeding out those communities which lack the leadership or felt need deemed necessary to maintain a completed supply.

Driving this effort to increase community participation was the assumption that it could solve the problem of sustainability. The tremendous investment in rural water supply during the Decade had resulted *inter alia* in a tremendous increase in the number of broken down, poorly functioning, and little used water supplies. Briscoe and de Ferranti suggested that as many as one in four rural water supplies in developing countries were not working, and that in some countries the construction of new facilities was not even keeping pace with the failure of existing ones (Briscoe & de Ferranti, 1988, p. 5). Sector specialists thought that community *participation could prevent such* problems in the future. Various specific assumptions underpinned this faith in community participation as a means to achieve sustainability. Table 1 also lists the principal claims made about the effects that more and better community participation would have on sustainability, and how these claims relate to the specific features in the standard participatory model.

Enough of these participatory projects have now been implemented that one can treat these assumptions about the relationship between project features and sustainability as hypotheses, and examine them in light of empirical evidence. Doing so is not just an academic exercise of historic interest. These assumptions *cum* hypotheses underpin and justify in part the new demand responsive approach, which is slowly and steadily gaining the status of received wisdom in the sector, and will constitute the strategy for designing the next generation of rural water supply projects. Substituting evidence for hypotheses can only improve future project design and implementation.

Indeed, the World Bank for this reason undertook in recent years two studies into the impact of participation on sustainability (Narayan, 1995; Sara & Katz, 1997). Both studies asked whether participatory (or demand responsive) projects have a more positive impact on sustainability than projects with no or minimal participation, and both studies found the answer to be yes. The preceding review of the standard participatory model however suggests an additional question: do *rural water supplies that are implemented with* good community participation achieve reasonable levels of sustainability?

The Malawi Rural Piped Scheme Program represents an obvious place to begin researching the answer. It meets the criterion of having been completed sufficiently long ago so that neither donor financing nor government construction crews are artificially bolstering operation and maintenance. More importantly, no other rural water supply project has ever been so widely praised or so often held up as a model of why and how to do participation right (Bhatier, 1978; Briscoe & de Ferranti, 1988, pp. 9, 13–17; Chauhan, 1983, pp. 64–70; Esman & Uphoff, 1984, p. 166; Glennie, 1982, 1983; Hill & Mtwali, 1989; Krishna, 1997; Liebenow, 1981; Liebenow, 1984a,b; McCommon *et al.*, 1990, pp. 19–20; Mukela, undated; Narayan, 1995, *pp.* 49, 51, 88–92; *Ostrom, Schroeder &* Wynne, 1993, pp. 99–100; Robertson, 1980; UNCHS, 1989; Uphoff, 1986, pp. 58, 64, 66–67, 71, 78, 287–288; Warner, Briscoe, Hafner & Zellmer, 1986; Warner, Isely, Hafner & Briscoe, 1983; World Bank, 1989, p. 85; World Bank, 1993a, pp. 112–113).

3. MALAWI RURAL PIPED SCHEME PROGRAM

The Malawi Piped Scheme Program refers to the activities of the Malawi government in building gravity schemes to provide drinking water to the rural population. These activities

Table 1. *Standard features of participatory rural water supply projects and their assumed effects on sustainability*

Project feature	Assumed effect on sustainability
Meetings to explain project before it begins, community has right to refuse it	–Provide communities with adequate information on O&M costs and responsibilities–– they will choose supplies which they are willing and able to maintain, or refuse project altogether
Contract signed specifying community's and project's responsibilities	– Communities will handle O&M responsibilities if clearly defined and understood from beginning
User committee formed with design and construction responsibilities	– –Strengthen organizational skills needed to manage supplies through e.g., supervising self-help labor
	Incorporate local preferences and knowledge in choice of technology, design, and construction––users maintain supplies because meet their felt needs and in line with their ability and willingness to pay for O&M
	Community acts as watchdog to control construction quality––well-constructed schemes requisite for sustainability
	Develop sense of community ownership→users maintain supplies because theirs
	Communities learn about technology and supplies––knowledge assists in performing O&M tasks
Same committee or new one assumes O&M responsibilities	– Local organizations have better potential to assess and collect user fees, and supervise routine O&M activities, than do central government or local institutions[a]
Community upfront cash collection (to contribute to capital costs, establish O&M fund, or both)	Screen out communities which lack felt need, unwilling, or unable to maintain supplies/service level
	Develop sense of community ownership––users maintain supplies because theirs
	Strengthen organizational skills needed to manage supplies
	Users will pay for O&M if made clear from the beginning that improved water services cost money
Community provides free labor and other materials	Screen out communities which lack felt need, unwilling, or unable to maintain supplies/service level
	Develop sense of community ownership –– users maintain supplies because theirs
	Communities learn about technology and supplies — knowledge assists in performing O&M tasks
Management and book-keeping training provided to committee members; management procedures established	Strengthen organizational skills needed to manage supplies
	Locally adapted tariffs, collection procedures, etc work better than standardized procedures imposed from outside
Technical training and tools provided to local repair persons	Trained users will carry out maintenance and repairs quickly because live closest to problem, and because other users inform and pressure them
Hand over ceremony	Communities will handle O&M responsibilities if clearly defined and understood from beginning
A staff of community mobilizers to carry out the above activities	Realizing community participation depends on having an agency and field staff responsive to the users as clients
Simple technologies (VLOM handpumps, gravity schemes, protected springs, etc.)	Make it feasible for communities to participate in all phases of project, including performing and financing maintenance

