MAINTENANCE OF RURAL DRINKING WATER SUPPLIES

The impact of factors at community level

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LIDESCO/R-87/8

LIDESCO

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PREFACE

The principal objective of development initiatives is to generate self-sustaining improvements in human well-being. So far, however, little attention has been paid to the sustainability of project benefits.

LIDESCO has recently been engaged in an attempt to fill part of that gap. For some years now research has been carried out by LIDESCO under the supervision of Prof. Dr. Ir. B.F. Galjart on the organizational and sociocultural backgrounds of maintenance. One of the special areas of interest is maintenance of drinking water supplies in developing countries.

Concerning this subject R. Leeflang and F. Werter have done some preliminary studies, which among other things have resulted in several publications and research proposals* .

In the spring of 1985 LIDESCO decided to organize another small preliminary study in order to identify factors at the local level which can be said to influence the occurrence of maintenance problems for rural drinking water supplies.

A similar interest, although with a somewhat broader scope, existed at the International Reference Centre for Community Water Supply and Sanitation (IRC). LIDESCO and the IRC therefore arranged a meeting in order to balance their activities and avoid repetition.

I would like to thank Roland Leeflang for the stimulating discussions we had on the subject of maintenance, and Ian Hall and Vicky Baker for correcting the English text.

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* Leeflang and Werter; Werter 1983; Leeflang and Werter 1984.

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1 TOWARDS AN EXPLORATION OF MAINTENANCE PROBLEMS

1.1 Purpose of this study

The ongoing development of technology, together with the ever more complex production processes and the expected rise in the maintenance costs of that technology, are all reasons for focusing special attention on maintenance as a specific problem.
When estimating the relative importance of maintenance at the level of enterprises in Holland, Smit arrives at the figure of approximately 15 per cent of the added value representing the maintenance costs. Depending on the type of enterprise, he allows for a variance of 5 to 35 per cent. These figures do not include maintenance-dependent costs like the costs of a standstill, the causing of a stop or the restart of production units, maintenance by production personnel, and product-loss and products that have been declared unfit (Smit 1983: 3).
At the level of separate objects he approximates a cost of between 5 and 7 per cent of the replacement value yearly for machines, and between 1 and 2 per cent of the replacement value for buildings. This means that globally the sum of maintenance costs during the mean life expectancy of a certain object is about equal to its replacement value (Smit 1983: 4).

In the developing countries maintenance costs appear to be considerably higher, meaning several times higher than the replacement value of the supply. From the literature we know that as a consequence of many different factors in many drinking water projects, within two years of construction sometimes as much as 80 per cent of the supplies is out of order.[1] So far it seems that in the field of drinking water supplies an enormous maintenance problem has come into existence, making the sustainability of project benefits doubtful.

Close to three billion people in the developing countries will need an improved water supply by 1990. This is the overambitious goal of the International Drinking Water Supply and Sanitation Decade. Since the beginning of the Decade many countries have adopted national targets, and are in the process of developing and expanding their programs accordingly. Too much attention to the construction of new supplies compared to the rehabilitation of existing supplies, however, could well lead to the

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1 See Pacey 1977: 7; Huston 1985: 1; Hofkes 1983.

effect that no significant headway towards the goal of clean water and adequate sanitation for all by 1990 will be made.[2]
Based on a literature research we can arrive at a first global ordering of the factors capable of explaining maintenance problems - factors one should take into account when organizing design, construction, use and maintenance of new supplies:

(1) the introduction of a supply;
(2) the sociocultural backgrounds of the future users;
(3) the infrastructure of the area;
(4) the organization of use and maintenance of the introduced supply;
(5) the technical specifications of the chosen technology;
(6) the government policy.

This study was limited, however, to the local level. It should serve to identify and clarify the relevant aspects of the social, economic and cultural backgrounds of the (future) users. Therefore this report will not discuss factors at the level of government agencies in general. I will try, nevertheless, on the basis of the information gathered so far, to estimate the relative importance of the local level for the maintenance function.

1.2 Research question

This study was addressed to the following general questions:

* Which factors at the local level influence the maintenance of drinking water supplies introduced in development projects?

* Is it possible when organizing project identification, planning, design, construction, use and maintenance, to account for these factors, and if so, in which ways?

2 See Pacey et al. 1986: vi; Feachem et al. 1978; Wolman 1985.

1.3 Conceptualizing maintenance

For this study I have chosen the following definition of maintenance:

> "Maintenance comprises those activities meant to either keep objects over which an actor disposes, in the condition, or bring them back to the condition deemed necessary for fulfilling the function as defined by the actor" (Leeflang and Werter: 3).

1.4 Research methods

Data gathering for this study included use of general and more specialized literature, project documents and interviews. I held eleven interviews with persons who somehow - either as a volunteer or as an employee of one of the Dutch co-financing agencies, consultancy-agencies, or the Dutch Government - have been involved professionally in drinking water supply projects. The first four of these interviews were held in close collaboration with Ir. T. Bastemeyer of the IRC and were thus not exclusively directed at local-level factors.Selection of the respondents was not done specifically to obtain a representative sample of projects (co-)financed with Dutch funds. It is therefore not possible to attach more value to the obtained statements than that of an inventory.

The conversations frequently took the form of unstructured interviews. Keeping the research question in mind, I left the respondents free to discuss those subjects which in their opinion were relevant to the subject. The information from those interviews is concentrated primarily in Chapter Three of this report; more general literature on the subject of collective goods, and especially the work of Mancur Olson, gave substance to Chapter Two.

2 SOME THEORETICAL CONSIDERATIONS ON PUBLIC WATER SUPPLIES

2.1 Collective goods and motivation

In 1978 the sociologists Ester and Leeuw published an article in which they tried, along the lines of a theory developed by the American economist Mancur Olson, to present solutions to such diverse problems as unemployment, crime, environmental waste and population growth. According to Ester and Leeuw these social problems are characterized by a common structure. Central to that basic structure is the friction between individual behavior on the one hand and collective behavior on the other. It is this friction that forms the heart of Olson's theory.
The decay of public drinking water supplies appears to be yet another example of a social problem for which Olson's theory is applicable. Therefore, I would like to dwell somewhat longer on the meaning and intricacies of the concept of public good and the consequences the public character of a water supply has for the motivation of the users to contribute to the provision of that supply.[3]

Following Olson I will define a collective good as "...any good such that, if any person x^i in a group $x^1,...x^i,...x^n$ consumes it, it cannot feasibly be withheld from the others in that group..." (Olson, p.14).

In many situations we can consider drinking water - clean, sufficient and within easy reach - as such a collective good. Better still would be to say that a continued supply of good drinking water is a collective interest. Wherever new drinking water supplies are being installed it would seem evident that the majority of the people involved have an interest in that supply and will thus be motivated to contribute to its maintenance.

In a book that first appeared in 1965 Olson sets out to explain how many people, among whom sociologists and economists, have come to believe that groups of individuals with common interests will act on behalf of these common interests, just as we expect individuals to act on behalf of their personal interests. Later Olson makes it very clear that even though individuals in a group would gain if they reached their group target, it by no means logically follows that every individual will indeed act in order to reach that goal.

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3 The terms public good and collective good are used interchangeably.

2.2 The impact of group boundaries

Olson makes a distinction between several types of groups which can have a common interest. In the smallest type, called privileged group by Olson, the members - or at least one of them - will find that their personal gain from having the collective good exceeds the total cost of providing some amount of that collective good, even if they would have to pay the entire cost of providing it themselves. In this type of group there is a presumption that the collective good will be provided. In terms of the maintenance of drinking water supplies the following can be said. If an installation policy exists whereby the intended group of users is small, and one or some of the members of that group of users has a sufficiently big interest in the ongoing functioning of the supplies to deem it worth the trouble to contribute all alone to its maintenance, then, in such a social setting, that maintenance will probably be taken care of.
Usually, however, the size of such a group will not be larger than that of a household, and thus it is less interesting for this study. All groups over and above this size, on the other hand, will have to cope with "free riders".[4] In most drinking water projects the planned user groups for any supply will indeed be larger than the sort of group mentioned above. What happens then?[5]
Olson states that generally in these larger groups no collective good can be obtained without some group agreement, coordination or organization. Moreover, he goes on to say that the larger the group is, the more agreement and organization it will need: the larger the group, the greater the number that usually will have to be included in the group agreement or organization.

