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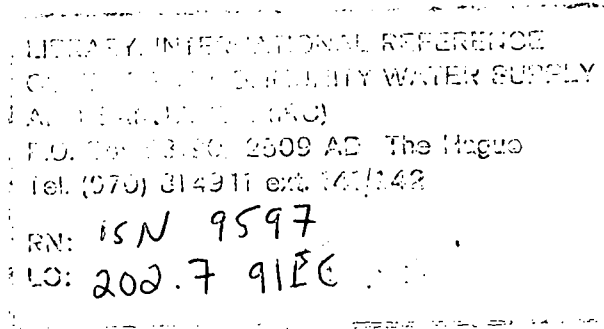
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Economic Benefits from Improved Rural Water Supply

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Preface

This paper is concerned with the economic benefits which can result from water supply interventions in rural areas in developing countries. The issue of economic benefits is particularly relevant in the context of current debates on making projects more community-based and user-oriented, improving the position of women, enhancing community management and cost recovery of improved supplies.

This paper has various purposes. In the first place it gives a systematic and analytical review of current data on economic benefits derived from rural water supply projects. In the second place the possibilities and implications for better incorporating these benefits in the planning and implementation process are assessed. Finally some aspects of the methodology of collecting data on the extent and scope of economic benefits, to whom they accrue and under which circumstances are examined.

The idea for this study was developed by Christine van Wijk, and the author is grateful for her stimulating support throughout the conception and elaboration of this study. In addition acknowledgements go to Joanne Hammeyer (ETC Foundation), Lane Hoffman (consultant) and IRC staff for their contributions in terms of comments, reviewing, editing and text processing.

The major source of information for this paper was the IRC Documentation Centre. Articles, books, policy papers, so-called 'grey' literature and several CD-ROM databases were used. Although a good number of publications touch the subject, there are relatively few systematic studies and 'hard' data. Another valuable source of information were interviews and discussions with colleagues at IRC, which showed an interesting variety of perspectives on the subject.

Evelien Kamminga

1. *Introduction*

The provision of safe, reliable, and convenient water sources is generally recognized as an essential service, and considered a precondition for achieving a minimum standard of living, good health, and economic progress. Up to now the improvement of health conditions has been a major justification for rural water supply programmes. The actual impact of water supply on health, however, has been difficult to prove and is far more complex than often assumed.

In recent times the issue of the potential economic impact of improved water supply on local communities, and women in particular, has been drawing more attention from planners and donors. This is no doubt related to concerns with sustainability of water supply interventions, cost recovery, income generation and enhancing the involvement of women. The objective of this paper is to give an overview of current information on the economic benefits derived from rural water supply interventions and to develop an analytical framework for analysis and planning. Emphasis is put on:

- the factors which promote economic benefits;
- the distribution and use of these benefits;
- the implications for project planning and future research.

There is a consensus among practitioners and researchers that most important economic benefits stem from improvements in accessibility and water quantity, and less from improvements in water quality. The most important economic benefits are considered to be:

- 1) Time and energy savings, and the reallocation of saved time and energy to productive activities.
- 2) The increased availability of water for productive purposes.

In this paper a distinction is made between water collection and use for "domestic" purposes and water collection and use for "productive" purposes. In the first case water is used for human consumption and in the second case for production (gardening, livestock, brick making etc.). This terminology does not intend to disguise the fact that water collection is essentially an economic, though usually unpaid, activity. (Cf. Goldschmidt 1987).

There are several reasons for studying the economic benefits associated with water supply projects:

the human resources argument

The well-being and living standard of rural households can improve, when women's labour is used in a more efficient way and becomes more available for change and development. (Carr, 1985; van Wijk, 1985; Carr and Sandhu, 1988).

the women and development argument

Women's practical needs can be met by reducing the burden of water collection and improving access to water for domestic as well as productive purposes. If women manage the water resources and the income subsequently earned, their position will structurally improve. (Carr, 1985; van Wijk, 1985; Carr and Sandhu, 1988; DGIS, 1989b; Moser, 1989).

the participation argument

Economic benefits meet perceived needs and therefore are likely to enhance users' active participation in water supply improvement. This has a positive effect on community management, willingness to pay, and the sustainability of water supply interventions in general. (Isely et al, 1986; Burgers et al, 1988).

the financial argument

Income benefits can strengthen the ability of communities (and women) to contribute financially to improved water supplies. (Churchill, 1987; Whittington et al, 1987; Whittington et al, 1989; Garn, 1990b).

the policy argument

Demonstrating quantified economic (and social) benefits can help at the policy level to justify investments in the water sector. (UNDP, 1990a).

In the literature the term "economic benefits" is confusingly used to describe both the immediate (socio-)economic effects in terms of time gains and access to water for production, and the ultimate economic impact: increased productivity or income. It is also often not clear who the receivers of the benefits are: the state, the project, the water-company, rural communities, households, women? Therefore throughout this paper a distinction is made between effects and impact. As major economic effects are considered the increased access and control over two basic resources, time and water. Time (labour) and water can be utilized under certain circumstances to increase productivity and income. When incomes rise as a result of the water intervention one can speak of an economic impact. The question of who receives the benefits is also one of the focal points in this paper.

Improved health conditions resulting from improved water supply can diminish medical expenditures and increase the productivity of household members. These kind of economic benefits are left out of discussion for practical reasons. Since the health impact by itself is already very hard to measure, it is even more difficult to grasp the spin-offs. As a result very few reliable data are available on these kinds of economic benefits.