[a] Uphoff defines local organizations as those whose members direct and control them. These include cooperatives, service organizations such as the Red Cross and membership organizations such as water committees. Local organizations thus defined stand in contrast to local institutions such as locally elected government or local administration representing central government ministries (Uphoff, 1986, pp. 4–6).

began in 1968, when the Ministry of Community Development and Social Welfare constructed the first small scheme. After successfully completing a second larger scheme, activities expanded nationwide, financed by the Christian Service Committee (a Malawian NGO), UNICEF, the United States, Denmark, Canada, and Oxfam (Glennie, 1983, pp. 11–16, 131–132). By 1980, 32 schemes had been completed to serve a design population of 640,600 (Glennie, 1983, pp. 131–132; UNCHS, 1989, pp. 38–40). The heyday of the program came in the 1980s when USAID provided US$ 6 million to construct 17 schemes and augment several others (Warner *et al.*, 1986, p. 63). Denmark, the African Development Bank, and

Canada also funded schemes during this period. By 1988, an additional 31 schemes had been completed or were under construction, which together with the previous schemes meant that a design population of almost 1.5 million would be served (Warner *et al.*, 1986, p. 5, 13, 17). The program began to contract from 1989, as USAID reduced support under its follow-up program (Roark, Burns, Daane, Holister & Raleigh, 1993, pp. 57–62, 65). Today, government rural gravity scheme construction has virtually ended due to lack of finance, although the World Bank has agreed to fund two new schemes and rehabilitate two more.

The piped scheme program incorporated almost all the features from the standard participatory model, as Table 2 indicates. The

Table 2. *Standard features of participatory rural water supply projects compared to features of the Malawi piped scheme program*[a]

Standard features	Malawi piped scheme program features
Meetings to explain project before it begins, community has right to refuse it	–Public meeting in area with traditional and political leaders, community must agree to provide labor and maintenance – Film on construction and other schemes shown in various areas; Main Committee taken to visit a completed scheme – *No, but the above verbal agreement made publicly by leaders*
Contract signed specifying community's and project's responsibilities	–Main Committee elected to organize initial work (e.g. on access roads and intake) and overall work program, and supervise other committees
User committee formed with design and construction responsibilities	Section Committees elected to organize trench digging for sections of main line, and supervise Village Committees
	Branch Committees elected to organize trench digging for branch lines, and supervise Village Committees
	Village Committees elected to mobilize and supervise villagers for assigned tasks, and to select tap sites in village
Same committee or new one assumes O&M responsibilities	Same or new Main Committee supervises caretaker and repair teams; collects money from Tap Committees to pay caretaker; mobilizes labor to clean tanks, repair major pipe bursts, etc.
	Repair Teams elected to repair pipe breaks and leaks; repair taps if asked; plug leaking taps if Tap Committees don't
	Tap Committees elected to care for taps, tap stands, aprons, soak pit, and surrounding area; collect money to pay caretaker, purchase taps, etc.; plug leaking taps until repaired
	Caretaker(s) selected to clean intake and screening tank, monitor and repair pipeline from intake to first tanks
Community upfront cash collection	– *No, told water is free in return for self-help labor and maintaining scheme*
Community provides free labor and other materials	Dig trenches, clear access roads, excavate tank sites, load and unload pipes, collect sand, lay pipes, back fill trenches, plant grass to mark pipeline, provide land easement
Management and book-keeping training provided to committee members; management procedures established	– *Limited. Main Committees received a 1–2 day leadership course at scheme completion. Instead, Monitoring Assistants to provide ad hoc training/back-up*
Technical training and tools provided to local repair persons	One to two days in addition to on-the-job training during construction. Repair Team Chair or Monitoring Assistant has supplies and tools
Hand over ceremony	– *Limited. Taps were handed over to users in ceremonies, but schemes were never handed over to the Main Committees*
A staff of community mobilizers to carry out the above activities	– *No, but technical staff recruited based on ability to work with rural people; program had strong community orientation*
Simple technologies (VLOM handpumps, gravity schemes, protected springs, etc.)	Unskilled labor did most of construction work – Local masons built tanks, tap aprons –Minimal skills required for majority of O&M tasks

[a] *Sources*: Briscoe and de Ferranti (1988, pp. 16–17), Glennie (1983, pp. 30–31, 66–78), Msukwa (1986, pp. 11, 13, 40–41), UNCHS (1989, pp. 22–23) and Warner *et al.* (1986, p. 40).

program also took a participatory approach to project initiation that has not yet become a standard feature in most otherwise participatory projects. For any request to be processed, a Traditional Authority chief would have to submit an application form to the District Development Council (part of local government), which would in turn prioritize the applications. The Water Department would inform the DDCs as to how many applications they could submit that year, and would then do feasibility studies for applications meeting the program's criteria (Glennie, 1983, pp. 30–31).

The feature of the standard model most notably absent was an upfront cash contribution from the community. Offsetting this to some extent was the enormous in-kind contribution from the communities, amounting to somewhere between 10% and 30% of capital costs (Msukwa & Chirwa, 1981, p. 21; Warner *et al.*, 1986, pp. 25–26, 28). (Fairly estimating the value of local contributions is difficult because the Malawian kwacha devalued quite significantly against the dollar during the 1980s.) In addition, the program provided only a limited amount of committee training, another standard feature. The strategy in Malawi was rather to have government-employed Monitoring Assistants backstop the committees as needed.