Larger groups are distinguished by the fact that whether one member does or does not help provide the collective good, no other member will be significantly affected, and therefore none will have any reason to react. The individual contribution of a single member in such a group will by definition be relatively small. Because of that, the extra chance of obtaining the collective good created by a single contribution will be very small.
This means that the efforts of the individual, even though these possibly represent a large investment for him, will have no noticeable effect on the organization. Thus, since no one in the larger group will react if someone does not help provide the collective

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4 The term free rider stands for those individuals who use a collective good but do not contribute to it.

5 The costs of individual house connections are so much higher than those which must be made for wells with or without pumps, that the first type of user group will remain relatively rare for a long time to come.

good, and the individual in question will still be able to profit from that collective good, he will not have any incentive to contribute. On a rational basis, by means of a personal cost and revenue analysis every individual can decide that his or her personal interest is being optimally served by not contributing to help provide the collective good.

2.3 How to use incentives

Acting on behalf of the group, in this case helping to provide the maintenance of a drinking water supply, can only be obtained by incentives which are separate and selective. Such incentives do not operate indiscriminately - like the collective good - upon the group as a whole, but rather selectively towards the individuals in the group. The incentives must be selective, as Olson says, so that one can treat differently those who join the organization working for the group's interest, from those who do not. These selective incentives can be either negative or positive, in that they can either coerce by punishing those who fail to bear an allocated share of the costs of the group action, or they can be positive inducements offered to those who act in the interest of the group.

Which are the incentives we are concerned with here? Economic incentives, well known to the larger part of humanity as a reward for some kind of input, are not abundant in many rural situations. Therefore, it is a good thing that economic and social status are not the same thing in most societies. Next to economic incentives there are other ones, such as esteem, prestige, respect, power and friendship. Social sanctions and social rewards are examples of the above mentioned selective incentives, meaning that they belong to the group of incentives which can be used to mobilize large groups.

In general, social pressure and social incentives operate only in groups of smaller size, in groups so small that the members can have face-to-face contact with one another. Accordingly there is no presumption that social incentives will lead individuals in large groups to obtain a collective good. This means that if the composition of the planned user group for a drinking water supply by far exceeds the face-to-face norm, the free-rider problem will grow; and informal social control alone will no longer be sufficient to cope with that problem. That norm of course can differ from one context to another.

Things are different if such a larger group is divided into a number of smaller groups in which a face-to-face contact does exist, making social incentives work again.[6]

Next to economic and social incentives, Olson's theory leaves room for force as an incentive for "maintenance friendly" behavior. However, the development of public administration in many areas in the Third World is often not such that, for example, an effective tax-raising system is feasible.

6 Although a lack of consensus of the potential users of a supply can be detrimental to the expectations of group action and group cohesion, it follows from Olson's plea that even perfect consensus concerning the wish to keep a public drinking water supply in good condition does not automatically result in the group actually acting according to that wish. Therefore, it is important to distinguish well between obstacles as a consequence of a lack of consensus, and obstacles as a consequence of a lack of individual incentives

3 THE IMPACT OF FACTORS AT COMMUNITY LEVEL

3.1 In search of systematic information

3.1.1 Field expertise or educated guesses?

All informants unanimously stressed that factors at the local level are important for the maintenance of public drinking water supplies. Nevertheless, not one of them seemed to be able to even estimate the relative weight of the specified factors at the local level in relation to those at the project level and at the government level. Secondly, they found it very difficult to distinguish between projects which are a success and projects which are not, between locations where maintenance could be called 'good' and locations where it could be called 'bad'.

One reason for this outcome is of course (their) lack of explicit criteria to evaluate their own projects. In search of such criteria one could state, in line with part of the literature, that drinking water supplies with breakdown percentages of no more than forty per cent within the first two years after completion can be called a reasonable success. Other examples from the literature, however, suggest that there is 'bad' maintenance if a breakdown percentage of forty per cent is met.[7] A second reason is that accurate knowledge about the current state of maintenance of the supplies in their own projects is often lacking. This holds especially for the larger projects. A possible third reason is that involvement with a project usually ends once the construction phase has ended, leading to a simple lack of information for those quoted in this report. Particularly the first two reasons would indicate a need for more concrete figures for planning purposes.

7 See Pacey 1977: 7; Huston 1985: 1; Hofkes 1983.

3.1.2 The nature of decisive factors at the local level

From the massive amount of variables presented, four types of factors could be distilled:

* sociocultural factors;
* economic factors;
* organizational factors;
* technical factors.

The following sociocultural factors will be discussed: the need for a supply and the priority of that need; the matter of access and distribution, or the way access to the different supplies has traditionally been distributed; how to take this traditional distribution of access into consideration when designing and constructing new supplies; knowledge and information; traditional rights; local participation in the decision-making process and in management of the supplies; power relations in the community; gearing the supply to the composition of specific user groups; and the role of cultural rules and social quality criteria concerning the supply, its use, its maintenance and its costs.

Additionally, in the section on economic factors a number of topics will be handled: financing problems; the ability and the willingness to contribute and therefore the degree of economic incorporation of the community; related to that, the possibility of forming surpluses from capital generating activities, and thus the availability of rewards in order to enable different forms of management; local experience with pooling and/or other forms of contribution; a differentiation of economic interests; and the possible role of corruption.

In the section on organizational factors the following will be treated: the lack of emphasis placed on the organizational prerequisites to sustainability of drinking water supplies so far, and some different organizational options available; the limits to government agencies and their interventions; users' maintenance and backup systems; the possibility to base a modern operation and maintenance organization on a traditional structure; the organization of user groups; the concept of accountability; local capability; the infrastructure of an area; training and education; and some examples from India and Bangla Desh.

In the discussion on technical factors several will stand out, namely: former solutions to the problem; the standardization dilemma; the demand of technological appropriateness

of a supply and the criteria to decide on that appropriateness; the different aspects of such appropriateness; user problems and the adaptation of engineering concepts to locally acceptable standards; the local technology as a starting point of project design; and the familiarity of the users with preventive maintenance.

3.2 Sociocultural factors

3.2.1 Needs and priorities

The priority a drinking water supply has for the community itself is a basic condition for ongoing success. Is the need a felt need, and if so, by which groups and/or categories in that community?[8]
Deciding on priorities is by no means simple. By informal consultation with a broad spectrum of community members, among whom are formal and informal leaders, men and women, one could arrive at such a decision. I mention men and women, because all too often their wishes do not run parallel. Frequently women are the ones who - with their children - take care of the drinking water, while men often are more interested in a productive use of water.[9]

In this context one respondent pointed out the Buba Tombali project in Guinea Bissao, where a special activation component had been built into the development program. It was precisely that component which enabled the project to assess the local needs and thus prevent too big mistakes. In this project, for example, was a village where the population (of course) agreed with the construction of a well. The activation team, however, was also informed about the salinization caused by a leaking dam. Without its repair the inhabitants would be forced to leave the area within a year. So they kindly asked the project team to repair that dam instead of spending seven thousand dollars on a well that would be out of use within half a year.

One respondent stated that during several visits to the villages in his project, drinking water appeared to have no priority at all for the local population. What did have priority, for example, was the construction of terraces on the slopes around the village. In his opinion the most important thing in a project is to give attention to the priorities of the

8 See Sumi 1985: 4.

9 See Rogers 1982: 20; Hannan-Andersson 1985: 28; Elmendorf and Isely 1982: 11; Jorgensen 1984: 23.

inhabitants when starting activities, because that at least offers a basis for a good project, that is to say, one which has a chance to be maintained.
Although at first sight such a conclusion seems to indicate failure of the project, it is possible that this also illustrates a too narrow vision of a seemingly critical observer. The desired terracing of the slopes he mentioned, might very well have been a wish uttered by the men, for example, while the women in the project possibly were happy with the project's choice of drinking water.

In one case in Indonesia it happened that the village chief became overloaded by all the projects offered by different donors: four to five projects, for which hardly any demand existed and for which completely insufficient staff were present. In the Indonesian system of patron-client relations the village chief has the responsibility to see that the projects are executed, and he will not refuse the task. According to the respondent, the problem there was the tendency to forcefully impose ideas that donors and authorities sometimes have of "what is good for the village", instead of taking the priorities of the villagers themselves as a starting point.

Sometimes, things are even worse, and apparent political support for a project veils the basic motive of obtaining a maximum amount of foreign assistance. Morss et al. quote an Indonesian official who noted that national-level officials responsible for negotiating project agreements with donors, are primarily interested in the amount of foreign aid that will be provided. Lower-level government officials, who have had little or no involvement in the design process, are then made responsible for implementing the projects (Morss et al. 1985: 223).