While systematic data on benefits are rather limited, information on costs associated with water supply is even scarcer. Poor water supply can have important financial and economic costs. Examples are costs of buying water from vendors; loss in agricultural productivity due to lack of labour in peak periods; loss of productivity due to bad health by drinking contaminated water (guinea worm for example) and daily arduous hauling of water; expenditures on medical treatment, etc. The consequences of so called "water crises" have been described by various authors. (Dankelman and Davidson, 1988; Shiva, 1988; King, 1989).

The introduction of improved water supplies not only generates benefits for community members, but also costs. The most important are the provision of labour and materials for construction; water rates; time-investment in community management activities and training; the reduction of employment opportunities in water carrying, water vending and well digging; an increase in women's workload due to new economic opportunities related to the water supply; increased inequality and conflicts among user groups, etc. (Yacoob et al, 1991; White, 1981; van Wijk, 1985). No systematic, quantitative cost-benefit analyses of new water supplies were encountered in the literature reviewed.

The structure of this paper is as follows. After the introduction (Chapter 1) a conceptual framework for the analysis of benefits is presented (Chapter 2). Chapter 3 deals in depth with the issue of time and energy savings. The use of water from improved water supply for production will be discussed in Chapter 4. In Chapter 5 the conclusions are presented and the implications given for project planning and implementation, and future research.

2. *Analytical Framework*

Studying 'benefits' implies seeking causal relationships. The impact of improved water supply on health, for example, has been the object of study of many researchers. The methodological problems, however, appeared to be so enormous, that the results have been on the whole disappointing. Some authors have come to the conclusion that it is better to give up the effort. (Churchill, 1987; Isely et al, 1986; Cairncross, 1989). Socio-economic benefits are equally difficult to grasp. They depend on a whole set of variables and relations of a different order. It is often even difficult to prove that changes have occurred because of the water supply rather than other causes (White and Gordon, 1987; Carr and Sandhu, 1988).

The model developed in this paper (see Figure 1) shows the steps which can be taken to assess the economic benefits derived from a water supply intervention and to analyze the influencing factors. Factors of influence are partly project-related and partly related to local conditions and dynamics.

A distinction is made between the immediate effects on the resource base of communities (and/or household members) and the ultimate impact on income levels of communities (and/or household members). Possible immediate effects on the resource base are increased availability of time and human energy ("labour") and of water for production. These gains can have a potential impact on socio-economic outputs in terms of increased productivity, income, well-being of the household and/or water collectors, etc., through the devotion of time and energy savings and of more water to production.

Step A concerns the project planning and design. What are the project goals? Are the economic needs of the target group taken into consideration, in addition to health problems? Are economic opportunities identified? To what extent will accessibility, quantity, and reliability of the water supply be improved? Is multiple water use included in the systems design (construction; source yield etc.)? Are auxiliary inputs planned to support and promote income generation (f.e. credit scheme, skills training, marketing promotion). What are the expected outputs?

Step B deals with implementation. Have the facilities been installed according to the set goals? Has accessibility and quantity of water been improved according the plans? Have auxiliary programmes been executed as planned?

Step C concerns the functioning and utilization of the water facilities. Are the water supply facilities functioning and utilized in such a way that benefits can be obtained and sustained in the short and/or long term?

In project evaluations, functioning and use (efficiency and effectiveness) are often chosen as indicators for the immediate results of the project, but in fact they are only the prerequisites for benefits to occur. A system which functions well, and is used and maintained properly, is likely to produce health and other benefits. In addition, a number of local factors (geographic, cultural, gender, economic, social, etc.) play an essential role in the degree to which benefits evolve.