The government introduced Monitoring Assistants, the bottom rung of an operation and maintenance monitoring system, in response to weaknesses detected in the first committees (Msukwa & Chirwa, 1981, pp. 22–25; Msukwa, 1986, pp. 12–13). Monitoring Assistants lived in the rural areas served by the schemes. The duties of these field technicians were to monitor scheme operation and maintenance by at least once every six months walking the pipelines and visiting all the taps, tanks, intakes, committees, and teams. The Monitoring Assistants were also to help the Repair Teams as needed with any work that was beyond their competence, and see that the teams had sufficient tools and materials for repairs. The next rung up the monitoring system were Monitoring Supervisors, who also lived in the rural areas. These supervisors were to draw up the six-month work programs with the Monitoring Assistants, receive and verify through field visits their monthly reports, and assist with major repairs. The monthly reports also went to Senior Monitoring Supervisors and Evaluation Officers in the regional or subregional offices of the Water Department. Engineers were to redesign scheme sections that the monitoring reports revealed to have chronic problems. The senior engineer might also initiate research into widespread maintenance problems (UNCHS, 1989, p. 24).

In other words, in operation and maintenance as well as construction, the government defined its role as backstopping community efforts. The Malawi program won praise, especially from advocates of the demand responsive approach, as much for limiting the responsibilities of government in this way as for the extensive role which communities played. Malawi was the proof that government could restrict itself to providing technical assistance, training, and monitoring, that the community could take on the primary responsibility for construction and maintenance, and the result could be a replicable and sustainable rural water supply program (Briscoe & de Ferranti, 1988, pp. 13–17; Warner *et al.*, 1986, p. 41).

This last point of course was key. The Malawi program would have received little notice, if not for its impressive achievements. The program appeared replicable in that it was both large scale and low cost. In the space of 20 years, it had provided water to 13% of the population (UNCHS, 1989, p. 30). Average construction costs by 1986 were US$ 20 per capita and operation and maintenance costs were estimated at 15 US cents per capita per year (Warner *et al.*, 1986, pp. 14, 17, 23, 25, 28, 42–44). Even more impressive, program benefits seemed sustainable: the schemes functioned well after completion, rather than falling into disrepair as so many other rural water supplies had. A Water Department study of five schemes in 1982–83 found that water was available at the observed taps between 85% and 99% of the days over a period of one year, and that in case of breakdown, was restored within five days. The following year, an analysis of the reports submitted by the Monitoring Assistants for three schemes showed that selected taps had water 80% of the days. A similar study in 1984 found that selected taps in eight schemes provided water 97% or more of the days, and in the other scheme, 91% of the days. Breakages were repaired in two days or less in 91% of the cases, and in only 5% of the cases did it take more than three days (Warner *et al.*, 1986, pp. 70–71).

4. ASSESSING SUSTAINABILITY

At the core of any assessment of sustainability for a piped scheme program is a judgement about whether the schemes have delivered an adequate and reliable supply of water to the target population for a sufficient period. Therefore, the first step in researching the impact of participation on sustainability in the Malawi program was to ascertain how well the schemes functioned in terms of supplying water to their intended consumers. This step also entailed evaluating the physical state of the schemes. Assessing the condition of the infrastructure would eliminate the possibility that schemes supplying water might nonetheless be on the brink of collapse, and more importantly identify the reasons behind the poor performance of any schemes.

To do this, the research team (a political scientist and two water supply/civil engineers) accompanied by representatives of the Water Department visited 17 schemes for one day each. A typical visit began by discussing the scheme's status with the Monitoring Assistant and usually the Main Committee. The team would then visit the intake, screening and sedimentation tanks, and problem installations such as improperly filling tanks. In addition, the civil engineers would identify vulnerable parts of the system to visit, e.g., taps at the end of long distribution lines. The original intention had been to do a more thorough evaluation of scheme design and construction, but this proved impossible because at the time of the study the Water Department had misplaced all the design reports, profiles, and any as-built drawings for the sample schemes.

The political scientist returned to four of the schemes to spend four to six days interviewing Tap Committees and Repair Teams, and re-interviewing Main Committees and Monitoring Assistants. The intention behind these case studies had only been to learn more about how the community operation and maintenance structures functioned, but in practice the longer visits contributed considerable additional information on scheme functioning. One of the civil engineers therefore revisited these four schemes for one-half day each, in order to double check their original technical assessments in light of the new information.

The 17 schemes in the sample represent a cross-section of Malawi's small rural gravity schemes. The sample includes schemes from all three of Malawi's (administrative) regions, and within each region from at least two districts with dissimilar socioeconomic profiles. Of the sample schemes, 11 came from the program's first phase, when the Christian Service Committee and UNICEF provided the bulk of the financing. Five schemes were constructed during 1981–88 under the first USAID project, and one scheme was built in the 1990s by an NGO with USAID financing. The sample was restricted to schemes that originally had less than 120 km of pipeline. Large schemes were excluded mainly because their technical assessments would be too time-consuming, but in any case, most of Malawi's schemes were designed with less than 120 km of pipeline. Table 3 gives the names of the 17 schemes and their distribution according to the sampling criteria.

(a) *Findings on scheme functioning*

The 1983–84 Water Department study of reliability, described above, used data from Monitoring Assistants' monthly reports on pipe breakages to calculate the percentage of days which the taps provided water. The Monitoring Assistants' reports on the whole however no longer provide the detailed, reliable information needed to do a similar analysis. Therefore, the present study aimed only at getting a more general impression of scheme functioning, by piecing together information from the Monitoring Assistants, Main Committees, Tap Committees and other consumers, and observations at the taps and installations. This approach produced the statistics presented in Table 4. Unfortunately, the information for five sample schemes was not adequate to make similar quantitative estimates.