3.2.2 Needs and extension requirements

Once it has become clear that drinking water in the community is a priority, further research into a number of more specific questions should be done. An example is the question of whether the need of drinking water exists during the entire season or is only important in the dry season. This is a factor which has definite consequences for the use of the supply - and therefore also for maintenance - in the wet season.

Is there a need for the project because there is not enough water available, or because the available water is too severely polluted? In order to arrive at good maintenance of those supplies which filter polluted water or pump 'clean' water as an alternative to traditionally used polluted sources, extra conditions like health education will have to be

fulfilled. Otherwise an ongoing interest in the supplies cannot be expected. Or, to quote Elmendorf, "Where a germ theory explanation of disease is lacking or even rejected, motivation to change traditional water use practices may be non-existent." (Elmendorf and Buckles 1983: III).

3.2.3 Distributing water

The composition of the group in the community that has the need, and the way in which access to the supplies has been distributed up to now, determine to some extent the future distribution of water.

Village communities very often are not homogeneous in spite of the romantic ideas about villages still encountered in some circles. In an attempt to clarify issues such as how participative change projects are distinguished from those which are technocratic and centralized, Cohen and Uphoff use as one of three key dimensions the question of who does the participating. They also emphasize that the rural poor do not see themselves as a homogeneous group, and that clear distinctions can usually be made between various groups. Whether this heterogeneity has to do with lineages, tribes, castes, or sections need not be elaborated here, because in all cases a naïve implementation policy will lead to failing maintenance. This will be the case not only if that maintenance is decentralized, but probably also - be it perhaps for different reasons - if it is centralized.
Respondents talking about Sudan, Guinea-Bissao and Ruanda made it very clear that a necessary condition for maintenance was taking into account the existing group formation within the communities when choosing a technology and a location. Those divisions may concern sex, age, place of living, religion, a nomadic versus a sedentary way of life, ethnicity, etc.
In the context of an Indian village it may well be quite a revolution if women from the lowest castes are free to pump their water or become responsible for a supply themselves. There are also situations where women, although they have to walk for miles in order to fetch water, may nevertheless not be in favor of changing that situation, because such a water place might be a kind of meeting place for these women.

3.2.4 Traditional rights

Traditionally several types of rights tied to the water source can be distinguished. Sources can be possessed by a family (Guinea-Bissao), by a clan (southern Sudan), or

can be communal possession (Guinea-Bissao). These different forms of possession carry different rights and duties concerning the supply as well as the potential co-users. The possession of the supplies, therefore, has to be clearly defined. Do the new supplies belong to the village as a whole, and if so, who is responsible, or does that possession reside with the (groups of) individuals, and in that case who, and with what form of reciprocity, has the right to use them? All these different rights like flowage rights, riparian rights, kinship rights or communal rights may invalidate a technically ideal solution, or as Banks puts it, at least require lengthy discussions and compensation before the solution can be implemented.[10]

3.2.5 Decision-making mechanisms

The way a project uses the existing decision-making mechanism in the villages in order to let the involvement of the community be as large as possible can definitely have a great influence on the maintenance of the drinking water supplies. Some respondents considered a linking with traditional decision-making processes important.[11] This idea is confirmed by Whyte and Burton, who in their discussion on water supply and community choice state that traditional community decision-making styles must be given due consideration if a project is to be successful. In a project in Sudan the biggest problem was to get everyone to attend the meetings. If (some of the) absentees thought that decisions were arrived at without consulting them, this definitely would lead to problems with repercussions for the care and maintenance of the supplies.

To arrive at willingness to maintain the supplies, the methods used in deciding upon the location of the taps seem to be essential. The distance to the new supply, for example, can be very decisive for the question of its use, and even more so for the question of whether there will exist a willingness to contribute to its maintenance.[12]

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10 See Wood 1983: 17; Banks 1983: 247.

11 The matter will be more complicated of course when 'taking into account the traditional decision-making processes' is dogmatically interpreted as taking the traditional patterns of decision-making as point of departure, whatever they are like. Twenty years of community development have shown traditional decision-making processes more often than not to be ruled by numeric minorities within the communities. If one of the guiding principles of the project is participatory development, then the following of traditional patterns of decision-making processes can easily be unwanted. See also Galjart et al. 1982.

12 Reduction of the distance to be covered daily and reduction of the effort it takes to fetch water, after improving the general health situation of the population concerned, is usually the chief objective of new drinking water supplies Water which is cleaner than that from the traditional source, yet to be fetched at greater distance, usually in itself will not be a sufficient incentive to use that supply, let alone maintain it.

In one project in Ruanda, location of the now no longer functioning taps was chosen by the village committee (nominated by the party, not elected). Had those taps been located differently, that is, had the social demands been taken into account, much more involvement - and possibly care - by the inhabitants might have been achieved. When evaluating this small project the respondent heard some users state that "those men (project team, F.W.) had just started their work, without ever having asked them (the villagers) anything, and had constructed the supplies as they saw fit".

3.2.6 The role of power relations

Control over the access to water gives power, power that often extends beyond the drinking water supply alone. Therefore, some crucial questions must be answered like those that follow, in order to gain a better understanding. Among others: Are decision-making processes being monopolized by certain persons or groups within the community? Do local participants have adequate power and authority to be able to execute the tasks they are being expected to execute? Factors like the bearers of that power and the kinds of water which are included, the users of the supply, the way they have access to the water, and the rights and duties with which they gained their access etc., all can influence the maintenance of the supplies. Whyte and Burton state that where introduction of a new water supply system commonly brings an alteration of the balance of power within communities as well as an alteration of external relations of the community with it, failure of villages to maintain the new water systems can often be diagnosed as an adherence to their patterns of social relationships to which the new water scheme was insensitive and disruptive (Whyte and Burton 1978: 124).

3.2.7 A differentiation of water needs

The general water situation, the functions different existing drinking water sources have for different persons, and the degree to which planned new supplies can provide for those functions, will all influence the willingness of the population to contribute to (the maintenance of) the supplies.Some respondents said that the drinking water supply has to be integral in such a way as to deliver not only drinking water, but also washing water, water for the cattle, etc. Kennedy and Rogers cite Scotney, who found that where expectations of secondary users of a new water supply are frustrated, negative attitudes towards maintenance can follow. Prohibition of irrigation and cattle watering in supply schemes in Kenya was a factor which contributed to damage and non-payment of water rates (Kennedy and Rogers 1985: 74). To circumvent these problems

timely research into the water needs of the people, or what is known as a user choice approach, is required.[13]

Is it customary to pay for water? If so, to whom, and how are these things settled? When free services have traditionally been provided, introducing user fees may prove to be extremely difficult.

3.2.8 Coping with cultural rules

A different matter is the degree to which the new supplies mean an intrusion upon important social rules and the cultural identity of the villages. Frequently, when constructing a new drinking water supply, an intrusion upon those rules will almost necessarily be made. It is important that the possible effects of such an intrusion for the future maintenance of the supply be recognized. In Buba Tombali this meant that

> "...no tree is to be cut, and especially: no hole is to be dug in the ground before the Gods agree to it. In the practice of the water project this not only implies that scores of rituals have to be honored, but also that the Gods, (i.e. the people themselves, and through them the elder men, homens grandes, because they are the ones that communicate with the Gods and thus interpret the opinion of the Gods) must be moved by a gradual process of dialogue and conviction directed at creating the insight into and interest in the new supplies..." (V.d. Ploeg 1979: 5).

3.2.9 Social quality criteria

Culturally defined ideas about the supply, its construction, use and maintenance, ideas about taste, sight, the flowing or standing still of the water, that is, social quality criteria, are all factors that influence use of a supply. Depending on the type of maintenance strategy, these factors can therefore also influence the maintenance of drinking water supplies. One respondent gave an example of a project where the philosophy of applied technology was implemented. Using a concrete sewer main as a sand filter, one tried to obtain clean drinking water. Although this project certainly seemed feasible from a technical point of view, it did not become a success, because the local inhabitants considered it impossible for water leading through a sewer pipe to be

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13 See Pacey et al. 1977; Hannan-Andersson 1985: 31, Whyte and Burton 1978: 115

clean. Had the pipe been produced locally, according to the informant, it might have been all right. By this he meant that if one had had the idea originate from the conversations held with the people, the problems possibly would not have occurred.