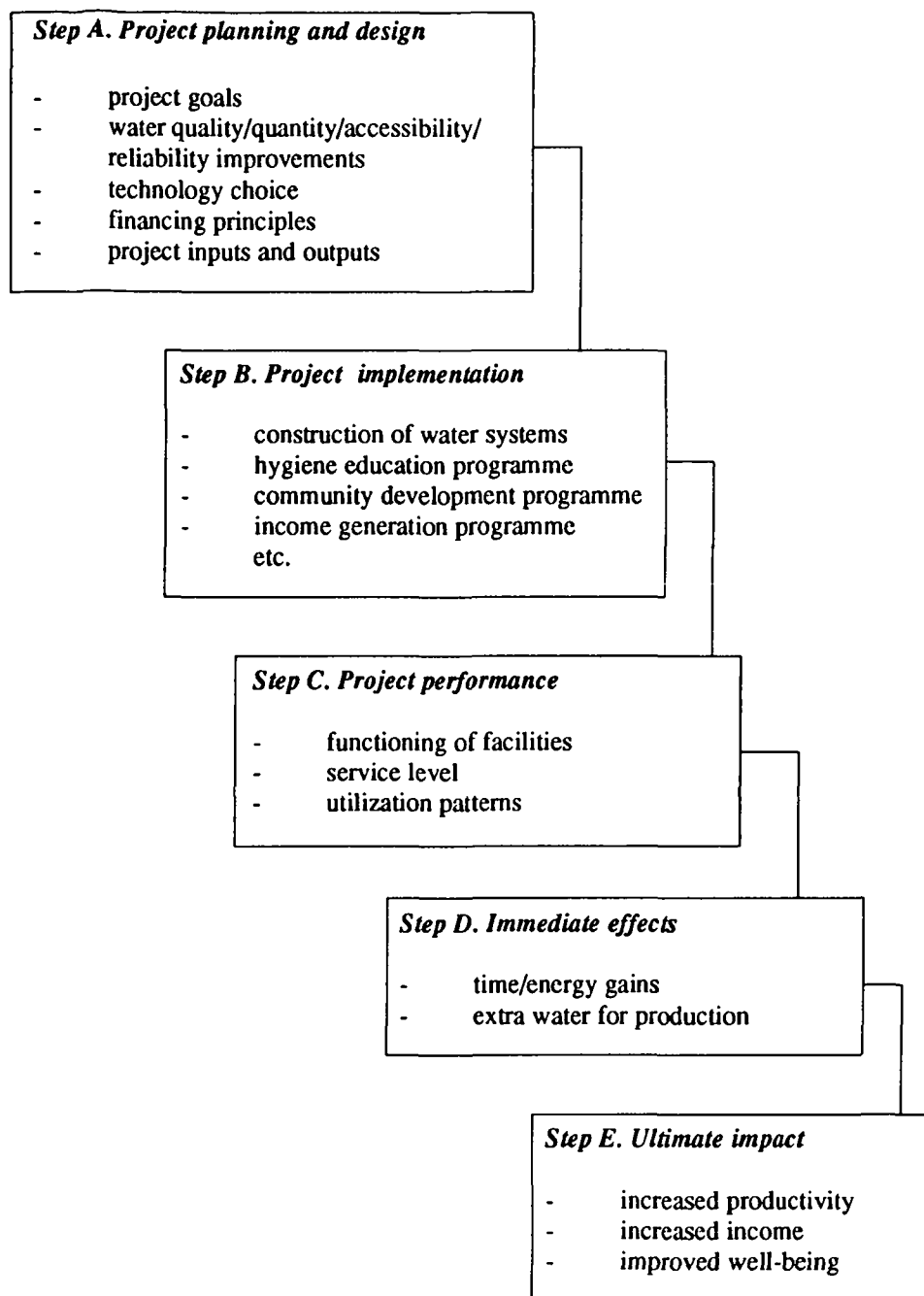


Figure 1. Model for the identification and analysis of economic benefits derived from improved water supply.

While the first three steps focus on the conditions for benefits to occur, the fourth and fifth step concern the actual benefits.

Step D This step assesses whether immediate economic effects occur, and if so, to what extent. How much time and energy are saved and how much has access to water for productive use been improved? How is access and control over these extra resources distributed?

Step E concerns the measuring of the ultimate impact¹. Have economic and/or social conditions improved? Have the extra resources been used to increase productivity and incomes, or for social purposes? How much income is being generated? Who are the beneficiaries? What are the major constraints to increasing incomes? Are there any negative impacts, for example on the environment?

Finally, information can be collected on the positive and negative changes (spin offs) which occur as a result of the impact of the project. Such effects might not be noticeable immediately, but only after a number of years. Positive changes could be: the position of women has improved; overall ability and willingness to pay water fees has increased; users feel more motivated to participate in community management; sustainability is increased, etc. Possible negative changes are increase of women's work-load; environmental degradation around water sources, etc.

The following two chapters concentrate in more detail on steps D and E of the model: the realization of time and water gains and their use for productive purposes.

1) Annex A provides methodological guidelines for measuring time gains and economic use of water and assessing the economic impact.

3. *Time Savings and the Reallocation of Saved Time*

3.1 **Water collection and time savings potential**

Time and energy spent on water collection involves walking to the water source, waiting, water-lifting and carrying of water. Women are the main collectors of water, while children, especially girls, often make a significant contribution as well. The possible negative effects of this form of child labour on, for example, health and school attendance have hardly been studied. In certain countries, mostly in Asia, men also have some responsibility for water hauling.

Women in developing countries are generally speaking overburdened. Productive and domestic (or reproductive) tasks are such that working days of more than 10 hours are common. Although women are often responsible for (a part of) the households' cash income, their income generating activities are usually characterized by a low productivity and low earnings. Water collection can take up as much as 27% of women's total energy consumption in steeper and drier areas in Africa (White et al, 1972). The burden of water collection can have serious consequences for the health of women (Curtis, 1985). In extreme "water crisis" situations water hauling can dominate women's lives and negatively impact the household economy and well-being (Iroko, 1985; Bosch, 1989; Whittington et al, 1989).

In villages in the Newala District in Tanzania women are reported to spend 11 hours to collect one 20-litre bucket in the dry season. As a result water consumption falls to 8 litres per capita per day or even less. Roughly a quarter to a third of the average household's labour is devoted to collecting water during the dry period. According to Whittington, the lack of water would not only be a threat to health, but it would also be a severe constraint on the economic production of the household unit (Whittington et al, 1989).

Time budget studies have been conducted in many countries all over the world. Because the actual time spent on water tasks shows an endless variation, no global generalizations can be made about the average time spent on water collection. The literature shows that the precise time and energy savings potential can only be adequately assessed on the spot, and should take account of the opinions of the women (and children) involved (see also section 3.4).

3.2 **Volume of time and energy savings**

To what extent does an improved water supply function as a labour-saving device, releasing women from a heavy, repetitive and relatively unproductive household task? Some statistics on the amount of time saved by improved water supplies are available. Unfortunately the data are difficult to compare, because they are site-specific and seldom indicate whether they are averages for the year or for a specific season only, whether they take into account all aspects of water collection (lifting, waiting etc.) or only the actual journey time, and how many family members participate in water collection (Carr and Sandhu, 1985). Often water collection is combined with other activities. Measuring each task individually instead of as a joint activity does not give a clear picture. The following table illustrates how variable the range in documented time savings can be.