As mentioned earlier in this article, studies in 1982–84 found that taps in most of the sampled schemes were supplying water 90% or more of the *days*, and breakdowns were repaired within five days or less. The above statistics report on a much less rigorous standard, that is, how many *taps* were supplying water on the day of the visit (fourth column) or give water more days than not (last column).

Table 4 indicates that the schemes in general are functioning nowhere near as well as reported in 1982–84. Overall 66% of the *taps* supplied water a minimum of 50% of the days over the prior three months. In a poorly functioning scheme such as Liwonde, the majority of taps did not have water more often than they did during the three months prior to

Table 3. *Schemes selected for technical assessment of sustainability*[a]

Length of pipeline[b] (km)	South region			Central region		North region	
	Machinga District	Mulanje District	Phalombe District	Ntcheu District	Salima District	Rumphi District	Karonga District
0–10			Chiringa	Kalitsiro			
11–30		Muloza C.		Lizulu		Ng'onga	Chilumba
31–60	*Mirala*[c]						*Iponga*[c]
61–90	Zumulu[c]			Nanyangu[c]	Chipoka[d]	Hewe	
	Chagwa			Ntonda		Nkhamanga	
91–120	Liwonde[c]	Chambe					

[a] *Sources*: Glennie (1983, pp. 131–132), UNCHS (1989, pp. 38–40) and Warner *et al.* (1986, p. 17).
[b] The length of pipeline refers to the original design, except for Ntonda (Ntcheu), where about half the original taps were disconnected from the scheme and linked to another scheme. Presumably, most or all of the other schemes today have more pipeline than originally.
[c] Scheme constructed under first USAID project (1981–88).
[d] Scheme constructed in 1994 with USAID financing. All other schemes constructed prior to 1981.

Table 4. *Estimated percentages of taps supplying water during the research visit and preceding three months in selected schemes*[a,b]

Scheme	Year of completion	Number of taps	Percentage of taps supplying water during[c]	
			Research visit	Preceding three months
Chilumba	1975	37	78–89%	84–95%
Kalitsiro	1977	13	85	85
Chipoka	1994	84	84	84
Ng'onga	1972	31	81	90
Iponga	1983	36	80	89
Chagwa	1976	106	71	74
Zumulu	1984	70	70	93
Nkhamanga	1978	126	69	70
Mirala	1985	77	48	52
Liwonde	1983	137	41	42
Hewe	1977	51	14	63[d]
Nanyangu	1983	120	0	40
Total		888	48	66

[a] *Source*: Interviews and observations during visits to schemes July–August 1997, and during re-visits to Zumulu, Chipoka, Chagwa, Mirala, and Liwonde in March–April 1998.
[b] These statistics contain a wide margin for error, depending as they do on what people can remember, how they express themselves, and their possible reasons for exaggerating or minimizing problems. Some sources of error, though, will tend to cancel each other out.
[c] Taps counted as supplying water were not necessarily supplying water every day. For instance, taps included in the last column percentages were simply supplying water more days than not over the past three months.
[d] Hewe experienced several major breakdowns in the months prior to the research visit. Until these are repaired, supply cannot again reach 63% of the taps, and will rather remain at about 14% coverage.

the research visit in 1998. This figure includes many taps that had been completely dry for at least that long. Incidentally, Liwonde was included in the 1984 study, which reported that the scheme provided water 99.2% of the days.

None of the documents from the time of construction state how long the schemes would be expected to perform as well as reported in the early studies. But, everyone involved clearly anticipated that the schemes would continue to deliver water at something like these levels. The program director went so far as to state that the systems *would last 100 years* before major replacement was required (Liebenow, 1984a, p. 22). If one applies these standards, then none of the schemes are functioning at an acceptable level.

That judgement, though, seems overly harsh. In the four smallest schemes (13 to 37 taps), 80% or more of the taps supply water on a regular, if not continuous basis. This means that only a few taps in absolute terms are not working, and all parts of the original supply area are being served (with one small exception in Ng'onga). Consumer satisfaction with these schemes is relatively high. By these sorts of criteria, performance is reasonable, especially considering that Chilumba, Kalitsiro, Ng'onga, and Iponga were constructed between 15 and 27 years ago.

On the other hand, less than half the taps were working at four other schemes when the research team visited, and this appears to be the standard state of affairs in these schemes. They all had major distribution pipes that had been dry for months or years, leaving whole sections of the supply areas without water for that long. The worst case is Nanyangu, which does not have any water half the time, and when there is water only 40% of the taps receive it. In Hewe, only the first seven taps were receiving water at the time of data collection, with little indication that the situation would improve. Liwonde had 82 taps not working, equivalent to the number of taps in a medium size scheme in the sample. Mirala, like Liwonde, had around 50% of its taps not working, and the lower sections of the supply areas had not had water for nine months to several years. One cannot visit these schemes and come away with anything but a sense that they function at completely unacceptable levels.

Somewhere in-between these categories of "O.K." and "definitely unacceptable" performance lie Chagwa, Zumulu, and Nkhamanga schemes, with about 70% of their taps working when visited. All three schemes have major distribution pipes that are dry, meaning that sizeable chunks of the supply area do not get water. On the other hand, a good deal more than half the schemes' taps supply water. Chipoka also belongs in this category of marginal performance. The scheme has a high percentage of taps working, but most of the nonworking taps are concentrated in areas that have been without water or nearly so for two years or more. People in other parts of the scheme are also unhappy about the erratic supply, even if they do get water more days than not. This is pretty poor performance from a scheme that was only three years old at the time of data collection.