3.3 Economic factors

3.3.1 Financing maintenance

The ability to finance a supply and the possibility to finance the maintenance of that supply were seen together as the most important economic variable. Although it is frequently possible to safeguard the community from the initial costs, which in itself might be a possible cause for future maintenance problems, this will often not be the case for maintenance costs.[14]

As a rule, donors do not finance maintenance of the supplies they paid for. Government agencies also are usually reluctant to carry the recurrent costs, be it for budgetary or for political reasons. According to some respondents it is easier for those authorities, when confronted with the decay of any supply, to stage a new request, which after some time is rewarded. Therefore, it seems more important to look for local sources of maintenance financing.

Inputs from lower-level governments can also help plug a revenue gap. Not infrequently drinking water services are provided within a limited area, and then local government revenue collections are a more appropriate source of financing than the central government budget. Still, local government revenue-generating opportunities are limited in many rural areas of the developing world, often because local jurisdictions do not make full use of their taxing authority (Morss et al. 1985: 231). The central question then should be whether or not the local population has the opportunity and the willingness to contribute to the maintenance of their supplies.

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[14] Supplies being a gift from the donor can easily cause the 'Santa Claus syndrome', a sort of indifference and passivity concerning a careful treatment and maintenance, to be encountered in the attitude of the recipient. No efforts were required to obtain the supply. The longer it can be used, so much the better. Besides, in many cases it is easy to quickly obtain a new one. This negative attitude will be even stronger if a water supply has a low position in the hierarchy of priorities. A related problem is the idea a recipient can have that the supply is not his or her property. He or she is only allowed to use it. One does not feel motivated to maintain the 'damned thing'. That will often be considered the task of the generous donor.

3.3.2 Forms of contributions

Other factors concern the form that the contributions made by a community may take. If the contribution of the local population during the construction phase is to involve labor, it becomes important to know something about the traditional division of labor by sex. Such a division always exists, so ask what components of the project work should be allocated to men, and which to women. Will men or women be available when required? Or does it occur - as a consequence of the agrarian cycle or prolonged fasting, for example - that no labor can be recruited during certain seasons? Should the timing of project work be altered to allow for the maximum availability of the two sexes? Concerning this contribution of labor, Kennedy and Rogers cite from a report with studies from Niger, Burkina Faso and Tchad, where it was found that the workforce required for community participation was different from 'normal' village labor and that the traditional division of labor makes water supply contributions less interesting for males (Kennedy and Rogers 1985: 76).

From the literature it is apparent that in many cases a contribution from the community in the form of free, unskilled labor can usually be obtained, but all too often that is where the involvement of the community stops. According to many respondents, however, due and timely awareness in the community that there can be no question of a one-time gift, but on the contrary that there will have to be continuous payment for the supply, is at least as essential. Promises for such a continuous contribution from the side of the community during community meetings for example, could possibly limit the chance of future payment problems.

3.3.3 The ability and the willingness to contribute

During a discussion on the drinking water supply in Tanzania, organized by the Bond van Ontwikkelingswerkers in Utrecht, the following statements were heard: "The people have the right to be able to maintain a development project", and "Development cooperation is a success when the right to be able to pay for the supplies evolves into the willingness to pay".

The possibility to develop new productive activities in order to generate resources to supply that contribution could very well be decisive for the question of whether those contributions can or cannot be raised by the community. The degree of economic

incorporation of the community will play a major part here, but incorporation in itself is no guarantee yet for the presence of sufficient resources.

Although construction and maintenance of supplies can at least analytically be distinguished as phases, the way the work has been carried out during the construction phase can decisively influence the willingness and the opportunity of the community to look after the future maintenance of the supplies. Therefore, it turns out to be very important to pay due attention to the potential contribution of the local population to later maintenance when preparing and constructing the supplies. As Glennie states, "Undoubtedly, the greater the involvement, the greater the degree of responsibility felt by the community". But, as Glennie and many others also stress, this sense of responsibility will have to be supported in practical terms by a reliable maintenance organization (Glennie 1983: 98).

3.3.4 Limits to fund raising

The issue of community participation programs being characterized by a mistrust of government intentions is raised in many reports. Therefore, the history a community may have concerning collective labor, whether this was connected to outside projects or not, can influence the willingness that now exists to contribute collectively. If there is strong opposition to the activities and the ideology of the government, attempts may be made to sabotage projects.

Additional problems could arise if several donors are (to be) active in the same area. Like the director of a Dutch water consultant agency lately stated in an interview: "If the French deliver water free of charge in their project, it is difficult for us, fifty kilometers along the road, to ask a contribution for it. Those are difficult matters, for in general the authorities and the local population are well informed about what is happening in other parts of the country" (*Vice Versa*, Vol.18, no.1, p.24).

3.3.5 Economic interests: buying and selling water

In some communities individuals can be found with a special interest in drinking water, for example professional water-sellers. In such a situation a potential conflict is present that needs attention; otherwise, negative consequences for the future maintenance of the new supply could be the result. According to Morss et al. the presence of incentives for

such individuals may be even more crucial than the presence of incentives for direct project beneficiaries (p.228).

A final economic factor in some contexts could be the difference in price between the tender for a project and the value of the work executed. Corruption is a phenomenon that is not restricted to the national level, but which can eat away at the budget avail able for a drinking water project at all administrative levels. One respondent stated that in some cases known to him this meant that up to one half of the original budget was lost, leading to poor quality of the resulting supply as well as to a lack of funds for maintenance.

3.4 Organizational factors

3.4.1 Organizational options

While increased attention has been paid to the financial prerequisites for sustaining project benefits, the emphasis that has been placed on the organizational prerequisites to sustainability of drinking water projects, according to some respondents and according to the bulk of the literature, is still very sketchy. It frequently seems that one simply has not thought about cultural differences and related different frames of reference - about different organizational forms, about how to link up with these, and about the organizational problems likely to be met in such situations.

There are no fixed rules for the choice between different options like (combinations of) centrally organized maintenance, maintenance at district level or village level, neither in general nor per country. This, however, does not change the fact that decisions in such matters should be taken as early as possible. Often the decisions will lead to a shared responsibility between authorities and villagers, in which case it is essential that there be no ambiguity in the designation of maintenance responsibilities if actual maintenance is to take place.

If the choice for a maintenance strategy falls on a one-, two-, or three-tier model which, apart from complete or partial local financing, also presupposes local activities

concerning maintenance, then the local availability of knowledge, material, tools and spare parts, i.e. the presence of production factors will be important.[15]

3.4.2 Limits to government agencies

A choice in favor of a central government agency, according to most respondents, renders a greater efficiency in the short run, but in the long run the allocation of money and resources for maintenance of far away supplies may likely become doubtful. In the well documented project in Malawi - a project with piped supplies and no handpumps, however - it was tried to have the District Councils take over the major supplies. After a while, however, it was felt that the maintenance of numerous water schemes throughout the country was basically beyond the resources of the majority of the councils. The policy was therefore abandoned (Glennie 1983: 100).

3.4.3 Matching organizational structures necessary

One of the respondents stated that concerning the organizational structure for the maintenance of drinking water supplies, one should look around for organizational structures similar to those considered for the new supply. This will help to judge its performance in the new setting. The presence of the necessary technology and infrastructure in the private sector by no means automatically implies the capacity to maintain public drinking water supplies; one could consider it an advantage, but no more than that. The necessary technology being present in the private sector, and the smooth functioning of the organization, do not mean that the same will apply in the public sector. Often one encounters a brain drain from the public sector to the private sector or from one public sector to another. In other cases the public organization sometimes functions more like a kind of private enterprise for service to the market sector.

3.4.4 Users' maintenance and backup systems

By now awareness has also grown at policy level about how important it is to enable users of a drinking water supply to operate and maintain their supply themselves. Yet, all too often this insight seems long overdue. Opting for such a policy would entail that

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15 For an explanation of the one-, two-, and three-tier model of maintenance see also Pacey 1976, Hofkes 1983: 39 ff.; Baldwin 1983: 8 ff.; Roy 1984: 13 ff.

no supplies are being forced on people, but that in advance a considered assessment is made of the local situation, both technical and social. If, on the basis of that assessment, the choice is in favor of a maintenance organization at the village level, then the entire spectrum of factors already discussed and still to be discussed becomes important for the question of whether that maintenance actually will succeed. Most writers on this subject share the opinion that a certain backup organization will always remain necessary.