Table 1: Time saved by new water supply according to case studies from five African countries

<i>Case study country</i>	<i>Time saved in minutes per household per day</i>	<i>Source of information</i>
Malawi	1.15	Msukwa and Kandoole 1981
Mozambique	106	Cairncross 1987
Lesotho	60	Feachem et al 1978
Kenya	17-86	
Zaire	100	

Source: Carr and Sandhu 1988.

In Indonesia a study showed 20 minutes of time saving per trip after installation of a new supply. Time spent on water hauling decreased from 41.2 to 21.1 minutes per day (Narayan-Parker, 1989).

The following data allow a direct comparison of time savings among households using improved water supplies (yard taps or public water points) and traditional sources.

Table 2: Effect of improved water supply on time use in Nyabera village, Kenya

	<i>users yard taps</i>	<i>users public points</i>	<i>users traditional sources</i>
Average no. trips/day	5.9	4.4	2.9
Average time per trip	5 min.	27 min.	127 min.
Total time/day	29 min.	108 min.	324 min.

Source: Whiting and Krystall 1979.

Various factors are mentioned in the literature affecting the volume of time and energy saved as a result of water supply interventions. The most important are:

a. Improved accessibility (Step A of Figure 1)

Distance to water sources and technology used are the key words. Most time gains occur when traditional sources are far away and limited in output (Feachem, 1978; van Wijk, 1985; Cairncross, 1989). House connections will produce maximum time savings, on the basis of both distance and technology. Limited or no time gains arise when traditional sources are sufficiently productive and nearby. This was found in Malawi and Tanzania, for example. Women are likely to continue to use traditional sources when they are more or equally conveniently located as improved sources, and the taste is liked (Msukwa and Kandoole, 1981; Hannan, 1985).

b. *Functioning and service level of the new supply (Step C)*

As might be expected, sufficient discharge, adequate number of outlets, reliable functioning and convenience of operation of facilities have a positive effect on time savings. On the other hand, long waiting time and breakdowns have a negative effect. Poor or inadequate maintenance has a negative impact on the time saving potential. (Hannan, 1985; van Wijk, 1985; Roche and Wright, 1987).

c. *Water use patterns (Step C)*

The following elements play a role:

- the perceived value of the new water supply
As long as users consider the costs (economic or other) of using the new supply higher than those of using the traditional sources, they will continue to use the traditional ones, even if they are further away (Carr and Sandhu 1988). This is related to how people value the various resources involved, including their own labour.
- the division of labour within households
Time savings are often shared between various household members (Ventura-Dias 1985). Women sometimes obtain no net time gain at all, for example if they lose the assistance of other household members, especially children, when the water supply becomes more accessible. In some cases (eg. Kenya, Guatemala, and Mexico) the time spent on water collection by adult women has even increased with the installation of a new supply (Whiting and Krystall, 1979; Carr, 1985; van Wijk, 1985; World Bank, 1990).
- water collection patterns
Water collection as an activity can be multi-functional, combining a number of other activities and purposes: child care, social contact, getting out of the house/compound (especially important in segregated societies), bringing grain to the mill, herding animals, bathing and washing clothes, etc. Better access to water sources does not always result in significant time saving, because these other tasks and needs have to be fulfilled as well (Iroko 1985, Ventura-Dias 1985).
- water consumption and changing hygiene practices
Often the amount of water used for domestic and sometimes productive purposes increases when the water supply improves. As a result more water is collected, and more time is spent. A case study in Mozambique showed that improvements in the water supply resulted in four times as much water being used as before (Cairncross and Cliff, 1987). Similar examples can be found for Kenya (Jorgensen, 1982) and Indonesia (Narayan-Parker, 1989). Hygiene education (Step B) generally advocates practices which are time demanding: use of more water, more frequent handwashing bathing and laundering, etc. In situations where access has not improved much, this can lead to an actual loss of time for women. (Cf. Blokland, 1990).

Considering the above factors, interventions which focus on increasing accessibility, water quantity, and service level, and on improving maintenance are probably most likely to have a time saving impact. Increased accessibility and reliability of water supply can also have important social and health benefits, apart from time and energy savings: relieving the burden for women, more convenience and comfort for the whole family, reduced demand for child labour, higher school attendance, better health resulting from increased water use, and so on.

3.3 Reallocation of time and energy gains for production and other activities

There are only a few studies of the impact of improved water supply on women's productivity and income. A small number of quantitative studies are constantly referred to in the literature. Best known is the work of Cairncross on the behaviour of water users. These studies were initiated to try to account for the apparent lack of health impact, and to demonstrate social and economic benefits (Cairncross and Cliff, 1987; Cairncross, 1988; Cairncross, 1989). Carr and Sandhu explain the lack of information on the relationship between labour saving technologies, such as improved water supply and grain mills, and productivity by pointing to the methodological difficulties involved and the unquantifiable character of many of the effects (Carr and Sandhu, 1988).