(b) *Findings on scheme condition*

The three most serious and immediate problems on the schemes are washed out pipes over river and gully crossings, vandalism, and pipe breaks and blockages. As Table 5 shows, these three problems caused a relatively high percentage of dry taps on four to five schemes.

Washed away pipe crossings almost inevitably affect a large number of taps. If residents can retrieve the pipe, they sometimes make temporary crossings, often repeatedly: residents at one tap complained about having to rebuild a crossing four times in four months. But the 55

Table 5. *Causes of dry taps*[a,b]

Cause	Number of schemes affected	Dry taps in past three months		Dry taps during visit	
		Number	As percentage of total taps (%)	Number	As percentage of total taps (%)
Washed out crossing	4	55	6	55	6
Vandalism	6	52	6	52	6
Pipe block or break	4	35	4	73	8
Design or construction	4	28	3	28	3
Source	2	24	3	126	14
Plugged taps	8	3	0	23	3
Flushing taps	1[c]	1	0	1	0
Uncertain[d]	8	105	12	105	12

[a] *Source*: Interviews and observations during visits to schemes July–August 1997, and during re-visits to Zumulu, Chipoka, Chagwa, Mirala, and Liwonde in March–April 1998.
[b] Dry taps were attributed to only one cause. Total number of taps in the sample was 888 (cf. Table 4).
[c] Flushing taps suspected to contribute to dry taps in two additional schemes.
[d] Most of these dry taps probably due to a partially blocked intake, combined with flushing taps, in Liwonde scheme.

taps referred to in Table 5 had been dry for anywhere from six months to several years, awaiting pipes and materials from the Water Department.

Vandalism accounted for so many dry taps because people frequently steal pipes, thereby cutting off water to groups of taps. Although thieves steal all kinds of pipe, their predilection for taking steel pipes to make hoes has the biggest impact per theft, as steel pipe is almost inevitably on a main line serving many taps. In addition to theft, some pipes are apparently cut just for malicious or frivolous reasons. Bibcocks are also frequently stolen, but the statistics in Table 5 do not capture the magnitude of this problem because in many cases the taps were then plugged (and coded as such) or were still supplying water (i.e., bibcock replaced, or tap left flushing).

Valve tampering is another kind of vandalism. In four schemes, the team came across evidence of supply problems due to consumers operating gate valves in order to direct water to their taps, and thereby depriving other taps of water. Monitoring Assistants and consumers confirmed these practices. It is hard to get an overview of this kind of clandestine tampering with the systems, and so the problem could well be even more widespread than the team was able to establish.

Pipe breaks and blockages are a larger problem than the statistics in Table 5 suggest. Often consumers at taps which were supplying during the visit or preceding three months reported that the taps had nonetheless recently been dry for weeks or months due to pipe breaks or blockages. Breaks and blockages have become such a big problem because they are the symptom of a whole host of other problems.

The team identified 10 common reasons for pipes frequently breaking or blocking, and then remaining for long periods unrepaired. Pipes break or leak frequently due to (i) exposed PVC pipe and (ii) poor previous repairs to the pipe, often with inadequate materials. Pipes block frequently because (iii) tanks are not cleaned, (iv) the lines do not have enough scour points or air valves, and (v) debris and dirt are frequently introduced into the systems during the many repairs. Once blocked or broken, pipes then remain unrepaired for long periods because (vi) Repair Teams fail to respond to consumer complaints, (vii) consumers fail to report problems with supply, and (viii) consumers refuse to provide unskilled labor necessary to assist Repair Teams in making repairs. In addition, (ix) Monitoring Assistants no longer walk the pipelines regularly looking for signs of leaks or breaks. (x) The dense bush covering many pipelines in any case makes it difficult or impossible to walk some lines, or to find leaks and breaks that are suspected in an area.

In addition to these three main problems of wash outs, vandalism, and pipe breaks and blockages, the team saw evidence of a gradual deterioration in scheme installations and capacity. The team visited 47 tanks, of which 16 were visibly leaking, 10 lacked their ball valves, and 12 had assorted other problems. Only 16 tanks had no visible physical problem, yet even some of these may have been silted, as the team could not always open the tanks, and three of them were dry due to problems on the lines feeding into or out of them. Out of the 19 intakes visited, 10 had some sort of problem. In addition, the case studies in two schemes revealed that blocked intakes caused frequent and prolonged supply interruptions during the rainy season. Considering that only two out of the 17 schemes had paid caretakers to clean the intakes, the team undoubtedly underestimated the problems affecting intakes. There is also good reason to suspect a large amount of wastage in the systems: undetected leakage from the bottom of tanks and from pipes that have been poorly repaired; and leaking or flushing taps.

Referring back to Table 5, design and construction faults appear as a relatively minor problem, although in the absence of the misplaced design reports, profiles, and as-built drawings, this is not a reliable conclusion. Some of the complaints made by consumers in the 1980s sound suspiciously like problems originating in the design phase (Ntata, Banda & Msukwa, 1990). Moreover, the team received information about design problems on schemes outside the sample. Finally, even within the sample, some dry taps have been attributed to other causes, when in fact the problem may stem from poor design and construction, e.g., poorly made crossings or the lack of air valves and scour points. Similarly, the pipes on Line D in Hewe scheme are too small to supply water to those taps, but the immediate cause for them being dry was vandalism.