3.4.5 Traditional and other existing organizations

Drinking water projects are not executed in a vacuum. There has always been water in whatever small quantities, however far away, and however polluted. This usually means that there also exists or existed a traditional organization in the field of drinking water supply. A possibly important factor for the maintenance of rural drinking water supplies, therefore, is the existing organization at the local level.

3.4.6 Organizing user groups

A question arising here is whether, when deciding upon the user group, one can associate with existing closed groups.[16] If not, the problem exists of how to transgress from an open group to a closed user group in which everybody is willing to contribute to the maintenance.[17] This associating with existing groups is a subject that still needs much study. In the literature on cooperatives much attention has been paid to the question whether and how it is possible to impose modern cooperative forms over traditional forms of cooperation.[18] It was apparent that extension of functions of such a traditional cooperative organization with all the new roles and norms that come along with it by no means always seems feasible. Still, more study on the possibility to unite water users on the basis of existing cooperative groups certainly appears worthwhile [19]

16 See Elias 1976.

17 See Chapter Two.

18 See Joy 1971.

19 See Jorgensen 1984: 26; Fortmann 1983: 22 ff.

3.4.7 Complexity, roles, and responsibilities

Depending on its degree of complexity, maintenance of modern technology demands a relatively high degree of organizational capacities. New roles and responsibilities must be introduced and distributed. The purchase of parts and the payment of eventual maintenance personnel demands the presence of resources. Those resources are not automatically present, and even if they are present, it is not automatically evident how the distribution of the burden among the members of the community has to take place.

In view of the probability that governments, because of a lack of resources or incentives will not (entirely) fund the recurring costs of a supply, communities are confronted with the problem of how to make the project organization and the users match. In an article on irrigation and organization Coward discusses the adaptation and incorporation of indigenous irrigation leadership roles for the achievement of satisfactory system-user interaction. He thereby characterizes the traditional form of irrigation leadership as an accountability model. As basic traits of this role he states that the carriers of the role:

1. serve relatively small groups of water users;
2. are selected, in some manner, by the members of the local group which they serve;
3. are subject to review and replacement;
4. receive compensation directly from the group members whom they serve.

That compensation can differ, and will sometimes be in the form of exemption from labor, sometimes in the form of land for cultivation, and sometimes will be based on either a proportion or a fixed amount of the crop.These three elements - small scale, local selection and direct compensation - are the basis of the accountability model of leadership. The methods of recruitment and reward, as well as the normative expectations of the water headman, make him accountable to the water users whom he serves. They are involved in his selection and have the ability to review his performance. He is dependent upon the water users and not the bureaucracy for the payment of his fees. Reluctance to pay provides a very direct form of job evaluation. Both these procedures reinforce the normative expectation that the person responsible for the water will act to meet the needs of the immediate water user group, sometimes instead of the needs of the water bureaucracy (Coward 1976: 102). In different contexts the reward will have to be different, but in all contexts the demand has to be met.[20] A formal sanction will also have to be available, as well as a controlling agent to apply that

[20] See Kerr 1982: 2.

sanction in case informal social control alone is no longer sufficient to force the caretaker to do his job.
As stated before, the above relates specifically to irrigation projects. However, exactly this accountability to the users is what seems to be lacking in many drinking water projects. It appears advisable, therefore, when designing a drinking water project, to pay due attention to the way accountability between caretakers of traditional wells and the users of those wells has been organized traditionally, in order to - if possible - build on those experiences with the new drinking water supply.

3.4.8 Local capabilities

Kennedy and Rogers cite Rahman and Howes, who maintain that the MOSTI (manually-operated shallow tube-well for irrigation) is easily maintained and repaired by Bangla Desh artisans using locally-available materials. This suggests that there is ample local technical initiative and that maintenance problems arise when there is a high degree of government involvement in installation and maintenance of the public handpump (Kennedy and Rogers 1985: 104). In short, it is useful to get an idea of what the people are capable of, and what the existing structure is capable of in similar sectors. With good personnel but lacking the structure to obtain the necessary inputs such as tools, one doesn't get far. Morss et al. probably rightly state that few project ideas are so compelling that they will perpetuate benefits without institutions equipped to carry them forward (p.225).

3.4.9 Infrastructure

Additional factors here are the presence of a web of dealers in the kind of material needed, and the obtainability on the market of anything needed in the repair sector as non-specific parts. The presence of small service companies, companies that deliver turnery and other metalwork, for example, also plays a role.

A factor corresponding with the earlier mentioned dependence is the distance to 'town'. One of the respondents mentioned the fact that it was the very remoteness of a certain project which had been the reason for concentrating maintenance and repair at village level. It also induced the project team to set up a kind of maintenance school, where for every supply some three mechanics were trained. This brings us to the subject of training and schooling.

3.4.10 Training

Before implementing a project it is worthwhile to visit any technical schools and/or training courses which may be present. Often when executing a project, one concludes there is a lack of technical training, and thus something new is started, e.g. an in-service training program, or an apprenticeship. According to some respondents it might well be better to use the structures that are present. Although it is probably feasible to specially train a number of people, it is also very probable that half of them or more cannot be held, and for whatever reason will leave the project. The only guarantee for a continuous maintenance in the long run might be to have the trainees come from the educational structures in the country.

Another respondent gave a quite different picture of the situation in a project in Sudan, showing that it is possible to provide people with a three-week training that makes them capable to perform necessary maintenance activities independently. Three youths were selected by each village and were trained to perform the maintenance function. Three were chosen because there is always the possibility that one or two of them will leave the village, especially in areas with great mobility. From a developmental policy point of view it may be added that it also seems a better policy to train youths and grown-ups in their own village, be it as a carpenter, a mechanic or as a bricklayer.[21]

3.4.11 Extension for users and caretakers

In general, organizations involved in the sphere of hand pumps in developing countries also provide information aimed at the potential pump users and maintenance teams. Considering the sometimes low literacy rate of the participants, however, it might be worthwhile to present the information in diagram form.

Because the fetching of water for the family in nearly all societies is considered to be women's work, it is advisable to give women the same opportunities to follow training courses as men. They too - or rather, they especially - must be enabled to master the technology in order to be able to ensure an ongoing functioning of the supplies. As yet, however, there appear to be only very few training programs in handpump maintenance and repair for women.

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21 Cf *Vice Versa*, Vol 18, no 1, 1984: 9.

3.4.12 Organizing pooling

Organization and ways of collecting contributions, the appointment of someone responsible for that collection, as well as the possibilities for sanctions in case of negligence in contributing, are all factors that are important for maintenance of the supplies. The history a community has concerning the collective financing of public goods, in other words the role of pooling in the community up to now, can be important for the possibility to get such a contribution organized. It is therefore important to know which public goods exist in the community and how they are being maintained.

3.4.13 Three-tier maintenance systems in India

India now has about ten years' experience with a so-called three-tier maintenance system for deep-well handpumps. In close cooperation with UNICEF a system has been developed that, according to some, has diminished the maintenance problems encountered so far.

Baldwin mentions five factors underlying the Indian experience (Baldwin 1983):

1. the design of a new type of handpump with far lower maintenance requirements;
2. rigid control of pump manufacturing standards to assure very high quality control;
3. a high standard of initial pump installation;
4. the careful design of a three-tier maintenance organization that depends on district-level, four-men mobile units;
5. top level Government recognition of the maintenance problem and a commitment to finance the program's recurring costs. These costs are estimated at about US $30 per well per year, roughly one-sixth the usual cost of maintaining deep-well handpumps.

At the end of 1982 some 150,000 pumps of this make were in operation in India. They were being maintained, in large part, by 230 mobile teams, according to Baldwin the key element in the three-tier maintenance system. These mobile teams at district level consist of four men each, a diesel pickup truck and a small workshop.
Under these teams at block-level a so-called block mechanic forms the second layer in this system. The first layer consists of a local caretaker. This caretaker, normally a literate youth doing something else for a living, who has been given two days of

training for this job, is primarily responsible for cleaning the surroundings of the well. He sometimes is expected to perform minor mechanical operations. His training also includes some simple health education. For any major repair he is supposed to notify the block mechanic by sending pre-printed, pre-stamped and pre-addressed postcards. The block mechanic is a full-time mechanic with a territory that normally includes 50 (originally 100) wells, which he is supposed to visit on a fixed schedule, roughly every two weeks. The block mechanic cannot deal with more complicated problems. Originally he represented the only outside help available to the villagers, because the mobile teams are of later date. It is hoped that with those mobile teams transport and pulling problems belong to the past. The pickup should enable the teams to transport all necessary equipment, the workshop to do the necessary repairs. With the three-tier system primary responsibility for mechanical maintenance lies clearly outside the village with the mobile units.