A recent report on water supply in the rural periphery of Chaoz City, People's Republic of China, gives a striking example of the potential of linking saved time and women's productivity:

"With the time saved from not having to fetch water, women were able to contribute to the development of the rural economy, increasing family income and improving living standards. Previously, one woman in each household had to spend at least one hour a day fetching water. Now that this is not longer required, they are able to participate in the township-run enterprises. Each household gains 365 working-hours each year, which is equal to 44,5 working days. At an income rate of 4 yuan (1 US\$=3.7 yuan) per day, this will amount to 178 yuan. Of the 249, 339 households in the city and its surroundings, 115,000 now have access to tap water. This means an increase of 20.47 million yuan (approximately US\$ 5.5 million) can be gained each year" (de Jong, 1991).

A similar example, also from China, of a simple projection of potential economic benefits is given in a recent joint publication of the Asian Development Bank and UNDP (1990). These calculations are rather theoretical and might serve promotional purposes as well.

Available studies on the reallocation of saved time in subsistence and market economies show little concrete evidence that time released has a direct effect on food production and income levels (Carr and Sandhu 1987). Exceptions are situations with a temporary high demand for labour during the agricultural peak season. Here additional labour can increase household production substantially (Saunders and Warford, 1978; Carr and Sandhu 1988).

According to studies in Lesotho, Mozambique, Burkina Faso, Tanzania and Kenya, rural women mostly devote saved time to non-remunerative work: cooking, cleaning, washing, care of children, social and leisure activities. Some authors explain this by a lack of economic opportunities (see section 4.3), others point out that people's preferences might play a role as well. Irrespective of how the time saved is actually used, however, a clear consensus exists that time and energy savings have a positive impact on the well-being of the total household and are highly appreciated by individual household members (Feachem et al, 1976; Hannan, 1985; Ventura-Dias, 1985; Cairncross and Cliff, 1987; Cairncross, 1989). Time gains, at the very least, generate *social benefits*.

At the same time, the literature gives plenty of examples of rural women exploiting the time savings in an effort to increase their incomes. Documented cases exist from Thailand, South Korea, Philippines, China, Indonesia, Burkina Faso, Togo, Zambia, Honduras, Panama and Peru (Bosch 1989; IRC 1991; Narayan-Parker 1989; UNDTCD 1990; van Wijk 1985).

Readily accessible and marketable activities, such as the preparation and selling of food and drinks, handicraft production, petty trade, and vegetable growing seem to be most common (Carr and Sandhu, 1988). Unfortunately most information is of a qualitative nature and no systematic data were found on the occurrence, scale and amount of income derived from these activities.

Some of the structural constraints rural women face in seeking to engage in (more profitable) economic activities are the following:

- *lack of access to, and control over, resources*
Women are often not only short of time, but also lack access to land, inputs, animal traction, starting capital, skills, etc. One of the most important constraints is the absence of a market to sell their produce (Carr and Sandhu, 1988; Cairncross, 1989).
- *lack of gainful job opportunities*
The availability of formal or informal employment opportunities for women is a precondition for increasing incomes. If such opportunities are present, time savings from an improved water supply may well be used for such work (Heyink Leestemaker 1989). Equally, without such opportunities income benefits are unlikely to be achieved.
- *lack of control over own income*
This is reported to be a possible disincentive for African women to reinvest freed time in certain productive activities. Work on the husband's land might sometimes be avoided for that reason (Carr and Sandhu, 1988). A study in Burkina Faso showed that women preferred to invest their time savings in unpaid work, such as collection and stockpiling of firewood for the rainy season. Women explained this by saying that if they earned more money their husbands would take less financial responsibility for the children, which would leave the women with very little extra net income (Bosch, 1989).

Considering these widespread constraints for women in most rural areas, additional measures will be indispensable in many cases to create the right conditions for women to increase their incomes. As noted, however, even if an improved water supply by itself has no visible impact on the economic output of rural communities, it might have important positive social impacts.

3.4 Perception of time gains and value of women's time

For rural women in developing countries, closer and more reliable water supply can have a variety of sometimes conflicting meanings: a reduced daily burden, less backache, more convenience, more time for other activities, but also less excuse to leave the compound, etc. Water collection has multi-dimensional meanings. Symbolic, physical, social, economic and other aspects are often difficult to distinguish (GIFED, 1985; Iroko, 1985; Katko, 1990). Little information was found on the more qualitative aspects of water hauling.

Several authors stress that for the users (men and women) improved accessibility (convenience and less effort) is one of the major benefits to be obtained from an improved water supply (Isely et al, 1986; Cairncross, 1988; Asian Development Bank and UNDP, 1990). Experience in hygiene education work also suggests that this factor can be an incentive for changing behaviour and for the acceptance of new practices, provided that perceived quality, taste and colour are adequately improved and the supply is socially acceptable (Burgers et al, 1988). Anticipated improvements in convenience was also found to be one of the factors influencing the "willingness to pay" for improved services of villagers, according to an evaluation of seven projects in Africa (Whittington et al, 1987).

In spite of these findings, most water supply programmes, especially those without explicitly participatory elements, aim almost exclusively at simply providing safe water. This gap in goals between planners and users results in programmes which are not based on the priorities and (perceived) needs of the users. Various authors, however, emphasize that these goals need not be seen as incompatible. Better accessibility and increased quantity often encourage higher water consumption, which is positive for health (Cairncross, 1988; Esrey et al, 1986; Isely et al, 1986).