Table 5 also indicates that the water source represented a relatively minor problem in that this caused dry taps in only two schemes, although both were severely affected. In one scheme, the problem was calcium in the water being deposited on the inside of the pipes and then reducing the flow. The other scheme had initially suffered from the same problem, and consequently most of its taps were connected to a neighboring mega-scheme, Mpira-Balaka. This simply created a new type of problem, as Mpira-Balaka only supplied water erratically to Nanyangu. Five other schemes could not get sufficient water from their sources in the dry season, and one of the five had difficulties even in the rainy season, but this problem could not be linked to specific dry taps.

These problems are evidence of failings at every level of the operation and maintenance system. At the grassroots level, an undoubtedly small but sufficient number of residents in the supply areas vandalize the schemes. Illicit tampering with control valves also represents a kind of vandalism. Consumers more generally undermine scheme performance through inaction, e.g., failing to report pipe breaks, to help Repair Teams, and to contribute money to replace broken bibcocks. Repair Teams also fail to perform as expected, in large part because so many members have dropped out. Although many consumers, Repair Teams, and Tap Committees have done admirable jobs, problems at this level are sufficiently widespread to make vandalism, pipe breaks and blockages, plugged taps, and possibly flushing taps, into significant problems.

At the next level up, Main Committees have failed to mobilize labor for routine maintenance such as cleaning tanks, clearing and marking pipelines, and covering exposed PVC pipe. Schemes are gradually deteriorating as a result. Main Committees have also failed to collect money to employ caretakers. Without caretakers, water supplies are frequently interrupted during the rainy season in at least two schemes, and likely others.

Finally, the Water Department at its various levels has failed to perform its backstopping functions. Misplacing all the design reports and profiles is an obvious example of this failure. Monitoring Assistants in general no longer inspect all parts of the scheme every six months; some of them who accompanied the research team could not even locate tanks and lines which they had supposedly been visiting regularly for the past four or five years. The above problems with Main Committees and Repair Teams indicate that Monitoring Assistants have not managed to provide the institution-building assistance for which their post was originally created. But shortcomings at the level of Monitoring Assistants reflect failings higher up: Monitoring Supervisors no longer visit the Monitoring Assistants regularly, or independently verify their work; and training courses for Main Committees and Repair Teams have largely ceased. By failing to supply materials such as pipe, solvent cement, and plugs, the Department is also in part responsible for why Repair Teams fail to fix pipes and plug taps. Not surprisingly under the circumstances, the Water Department has failed equally to perform its direct maintenance responsibilities on the schemes, namely to repair washed out crossings, to rectify design and construction faults, and to supply acid to clean out calcium deposits.

5. IMPROVING THE PARTICIPATARY MODEL

The preceding analysis of the problems on the schemes points to some concrete ways to improve the impact of the participatory model on sustainability. With 20/20 hindsight one can see that in particular Malawi's implementers made poor choices in regard to cash versus in-kind contributions for maintenance and to the physical size of the schemes. The schemes would likely be in at least somewhat better condition today, if other decisions had been taken on these two issues.

(a) *Cash vs. in-kind contributions*

As discussed above, the Water Department said that people would not have to pay water fees in return for participating in construction (that is, contributing 10% to 30% of capital costs). Consumers would only have to replace taps, the subsidy for which was just dropped recently. Later, the Water Department advised Main Committees to collect money to employ caretakers. (This money has always been carefully referred to as "contributions" to retain the sense of voluntary donations rather than fees.) The Water Department retained responsibility for the cash costs of all other maintenance, even the most routine.

This decision was taken for two reasons. First, plans for local government to provide the financing had to be abandoned, when the Ministry of Local Government decided that the scheme maintenance was beyond the financial capacity of most district councils in Malawi

(Glennie, 1983, p. 100). Second, the implementers believed that collecting maintenance fees from consumers would be more trouble than it was worth. The following quote from one implementer explains the thinking behind this decision.

> Consumers are usually reluctant to pay regularly towards a maintenance fund when everything appears to be working satisfactorily. The routine collection of money can become a major task which completely dominates actual maintenance work and can lead to a breakdown in the essential good relationship between the consumers and the water agency. On the other hand, communities are usually able to collect some money for a very specific item, such as a replacement tap or parts for a handpump. (Glennie 1983, p. 104)

Therefore, the Water Department adopted a strategy under which donors ended up paying the bulk of maintenance costs: the Water Department added 10% or so to the bills of quantity for scheme construction projects (Glennie, 1983, p. 100; UNCHS, 1989, p. 29). This financing naturally disappeared when the construction program and donor support ended. Now, the Department has no source of income to finance maintenance other than budget allocations from the Treasury, which are predictably minuscule. As a result, even very simple and inexpensive materials are often missing at the schemes, e.g., solvent cement, hacksaw blades, and small diameter pipes to make pipe repairs; plugs to plug up flushing taps. The lack of these materials explains in part why pipe breaks and blockages are one of the most important causes behind dry taps.

This deplorable state of affairs makes it easier to see the fallacies in the original arguments against user fees, as expressed in the above quote. First, securing finance for operation and maintenance is a major part of the maintenance task. Doing so is more critical to scheme sustainability than preserving the Water Department's good relationship with the consumers, based as this was on telling the people that water is free. Second, there are a number of ways to organize fee collection, some of which would put the main burden on the consumer organizations. The Malawi implementers seem to have shied away from user fees partly on the assumption that Water Department staff would have to collect the money. Ironically this very participatory program did not assign any real financial management role to Main Committees. Third, many of the routine maintenance tasks requiring money are very specific and easily understood by users, e.g., pipe repairs. The importance of other such tasks, such as keeping the intake clean, could be explained, particularly after they cause the water to stop flowing a few times. Raising money for hacksaw blades, solvent cement, and pipe lengths is not really so different from getting it for O-rings, U-seals, pump rods, and other handpump spares.