3.4.14 Limits to the three-tier systems in India

An organizational model like this can have its own problems, as shown by Sanjit Roy He states that by far the most serious flaw in this maintenance system is the marginal and superficial involvement of the community which will actually be using the handpump (Roy 1984: 13).
Roy sneers at the 'experts' who have come up with the idea of the three-tier system:

> "...engineers and economists who have never lived and worked in a village. They have never experienced what it is like to live without safe water for months because the handpump is out of order, when neither the Block Mechanic nor District Maintenance Units have shown the slightest interest in responding to repeated calls from the community."

Another example is equally biting:

> "To my mind the Three-Tier System is yet another example of one designed by people who do not have confidence in the community. It has not made allowances or used the knowledge and skills available in the village itself and, quite clearly, it has ignored (from ignorance, undoubtedly) the fact that villagers do not appreciate what is given free and feel that things which are set up by the government are not really theirs" (Roy 1984: 13).

3.4.15 Alternative maintenance systems in India

The Social Work Research Centre in the state of Rajasthan of which Roy is the director lately has had much success implementing a one-layer maintenance system of handpumps. Because the staff agreed that the system with three layers as planned by the Government did not function and made the villagers very dependent, the Centre started thinking about another system. By now it has installed over 300 handpumps of the India Mark II make, for which the local population had to make a small contribution. The maintenance system is entirely taken care of by local repair personnel. Just like in the earlier-mentioned project in Sudan, a rural youth with some mechanical background is selected by the community and is sent for three months of training to Tilonia, after which he is officially called a Handpump Mistri. In this way the community no longer depends on the chance that the repair team will show up after being notified by a block mechanic. Instead the villagers themselves stay in charge[22] (Spruyt: 28).

3.4.16 Maintenance backup systems in Bangla Desh

Lowering of the water table below seven meters as a consequence of an increasing use of motor-driven deep-well pumps in Bangla Desh resulted in the drying out of shallow tube wells, thus increasing the area requiring 'deep set' hand pumps. Since a maintenance backup system has so far proved inadequate to cope with the few deep-set handpumps that are already in operation, another type of deep-set handpump, one which can be quickly installed and which requires minimum maintenance to be carried out by village caretakers, has been developed. For this Tarapump to be applicable for rural water supply in Bangla Desh on a mass scale, however, it must withstand years of heavy use without increasing demands on the already over-extended public sector. Kennedy and Rogers rightly pose the question of whether the users will be able to change valves and seals on a routine basis (Kennedy and Rogers 1985: 66, 69).
Glennie, for one, in a very general sense states that the community is unlikely to carry out on its own initiative all the routine preventive maintenance tasks that are necessary for the continued reliability and long life of the supply. Therefore, he adds that it is necessary for the government to supply both the technical supervision and material support required (Glennie 1983: 99).

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22 It is of course necessary to distil the essential elements of this apparent success before it be imitated, since a success in one country obviously cannot easily be transferred to another with different social and cultural patterns.

3.5 Technical factors

3.5.1 In search of technical solutions

Next to the three categories discussed above there is a fourth one concerning the technical factors. Originally it was hoped to minimize maintenance problems in drinking water supplies by means of technical solutions. This was a plausible approach of course, since only recently has man's view of technology broadened to include more than material things only. As Drucker puts it: "Today [technology] is a concern of man as well" (Drucker 1970: 77).
First, so-called maintenance-free pumps were developed. Yet these pumps, too, proved to be vulnerable to breakdowns and, once broken down, were even harder to repair. A second technical solution was adapting the design and construction in such a way as to enable the local population to maintain the pump. Both technical solutions were not a sufficient condition for the lessening of maintenance problems.

3.5.2 Standardization problems

An important technical factor especially prominent in those countries where many donor countries and organizations operate is the degree to which it is possible to arrive at a standardization of the supplies. The standardization problem, according to many respondents in many developing countries, is the bottleneck for maintenance. Spare parts, tools and knowledge, things which locally are sparse as a consequence of an often weakly developed infrastructure, will be needed in even larger quantities if no standardization of the supplies can be achieved.

Frequently, however, it is difficult to counter such a lack of standardization. On the one hand, donors - partly due to trade-interests and partly from a lack of knowledge - help perpetuate the situation. On the other hand, the authorities of the recipient countries are not too keen to refuse when offered a new supply, even if this offer enlarges the problem of standardization. It is often very well possible to discuss these matters, yet donors, authorities and participants are apparently still not conscious enough of the problem.[23] Besides, as is stated by a number of respondents, project planners and

[23] In countries like Indonesia, Burkina Faso, Yemen and Tanzania, donors almost stumble over each others' supplies. Possibly the Round Table meetings (to be) held by the Development Program of the United Nations can achieve some coordination of the development efforts, and as a consequence perhaps also somewhat more standardization.

consultants usually have a better eye for the intricate technological problems of the system than they do for the possible difficulties of adapting the system in the specific local context. This is also the reason that much of the intermediate level alternative technology is still not appropriate to many of the maintenance problems of rural areas. Although technical solutions are proposed, the socio-economic factors often inhibit any widespread adoption (Kennedy and Rogers 1985: 1).

The problem as it presents itself here is how to mix the demand of standardization of the supplies with the demands of technological and social appropriateness. Somehow a balance between the two variables will have to be found.

3.5.3 Technological appropriateness

Following Farrar (1974) Pacey speaks of technological appropriateness of supplies and states that in order to take a sensible decision on the criteria for technological appropriateness, the precise goals and objectives of a drinking water project will have to be clarified first. He distinguishes three aspects of that technological appropriateness, of which especially the functional and the environmental appropriateness will be decisive for the question as to what degree maintenance can be guaranteed for those supplies.[24] The different criteria for functional appropriateness have to do with the basic specification and design of the equipment used, the choice of materials and components, and the dimension of pipes, tanks, and so forth in relation to the volume of water required. Shortcomings in construction are often very difficult to rectify, which makes competent supervision during construction an important factor. Somewhat different from the functional criteria discussed so far are the ergonomics of handpump design. Pacey stresses that misuse and damage to pumps often arises because poor ergonomics make it difficult to pump with smooth, even strokes of optimum length.

3.5.4 User problems; western solutions and local standards

When designing appropriate technology, so some designers claim, bad use must be taken into account, that is, one should expect the supplies to be used in an improper fashion. An important question, therefore, concerns the willingness of western-trained engineers to adapt their concepts and solutions to locally acceptable standards instead of

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24 Besides functional and environmental appropriateness Pacey distinguishes health and sanitary appropriateness, i.e. the usefulness of the technology chosen as far as the expected improvements in the health situation are concerned.

remaining fixed on relatively advanced supplies based on western standards. Local skills are often attuned to different types of materials, construction methods and technical problems than is western technology. The gap is thus a cultural one: most self-reliance pump designs have more in common with a western do-it-yourself approach than with the style of work done by real village craftsmen (Kennedy and Rogers 1985: 102).

A complicating factor in this respect may be that the users' governments tend to equate the type of facility built, with status. In the view of some respondents more attention should be paid to links with the local technology instead of taking as point of departure that which has been thought of by the donor or the authorities. They feel it is better to build on local traditional knowledge about drinking water supplies than to strive to attain the earlier-mentioned technical solutions.[25]

3.5.5 Local technology as a starting point

By taking the local technology as point of departure and by working together with local artisans, one is confined to the traditional body of concepts. For example, in a project in Guinea Bissao the presence of well-diggers, among other things, was one of the reasons to dig a well instead of drilling a well. Also it was the village in the first instance that decided on the location of the new supply.[26] It is conceivable of course in such situations to use an improved technology. The wells by no means need to be exact copies of the traditional patterns. A slightly modernized form with, for example, concrete linings to prevent it from falling in and with a concrete floor around it to prevent polluted water from entering the well is certainly possible. It will be important, however, not to upgrade the existing supplies so much that people cannot afford (to maintain) them, or to the extent that it may not be possible to replicate them widely.

3.5.6 Preventive maintenance and technological levels

Traditional supplies, according to some, generally are of a low technological level. Preventive maintenance as practiced by the western countries in the last thirty or forty years is virtually unknown. In an account from a piped supply project in Malawi,

25 See Hannan-Andersson 1985: 28; Chambers and Howes: 1979.

26 For additional reasons for digging wells instead of drilling them on the locations concerned here, see Visscher and Hofkes 1982.