One way of measuring economic benefits is estimating the monetary value of time savings. This can be done by placing an economic value on water collection time (Roche and Wright, 1987). Different methods are used to measure the *economic value* of time and energy spent on water collection:

- *energy spent on water collection as a percentage of total available daily energy*
In the New Guinea Highlands, for example, an average of 1.6% of daytime energy is spent in water collection (Feachem et al, 1978). White, Burton and White, in their classic study "The Drawers of Water", found that women in Kenya expend on average 12% of their energy in fetching water. In steeper and drier areas this can rise to as much as 27% (White et al, 1972).
- *monetary value of the food intake necessary to provide the energy for water collection* (Feachem et al, 1978).
- *value of collector's time expressed in market wage rate of unskilled labour*
This method is used in several World Bank studies (World Bank, 1989). One study in Kenya showed that the value placed by people on water collection time was indeed close to current wage rates. The study examined users' decisions concerning different water supply options (vendors to the houses, kiosks, and traditional sources further away). Choices were related to the household's income and number of adult women within the household (Whittington et al, 1989).
- *value of collector's time expressed in the comparative costs of new supply and unskilled wage rates*
For example, if an improved water supply were to cost 10 pounds per capita per year and the time saved by each adult woman were an hour a day, the cost of each hour saved would be only 7p per hour, if adult women constitute 40% of the population. This would be well below the unskilled wage rate, and therefore an economically sound investment (Feachem et al, 1987).

- *opportunity costs of water collection time*
The value of women's time is calculated in terms of the possible alternative uses of water collection time. Access to productive work is a precondition. When time is a clear constraint for increasing incomes or agricultural production, water collection time can be expressed in terms of lost income or production (Goldschmidt 1987; Carr and Sandhu, 1988; Heyink Leestemaker 1989).
- *relative costs of paying another person to collect water* (Curtis, 1985; Roche and Wright, 1987).

It should be noted, however, that in subsistence economies, people do not always value their inputs in monetary terms. Non-economic, social aspects such as leisure time and status can be more important for people, but are hard to quantify (Feachem et al, 1978).

Little is currently known about possible differences in male and female perceptions of problems related to water supply. What value do men compared to women give to water collection time and effort? This is relevant for the initiation and planning of water projects. It might also have consequences for the willingness of household members to contribute financially or otherwise to the installation, operation and maintenance of improved water supplies. According to Briscoe and de Ferranti men typically do not value improved water supply as highly as women, because water collection is a women's task. In Zimbabwe, women were found to be willing to pay 40% more for an improved water supply than men (Briscoe and de Ferranti 1988).

3.5 Distribution and control of benefits

Most of the time saved is women's and to lesser degree children's time, because they are the principle water haulers. Since the time spent on water hauling varies significantly among women in the same village, or even in the same household, individual time savings differ as well. Main influencing factors are: marital status, stage in the life cycle, socio-economic class, income-level, household composition, and division of labour within the household (van Wijk, 1985).

Evidence suggests time and energy savings for women, which they can devote to other activities (domestic or productive; non-paid or paid), bring advantages for the whole household. Women usually spend their earnings in the interest of the household (Feachem et al, 1976; Hannan, 1985; Ventura-Dias, 1985; Cairncross and Cliff, 1987; Cairncross, 1989).

Generally speaking the poorer the household, the more hours women work and the more important are the women's economic activities for household survival. A reduction in time spent on subsistence tasks can be of crucial importance to poor families. It is also the poorer families, however, that have most difficulty in paying water charges, and are therefore sometimes denied access to improved water supplies, especially house connections (Tinker, 1986; DGIS, 1989b). Poor women and men are also most likely to earn money by hauling water for others. New water supplies can mean a loss of income for them.

A study in an upcoming industrial centre in India concluded that improved water supply affects women in different ways. Upper middle class women, who had access to the formal labour market, and the poorest women, who had to earn money in the informal sector in order to survive, were found to use the saved time directly for income earning, while other women did not (Heyink Leestemaker, 1989).

The degree to which women have control over their own labour, income and other resources will define how much economic return they receive from time gains. Women do not necessarily reap the cash benefit of their own work. In certain countries, the household as a whole is more likely to benefit if women can divert time savings into activities unrelated to their husband's work (Carr, 1985; Carr and Sandhu, 1988; Hoffman, 1990).

In summary, who receives the ultimate economic benefits from improved water supplies seems to change from situation to situation. It is clear, however, that an eased burden of water collection means a considerable improvement in the working and living conditions of rural women and children.

4. *Availability and Use of Water for Production*

4.1 **Water for production: a side effect**

Traditionally in rural areas water sources are used for a combination of domestic and productive purposes. Vegetable growing and preparation of foods and beverages for sale etc. are widespread examples of water-related work of women. Although these activities are usually small scale, the benefits in terms of food, nutrition and income can be critical for rural women and their households. Men use water for livestock, fish farming, brick making and sometimes for vegetable growing. Products are either consumed by the household or sold.

Economic activities are sometimes stimulated by the new water supply, even when this was not an explicit goal of the project. Most common are animal husbandry, vegetable growing, food processing (including beer brewing), fish farming, construction and tree nurseries (Saunders and Warford, 1976; Copperman, 1978; Carr, 1984; van Wijk, 1985).

In Indonesia an improved water supply was found to have encouraged fish farming as a gainful activity. Villagers took the initiative to expand existing fish ponds and build new ones, using water from public standposts. The water comes from a spring and is plentiful (in terms of both excess output and waste water). Other favourable conditions are already existing skills and a good market for fish (Boesveld 1988).