A by-product of asking for too little in the way of cash turned out to be expecting too much in the way of in-kind contributions, in particular volunteer labor. Maintaining the schemes requires a good deal of unskilled labor from consumers for cleaning tanks, tracing breaks and leaks, keeping the pipelines clear of brush, covering exposed PVC, and so forth. The schemes require even more time from the consumers serving on the various committees and repair teams.

Consumers may have worked more on the schemes during the coercive regime of Dr. Banda, when rural people regularly had to contribute free labor for various purposes. The literature on the Malawi piped scheme program contains numerous references to the important role which Banda's Malawi Congress Party played in getting people to work (Msukwa, 1990, p. 45; UNCHS, 1989, p. 34). On the other hand, there are also reports from the late 1980s on problems in this respect (Ntata *et al.*, 1990). In any case, the schemes today suffer from a lack of time invested in their maintenance.

The conclusions and lessons to draw from this situation are not clear. On the one hand, Yacoob and Walker (1991) argue that community-managed piped supplies are just too costly to maintain if one computes the real economic value of the community's time. In the authors' view, donors and central governments have gone ahead with such schemes by focusing only on the low financial costs and ignoring the economic costs to the community. Yacoob and Walker specifically hypothesize that Malawi's piped schemes will fall into disrepair because they are too costly in terms of time for the community to maintain (Yacoob & Walker, 1991, pp. 30, 32). On the other hand, communities might have been able to raise enough cash to pay a small gratuity to committee and repair team members, if user fees had been introduced from the beginning. That incentive might have been enough for them to do a better job of mobilizing people to work on the schemes.

(b) *Physical size of the schemes*

Malawi's piped schemes are huge compared to rural gravity schemes in a number of other developing countries. Unfortunately, few available reports describe physically the schemes that projects have constructed, but one can at least piece together an impression of size differences.

As of 1987, the median sized schemes in the Southern, Central and Northern Regions had 105, 50, and 37 km of pipeline, respectively (Kleemeier, 1998, p. 3). The largest scheme in the research sample, Liwonde, had 110 km of pipe when designed, to serve a design population of 23,000 in 30 villages over an area of 160 square kilometers. A medium sized scheme in the sample, Mirala, is half the size of Liwonde in terms of pipe length, but still serves a design population of 13,000 in 40 villages in a 47 square kilometer area. The two smallest schemes in the sample were designed with six and eight kilometers of pipe to serve populations of 1,000 and 2,000, respectively.

These very smallest of the Malawi schemes are average or large-sized compared to those in other countries. In Peru, USAID financed the construction of 51 piped schemes, each serving a village with a population under 2,000. The standard design for the largest scheme built had 12 km of pipe in total (USAID, 1981, pp. 1, 3, 5, Appendices F and I). In Indonesia, CARE has built hundreds of gravity piped schemes since 1978, most serving 1,000–2,000 people. The only information on pipe length is for a scheme serving 6,000 people and so relatively large by that project's standards which has nine kilometers of pipe (Hodgkin & Kusumahadi, 1993, pp. 1, Appendix H). In Panama, USAID funded 562 piped schemes serving villages with populations between 250 and 500 (USAID, 1982, p. ii). There is no information on pipe length, but given the very small populations served, one assumes that the schemes only had a few kilometers of pipe each. Only literature from Ethiopia reports gravity schemes somewhat larger than Liwonde (Silkin, 1998, p. 9; Olsson, Narrowe, Asfaw, Tefera & Negussie, 1996, p. 10).

Size has a tremendous impact on maintenance tasks such as repairing pipe breaks and blockages: the smaller the scheme, the fewer the pipes, and the easier it is to find the burst and blocked ones. Problems on large schemes are also that much more difficult to diagnose, because the scheme has that many more interdependent components. It becomes difficult even to find out about problems in one part of the system that are having an effect on taps 20 or 50 km away. Size also increases the burden on leaders and those who volunteer their unskilled labor. Just attending a Main Committee meeting may require some members to walk 10 to 20 km. Likewise volunteers have to walk long distances to clean tanks. Lengthy stretches of pipeline lie in the bush between villages, making the search for leaks and blockages there very time-consuming and tiresome. One can find many such examples of how management and maintenance tasks increase disproportionately with the physical size of the schemes.

These considerations explain in part why the four smallest schemes in the sample were among the top five schemes in terms of performance (cf Chilumba, Kalitsiro, Ng'onga, and Iponga in Tables 3 and 4). (Age and a particularly diligent Monitoring Assistant explain the good performance of Chipoka, the fifth scheme, which was only completed three years ago.)

6. EFFECTIVENESS OF THE PARTICIPATORY MODEL

The claims and promises about the sustainability of Malawi's piped schemes were not put in quantitative terms, but certainly one was led to expect better performance and maintenance than what characterizes them today. What does this imply about the effectiveness of the standard participatory model in delivering sustainability?

The above findings do not contradict those of the two World Bank studies mentioned earlier, which concluded that participatory projects are more sustainable than those implemented with little or no participation (Narayan, 1995; Sara & Katz, 1997). Nothing suggests that less participation would have prevented or solved the problems facing the Malawi schemes. On the contrary, less participation would imply more input from government, whereas the Water Department is having trouble in fulfilling even the relatively limited role assigned to it under the participatory model.