Glennie shows us how this absence of preventive maintenance can and will continue on sites where new supplies were built by some projects.

> "This policy did not achieve a sufficiently high standard of maintenance. It is true that the committees did repair bursts, and the intakes and screens were cleaned when they became blocked, but these were curative activities carried out because the supply had been interrupted. When the screens broke, or a pipeline was exposed by erosion, nothing would be done as long as the water continued to flow. Once the exposed pipeline was finally washed away, the committee would send a report to the program office. This message would take a long time to get through and program staff, who were busy elsewhere, inevitably would take a long time to react. Even then, the program had to supply materials and carry out repairs with the resources available from the nearest project under construction, as there were no specific funds or staff available for maintenance" (Glennie 1983: 99).[27]

27 Handing over completed projects to the community with sufficient spares and materials is a policy no longer applied in Malawi, but still existent in other countries.

4 DWELLING ON POLICY IMPLICATIONS

4.1 Conclusions

From this preliminary study it is apparent that better maintenance of new drinking water supplies in almost all projects is a necessary condition for achieving the short-term objectives of those projects.[28] This especially holds true for those projects where, on a local scale, one could speak of technological innovations.

Another point that was raised concerned factors which were insufficiently taken into account during the preparation of the project, i.e. factors influencing the maintenance of new drinking water supplies and necessary for keeping the new supplies functioning. This state of affairs is partly due to a wrong assessment of the local sociocultural and socio-economic factors influencing maintenance, and a too optimistic planning of the organization of the maintenance, both in a financial as well as in an organizational sense. It is also partly because some factors appear less manageable than presumed. Besides, project managers and experts showed a need of easily applicable and practical knowledge about maintenance, with the help of which in an early stage maintenance problems - to be expected with certain new drinking water supplies - can be taken into account.

The preliminary study also revealed that too often the problem is considered to be a technical one, while actually the problems tend to be in the organizational and sociocultural sphere. This idea is confirmed by the fact that the Development Assistance Committee (DAC) of the OECD has agreed on a number of organizational and financial guidelines to encourage the member countries to take maintenance problems at the organizational level into account when planning projects (OECD Observer, Jan. 1983).

It became clear that, although some of those factors at the local level in the organizational and sociocultural sphere which bear responsibility for maintenance problems can be traced by respondents from different projects, other variables cannot be quantified by the interviewed experts:
How many supplies in a project are broken down at any given time? At what (kind of) places (socially and geographically) do they break down? What is the maintenance

28 The long term impact is far more difficult to measure. See also Sumi 1985: 2 ff.; Grover 1983.104.

situation in the project in general, and is it possible to show differences within the projects?
These are important questions that have to be answered before an effective and efficient maintenance policy can be pursued. In short, there is a lack of systematic knowledge.

In addition, it turned out to be very difficult for the respondents to distinguish between projects that can be called a success and projects that cannot. As long as staff involved do not or only scarcely seem to have quantitative data to judge their own projects as either being successful or less successful, it is difficult to judge the relative importance of the factors given by them.[29]

Another important conclusion seems to be the difficulty one encounters when trying to arrive at an estimation of the relative importance of the factors at the local level compared to the ones at the project level and at government level - something with important policy consequences. Because of this difficulty it is not exactly clear where strategic interventions could or should take place.

Bearing in mind the fact that governments will probably not be willing or able to bear the cost of maintenance of rural drinking water supplies, it is reasonable to expect factors at the local level to be substantial, if not decisive, in their influence on the maintenance of rural drinking water supplies.

4.2 Policy

Which factors should be emphasized in policymaking?

4.2.1 Sociocultural factors

It appears that a large-scale approach in the different phases of a project, with little attention for participation of the people involved, does not make an effective project design - especially when also considering the longer-term perspective. Particularly in the first phases, i.e. identification and design, involvement of the local population and local counterparts seems to be of great importance. Firstly, such involvement may ensure that drinking water in the local situation really has the priority that might make

[29] Success as used here has the meaning of 'supplies remaining in good shape'. Thus nothing is implied yet about actual use of the supplies. See also Schultzberg et al. 1983.

the people willing to consider at least a primary, one-time contribution in either labor, kind or cash. Secondly, involvement is important because in the great majority of cases the people themselves will have to take care of (the contributions to and/or the maintenance of) their supplies.

Experience has taught that project designs may not confine themselves to just creating the supplies. The design must entail ideas regarding how to strengthen the institutional structures that will have to take over the project once complete; what resources will be required when external funding ends; whether project systems can be self-supporting, or (that) a permanent subsidy (will) be required, and if so, what will be the source (Morss et al. 1985: 239). It will have to indicate how the local population can be involved in the design, execution, operation and maintenance of the supplies.[30]

Assessing the existing priorities and doing research into the needs and into the distribution of those needs among different groups of the population - especially between men and women - is a first demand for success. The Norwegian development organization (NORAD), for example, states in its strategy document: "Water projects must become women's projects. Women must be consulted on all aspects of projects and must be involved in planning, implementation and follow-up of all water projects. Besides, women, rather than men, will be made responsible for, and trained in, maintenance for new water sources" (Wiseman 1986: 28).

More research will also be needed in the earliest phases of a project into:

- culturally defined ideas about the supplies;
- the degree to which new supplies mean an intrusion upon important social rules and upon the cultural identity of the villages;
- the general water situation and the functions different water sources have for different persons/groups within the community;
- the tradition with regard to paying a contribution for water;
- the traditional decision-making processes, and the possibilities to include use of these without losing the participatory character of the project;
- the power- and property relations, and the implication they have for access to and the maintenance of the new supplies.

30 See Eggers 1968.

4.2.2 Economic factors

- Besides research into the tradition concerning payments for water, research will be needed to determine the actual local possibilities for recovery of the recurrent costs of a drinking water supply.
- One will have to look for some organizational form for that cost-recovery. Of course some form of agreement on this subject will be needed. Construction should be delayed until this agreement has been reached.
- Research to determine the local availability of knowledge, materials, tools, productive capacity and general infrastructural conditions will have to be planned and executed as early as possible.

4.2.3 Organizational factors

- It is recommended to do preliminary research into the degree of organization existing and the possibility for making links with existing processes in view of the future user groups.
- The selection of an organizational structure for operation and maintenance of the supplies needs to be done as early as possible.
- It is recommended to carefully assess whether an organization as proposed is present, and if yes, how it functions.
- It still needs to be stressed that for the continuity of a project it is imperative to look for local counterparts to take over the project when completed.
- Depending on the technology chosen and the knowledge that is locally available, demands for timely training and schooling for those responsible for the supply will have to be met.
- To this end it is also recommended to cooperate with the already existing schooling opportunities in the country, because such a link can offer the best guarantees for continuity.
- Finally, it is recommended to arrive at such a structure that those in charge of the maintenance of the supply are accountable to the users of that supply.

4.2.4 Technical factors

- Concerning the technical factors it is both the maintainability of a supply and the maintenance needs of that supply which can be influenced.[31]
- It should be avoided that a supply with low maintainability (technically underdeveloped) be installed in a setting with underdeveloped infrastructure where the demand of maintainability of the supply cannot be met.
- A timely decision about the criteria to be used for judging the technological suitability of a new supply is needed, and therefore an early formulation of the precise objectives of a project is a primary requirement.[32]
- It is recommended that so-called 'bad use' be taken into account when designing a supply.
- It is also advisable that links be made with the local technology.
- To arrive at an efficient operation, all possible efforts should be undertaken to obtain an optimal standardization of supplies, especially in those areas where there is relatively low development of the infrastructure.

A possible way to achieve these measures is through an optimal tuning of the developmental efforts of the different donors by means of coordination.

4.2.5 How to mix such diverse factors?

Technical choices appear to be easier than social ones, especially because, as Pacey states:

> "... neither the high technology of the West nor intermediate technology is an entity in itself. Each is an expression of human organization and culture, and of the goals and objectives of human society. Neither is capable of realizing its full promise if used in circumstances where the organization needed to operate it is lacking, ... or when goals and objectives are ill-defined. So technology by itself promises nothing; there is no purely technological solution to the problems of poverty and underdevelopment. Technology only yields its full

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31 Support in this field can be obtained by taking notice of reports like the one from the recently ended laboratory research by the World Bank into the functioning of thirteen types of handpumps. See Rural Water Supply Handpumps Project.