Most conventional water supply projects are designed for domestic purposes only (Isely et al, 1986). A WHO study group on Technology for Water Supply and Sanitation has formulated the objective as follows:

"An adequate water supply is one that provides safe water in quantities sufficient for drinking, and for culinary, domestic and other household purposes so as to make possible the personal hygiene of members of the household" (WHO, 1987).

Major reasons for neglecting the water demand for production are probably the focus on safe drinking water (health) and the lack of recognition of women's productive role. As a result system design and quantities of water supplied are often not sufficiently adapted either to the users' needs or to the realization of the economic potential offered by improved supplies. Most new water supply projects fail to take account of these multiple water needs. In cases where improved water supplies are being used for production, this is often an unplanned side effect.

Data on the availability and use of improved water supplies for production (income generation) is scarce and unsystematic. Reference is sometimes made to whether or not a new supply is being used for production, but it is usually not clear if this was planned or not, and if the water used is surplus or waste water, overcharging the system's capacity or competing with other uses. Hardly any data were found on numbers and categories of women, men or households involved; levels of income generated; how revenues are spent, etc. No benefit-cost analyses looking at the feasibility of the activities in relation to the extra costs of increasing system capacity and other factors, were encountered.

The use of improved water supplies for unplanned and uncontrolled productive uses can have negative consequences for (sections of) rural communities, system sustainability, and the environment. Unequal access, unauthorized use, overuse, environmental degradation around water points, water contamination, and conflicts between user groups are examples of negative effects. The water used may not always be 'surplus' or waste water. Water use can also be competing with other uses, or can overcharge the system (van Wijk, 1989).

It is notable that scarcely any information exists on the effects of new water supplies on the use of traditional water sources. One study in Malawi showed that a new water supply was not used for production at all, but that a nearby traditional source, previously being reserved for domestic use, was now used for brick making, vegetable growing and stock watering (Msukwa, 1981).

4.2 Water for production: a project goal

Although examples of projects which have included economic benefits as an explicit goal are scarce, the literature gives some information on the implications of providing multi-purpose water supplies:

a) *Design implications*

Improving the accessibility and reliability, and augmenting the quantity of the water supply, are elements which most directly effect the availability of water for production (Isely et al, 1986). In project design the demand for water and the potential of traditional and new water resources for multiple uses should be thoroughly assessed (WHO, 1987). Different water sources (groundwater, surface water, and rainwater) can be improved for different purposes. Complementary facilities such as animal watering troughs, channels for the utilization of run-off water, etc. might be necessary.

b) *Economic implications: the value of water*

If system capacity has to be expanded to satisfy the demand for production, the costs of the supply will increase (Churchill, 1987). Devoting high quality water for production seems economically most justifiable when only wastewater or 'surplus' water is used for this purpose. This places limits, however, on the potential and scale of activities. Payment systems might need adaptation as well. Structural differences in access and economic possibilities between different user groups and individuals must be considered (van Wijk 1989).

In conventional projects water supply is often provided in limited quantity for common access as a free good. Those who use this water for economic activities generally do so without additional costs. The trend towards cost recovery can have important consequences for the costs of water to users. Water will no longer be a free input. Those with substantial economic benefits should contribute proportionally. Negative effects on the small scale economic activities of women, however, should be avoided (Isely et al, 1986; Melchior, 1989; van Wijk, 1989; Katko, 1990).

c) *Environmental implications*

If the supply is not used in an optimum way, but only to maximize short-term financial gains, the danger exists that water sources will be overexploited and insufficiently protected, causing long-term detrimental effects on the water source and diminishing the benefits for users (Narayan-Parker, 1990). A water resources management perspective is therefore indispensable.

d) *Institutional and social implications*

The development of a new resource usually requires institutional adaptations within communities. The approach to water supply improvement must be institutionally appropriate: user groups and their rights must be defined and agreed upon; operation and maintenance must be effectively organized; and the financing policy for the users must be agreed (van Wijk, 1989). Conflicts can easily result from competition between and within user groups, and unequal distribution of benefits.

It is clear that developing water as an economic resource has a wide range of implications which have to be carefully assessed in the project preparation phase, and monitored during implementation.

Several authors emphasize the positive effect of the integration of the water supply system with the village production system on users' participation, and on the sustainability of water supply improvements (van Wijk, 1985; Isely et al, 1986; Melchior, 1989).

Community-based and multi-purpose water supply interventions are expected to be more attractive for community members, and thus stimulate their willingness to properly use and sustain the water systems (including willingness to pay water rates and undertake community management).

4.3 Conditions for income generation

As noted, the availability of time ("labour") can be one of the limiting factors for increasing productivity and income. Water can be another critical element for productive activities. In general the following local factors can play a role in making an activity economically viable (Carr, 1984; Jansen, 1988):

- access to raw materials and other resources
- availability of time
- market demand
- access to credit/loans
- appropriate and dynamic organization
- available technologies
- degree of commercialization
- availability of skills.

External inputs in these areas are frequently necessary to facilitate income generation (see Step B, of Figure 1). The literature reviewed shows that water supply and income generation have been successfully combined in various kinds of projects: self-help projects, income generation projects with a water supply component, water supply projects with an income generation component, and integrated rural development projects.