Consumers and community organizations are without doubt making an important contribution to scheme operation and maintenance; the problem is that this input is not sufficient to prevent significant numbers of dry

taps and a gradual deterioration in the condition of the schemes. Community groups turn out to be good at making the small repairs necessary to keep water flowing, but poor at preventative maintenance and repairs. In fact, the Malawi committees revealed rather quickly that they were not going to carry out preventative maintenance, leading the Water Department to introduce government-employed Monitoring Assistants and Supervisors. CARE found the same situation with committees that were responsible for its completed schemes in Indonesia. A study reported that most communities made repairs to the systems and had added taps, but "there was little evidence of preventative maintenance or attention to minor maintenance and repair" (Hodgkin & Kusumahadi, 1993, pp. x–xi, 26–29).

The standard participatory model at best sets up an institutional framework suitable for maintaining very small rural piped gravity schemes. The model concentrates on creating consumer groups to manage the water supplies; it does little to strengthen external agencies to support these groups after construction. With a bit of luck, small schemes do not require much more maintenance than what the active members of the consumer organizations can offer. Larger schemes, though, are more likely to run into the kind of problems requiring external technical input and financing. If that external agency is weak, the schemes will eventually perform poorly.

This at least has been the experience in Malawi. The smallest rural schemes in Malawi continue to function with most of their capacity many years after completion. The Monitoring Assistants with a few public-spirited committee and repair team members repair minor breakdowns, but do little in the way of preventative maintenance and repairs. Fortunately, this is enough to keep the schemes operating reasonably well. By contrast, Malawian schemes with more than about 30 km of pipeline have mediocre to abysmal performance. These schemes need Water Department assistance to correct design and construction faults, replace washed out crossings, diagnose why parts of the system are dry, and so forth. The schemes also need more management and repair capacity than the volunteer committees can deliver. (Whether a gratuity to these erstwise volunteers would improve capacity sufficiently remains untested in Malawi.)

Uphoff and Esman (1974) concluded many years ago that local organizations have to have links with political and administrative centers in order to be effective. In other words, rural development depends on a system of institutions with linkages among them. In Malawi we see that when local organizations have links to an ineffective administration, they can manage only the simplest types of technology.

NOTES

1. Before 1979, 14 different sections in five different ministries handled various aspects of water supply. As the result of a 1978 WHO/World Bank water sector study, the government transferred all of these departments in late 1979 to the Department of Lands, Valuation, and Water under the Office of the President and Cabinet (Warner *et al.*, 1986, p. 4). Since then, the section dealing with rural piped water has changed ministry several more times. To avoid confusion, the generic term "Water Department" will be used in this article in place of the exact name of the section and ministry handling the rural piped program at any given time.

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Environmental Enforcement and Small Industries in India: Reworking the Problem in the Poverty Context

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Summary. — Environmental enforcement in India has been *ad hoc* and generally ineffective. Environmental agencies have been more active in recent years, targeting small and medium industries. A sanction-based strategy is used to enforce environmental standards. This study shows that the present policies have severe limitations, are counterproductive to long-term environmental management and are anti-poor. A solution to these problems may be a participatory and interactive approach to enforcement backed by a package of incentives and penalties. This requires a combination of sanction and compliance-based strategies. The shift, however, is fettered by an uni-dimensional conceptualization of what is fundamentally a multidimensional problem. © 2000 Elsevier Science Ltd. All rights reserved.

Key words — India, environmental policy, small industries and participatory, interactive approach

1. INTRODUCTION

India has a fairly comprehensive set of environmental laws and regulations [1] but their enforcement has been *ad hoc*, generally ineffective and has attracted little debate. Increased environmental awareness, the provision for individual citizens to bring polluters to court, [2] and greater judicial activism, however, have pushed Pollution Control Boards [3] (PCB) into more active enforcement. A sanction-based strategy is used to enforce environmental standards. The trend has been for an individual or a PCB to bring a case against an industry or a group of firms for contravening environmental standards. The judicial response has been to set a very limited period of time for installing pollution abatement equipment or to change technology used or face closure.

An in-depth analysis (Dasgupta, 1998) of the impact of court orders issued by the Supreme Court affecting thousands of small firms in Delhi (discussed in detail in this paper), and a review of other instances of closures in India show that the *ad hoc* and harsh sanction-based responses are leading to (a) a loss of sustainable livelihood for urban poor; (b) a postponement of improved environmental management and governance by pushing end-of-pipe measures; and (c) a reinforcement of the present perception among small factory owners that environmental investment is unproductive, lowers profit and reaps no economic benefits.

Scott (1998), following a Review of the Environmental Impact of Small-scale Industries in the Third World, concluded that "relying solely on the enforcement of any statutory regulations and standards to control and reduce environmental damage by small-scale industries is unlikely to work." There is growing evidence (Lei & Yang, 1993; UNIDO, 1997; Dasgupta, 1997; Waste Management Circle Newsletters, 1997–98) of a need to assess alternative combinations of enforcement options available in the continuum of sanction-based and compliance-based approaches.

Lane *et al.* (1999) note that sanction-based strategies are underpinned by a techno-centric attitude, which assumes that pollution can be readily defined. It is perceived as a technical problem which can be "tackled by 'modern' technology, both in the enforcement and the identification of deviance." This perception has its roots in the "modernist" approach and in the early experience of the developed countries. Evidence [4] from small industries in India implies that this conceptual approach is

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