32 See also Pacey, 1977: 9 ff.

benefits when used within a framework of social development and strengthened organization" (Pacey 1977: 3).

Thinking back on the conclusions of Chapter Two, it must also be clear that one cannot simply expect individuals in a group who have a common interest in a drinking water supply, to actually maintain this supply simply for that reason. Demands are made on the size and internal organization of such a group. If those demands are to be met, then a certain commitment from the side of policy to make resources available in order to gain an insight into those specific demands is required.

On the basis of the amount of sociocultural and socio-economic factors that can influence the lifetime of a drinking water supply, and on the basis of the demands for an organization to maintain those supplies, a larger role of social scientific research/knowledge in the entire project cycle of rural drinking water supplies is desirable. A sociologist is therefore an essential member of a team to design a drinking water project. If the project is to be successful, technical expertise must be integrated with solutions that are acceptable to the beneficiary population.

Investment in collecting knowledge of social organizational and sociocultural factors, important for making strategic choices and for the ongoing functioning of, for example, a drinking water supply, looks nominal when compared to other development projects. The following quotation relates to forestry projects but applies to many drinking water projects as well:

> "Figures are sometimes extrapolated from aggregated estimates or generalized from local studies and then supplemented by limited cross-checking during field missions. The lack of data is in part the result of both the composition of project design teams and cultural conditions. Design teams usually comprise men only, and in many countries men cannot communicate with the women, who are the main beneficiaries of drinking water projects" (Naronha and Spears 1985: 238).

The conclusion of a report by the Inspection of the Dutch Development Agency concerning drinking water supplies mentions that one of the main causes of partial or complete failure of such projects is the gap between the necessary and the actual input of time, organization and personnel: a too small personnel corps and minimal capacities for good project preparation and monitoring of target group projects (I.O.V. 1983: 41).

Too often one conceives a project consisting of buildup, financing and further technical assistance by the donor during two years, after which the donor retreats. In such a situation sometimes within three years the first rehabilitation mission has to be sent out, followed by additional investments up to the amount of the original investment after some four years in order to get the project operational again.

4.3 A quest for more research

In view of the limited amount of knowledge and the global character of that knowledge so far, it is necessary - if one wants to execute an effective maintenance policy - to create opportunities for a more detailed research into these problems.

Some research areas that come to the foreground are the following:

- Research into the question of the relative weight of the different levels - government, project, and local - as far as their influence on the occurrence of maintenance problems of rural drinking water supplies is concerned. For the policy it is important to know whether perhaps factors at one of the three levels only are responsible for the bulk of the maintenance problems.

- Research to obtain systematic knowledge about the relative weight of the different factors discussed in this report, and the way to influence them.

- Research into the way both formal and informal social control as well as accountability can be used to assure maintenance of the supplies. To this end both concepts need operationalization in order to be able to make explicit their precise role in the failure or accomplishment of local maintenance.

- Research into the question how to stimulate the people's own responsibility for maintenance of their drinking water supplies, especially research into the role of selective incentives.

- Research into maintenance attitudes and maintenance behavior, organizational structure and the degree to which people have a say in the maintenance organizations, with a view to promoting their own responsibility for the maintenance of public supplies.

- Research into the relationship between culture and ideas about maintenance.

- Research into the possibilities and difficulties of different forms of cost-recovery.

- Research into the realization possibilities of the recommended policy, including a more narrow specification of this policy.

- Execution of a pilot project by which to study how a policy that directs its attention to the discussed factors from the very beginning, in reality functions.

5 SUMMARY

5.1 The nature of this study

This report is the outcome of a desk study and an interview round. It was aimed at identification and inventarization of factors at the local level which influence the existence of maintenance problems of rural drinking water supplies in developing countries.
As working definition for maintenance I opted for the definition of Werter and Leeflang, since that definition allows for a role to be played by the user of the objects to be maintained:

> "Maintenance comprises those activities meant to either keep objects over which an actor disposes, in the condition, or bring them back to the condition deemed necessary for fulfilling the function as defined by the actor" (Leeflang and Werter: 3).

Considering the attention which has been given to the construction of new drinking water supplies, it was felt that maintenance of those supplies was a neglected subject area which deserved greater study.

Although this study has been explicitly directed toward the local level, the complexity of some factors that border on the project level and the government level has sometimes led to an inclusion of those levels.

For this preliminary study interviews were held with persons who somehow, either as a volunteer or as an employee of one of the Dutch co-financing agencies, consultancy agencies or the Dutch Government, have been involved professionally in drinking water supplies in developing countries. The interviews aimed both to obtain answers to questions concerning the experiences these professionals had had with maintenance problems, as well as to gain an insight into the causes for those problems as perceived by these professionals. The role of local factors was especially prominent in these conversations.

5.2 Four types of factors

Because all the factors mentioned in the report were taken from the interviews and from a small amount of literature on the subject, knowledge of the subject is still only global. Therefore, in order to arrive at practical solutions, further research will be necessary. Summarizing, one can say that at the local level four categories of factors can be distinguished: sociocultural, economic, organizational and technical. All these factors more or less influence the lifetime and maintenance of rural drinking water supplies. Some of them cause this effect directly, some by intervening factors.

5.2.1 Sociocultural factors

Under the heading of sociocultural factors were discussed: the need for a supply and the priority of that need; the matter of access and distribution, or the way access to the different supplies traditionally has been distributed; how to take this traditional distribution of access into consideration when designing and constructing new supplies; knowledge and information; traditional rights; local participation in the decision-making process and in management of the supplies; power relations in the community; gearing of the supplies to the composition of specific user groups; and the role of cultural constraints concerning the supply, its use, its maintenance and its costs.

5.2.2 Economic factors

As economic factors, one can distinguish financing problems; the ability and the willingness to contribute and therefore the degree of economic incorporation of the community; related to that, the possibility of forming surpluses from capital generating activities, and thus the availability of rewards in order to enable different forms of management; local experience with pooling and/or other forms of contribution; a differentiation of economic interests; and the possible role of corruption.

5.2.3 Organizational factors

Under the heading of organizational factors I handled: some different organizational options, and the lack of emphasis placed on the organizational prerequisites to sustainability of drinking water supplies so far; the limits to government agencies and their interventions; users' maintenance and backup systems; the possibility to base a modern operation and maintenance organization on a traditional structure; the

organization of user groups; the concept of accountability; local capability; the infrastructure of an area; training and education; and some examples from India and Bangla Desh.

In view of the limited financial role to be played by authorities with regard to the maintenance of drinking water supplies, the attention given to maintenance will increasingly be directed to the local level. If the question whether local communities are capable of raising the costs connected to that maintenance can be answered positively, the remaining essential question will be: how?

As a conclusion of this preliminary study, two important concepts to be dealt with by policy makers when planning and implementing drinking water projects can be cited: 'social control', to get the users to use supplies in the right way and pay their contribution to maintain the semi-public supplies on the one hand; and 'accountability' in order to get those made responsible by the community for the maintenance of the supplies, to keep them well maintained, on the other hand. To be useful in further research, however, both these concepts need operationalization in order to make explicit their precise role in causing success or failure of local maintenance.

5.2.4 Technical factors

Even though in Chapter Three we stated that the hope for a reduction of maintenance problems in drinking water supply projects in the Third World by means of technical solutions has been relatively futile up to now, technical factors do continue to play their part. To some degree these concern: the standardization dilemma; the requirement of technological appropriateness of a supply, and the criteria to decide on that appropriateness; the different aspects of that appropriateness; user problems and the adaptation of engineering concepts to locally acceptable standards; the local technology as a starting point of project design; and finally the familiarity of the users with preventive maintenance.

5.3 Overall conclusions

One important conclusion is that it is very difficult to arrive at an estimation of the relative weight of the factors at local level in relation to those at project level and at administration level, something that could have important policy consequences. It is still

by no means clear which are the strategic places where action should or could be undertaken.

A second important conclusion is the difficulty respondents experienced in distinguishing between project results which could be called a success and those which could not. As long as the people involved appear to have very little quantifiable data, or none at all, in order to evaluate the success of their projects, it is difficult to interpret their judgements on the relative importance of factors.

5.4 Follow-up activities

For a follow-up to this preliminary study it seems especially important to find out which factors are crucial, how they can be administered, and how these factors can be taken into account at different policy levels.

Finally, an experimental model project could be undertaken to study how a policy on drinking water supply maintenance, which from the very beginning directs its attention to the factors discussed in this report, in practice works out.

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