A self-help project in Casamance, Senegal, assisted women's groups in making gardening a gainful activity. Water supply was one of the crucial elements in making this income-generating activity a success. Other positive factors were:

- *access to land guaranteed by local authorities*
- *introduction of several time saving devices (grain mills, daycare, better access to fuel)*
- *transport and water supply subsidized by external agency (UNICEF)*
- *good group dynamism built on traditional cooperation*
- *good marketing possibilities (sufficient demand from tourists)*
- *availability of necessary skills in the community (Soon Young Yoon 1983).*

Project-promoted economic activities for women, such as vegetable growing, food processing and beer brewing are relatively labour intensive and time consuming. A convenient water supply is therefore even more important. In addition, vegetable growing and husbandry are relatively high-risk investments. When practised on a larger scale, severe losses can result from spoilage by pests and other infestations, disease, theft, lack of outlets, etc. (Carr, 1984).

Especially in drier areas, water availability and reliability can be important pre-conditions for starting new, or expanding existing, productive activities. If other conditions, with or without external assistance, are also fulfilled incomes might increase (see Figure 1). At that point a quantitative and qualitative study of the economic impact will become meaningful. Over-exploitation of the water sources, however, must be avoided and water-efficient methods for (re-) use of water for productive purposes should be encouraged.

4.4 Distribution and control of benefits

Various user groups usually have different resources, interests and powers. The distribution of exploitable economic opportunities is generally not equal. For example, those with access to land, livestock, or capital to invest, are probably better able to increase their incomes with water-related activities than those without such resources. Land around water points for vegetable gardening is usually scarce and the potential benefit is often limited to a small number of households. This is especially the case, when siting has not been well planned and discussed with the community. Special measures and inputs might be needed to assist the poorer sections of a community in receiving more benefits from the improved water supply.

When the demand for water is higher than the supply, competition is likely to occur within and between user groups. Women may have limited access to the new water supply because those with large economic interests such as cattle owners, stand in a stronger position (van Wijk, 1989). Community rules can also affect access to water for domestic and productive use. In some communities the use of the new water supply is restricted to domestic purposes.

Income derived from water-related activities is often not only inequitably distributed between households, but also within households. Women working in water-related activities for their husbands often obtain little benefit, as examples from dairy farming in India, poultry raising in Burkina Faso, vegetable gardening in Zaire, and livestock keeping in nomadic areas have shown (van Wijk, 1985).

Payment of water rates can be another source of inequity. Where there is a system of "flat water rates", the total costs are divided over all households equally. The result is often that people with fewer cattle, less land or a less powerful voice have to make an equal contribution to the water supply, but do not receive an equal benefit from it (White and Gordon, 1987). On the one hand water fees should be in proportion to the quantity of water used, when productive use is involved (cf. van Wijk, 1989). Certain user groups do not need a subsidized water supply, but can afford to finance their own. On the other hand, it should be avoided that the rating system has a negative effect on the quantity of water used by poorer sections of a community for domestic purposes (Lindskog et al, 1990).

When improving access to water as a resource for production, the distribution of benefits and costs should be a point of attention. Relevant questions to be answered are:

- How are the interests of the various user groups taken into account?
- What value is given to water as a resource for different purposes?
- What should be the criteria for water rates at community level? How do they effect a potential health, social and economic impact? How do they effect the position of poorer sections and women?

5. *Conclusions and Recommendations*

Major conclusions

This paper has tried to contribute to a better understanding of the phenomenon of economic benefits derived from water supply interventions. Apart from some dated studies on the amount of time saved and the reallocation of saved time, few systematic data are available. Recently, however, there have been some attempts at quantifying the economic value of women's time (see section 3.4).

The study has shown that most water supply projects focus on drinking water supply for the improvement of health conditions and pay little attention to economic benefits, except sometimes in project evaluations. Even in "crisis" situations where water is far and difficult to get, agencies and governments tend to give priority to providing *safe* drinking water, whereas the people are more interested in an accessible and reliable water supply.

The kind and amount of economic benefits derived from water interventions varies from community to community and depend on project design, functioning and utilization of facilities, and not least on site specific variables. While the availability of more time and water can lead to increased productivity and incomes, it can not be assumed that this is automatically the case. Time and water are often not the only conditions for increasing incomes. The way in which these assets are utilized depends on individual opportunities and needs, priorities and local variables. Often complementary inputs are needed to assist selected user groups, for example women (credit programmes, skill training etc.). While time gains do not always generate clear economic benefits, they seem always to produce social benefits, which are highly appreciated by the beneficiaries.

Water supply improvements in areas with distant, limited and unreliable water sources have more potential for having an economic impact than areas with plentiful water close at hand. Referring to the arguments presented in Chapter 1 (Introduction) the following conclusions can be drawn about the significance of the issue of economic benefits from improved rural water supply:

Human resources

The literature supports the assumption that reducing the daily burden of water collection and improving access to water for productive uses makes women more efficient in both their domestic and productive roles. This will generally be positive for the well-being of rural households. The total workload of women, however, may not necessarily decrease.

Position of women

Economic benefits from water supply can indeed fulfil important practical needs of women, especially of those who are poor, through improved working conditions, released time, access to water for production, and sometimes increased income. Women's structural position might be enhanced, when they receive not only better access to, but also more control over, water resources. A project can encourage this by giving women an active role in decision making, design, implementation, and management.

Linking economic benefits with cost recovery

Linking the financial contribution of communities to extra time and/or income obtained from improved water supply is a delicate issue. Considering the characteristics and performance of many conventional water supply programmes, the economic circumstances, and the characteristic absence of additional inputs to stimulate income generation this does not seem justifiable in most cases. As Yacoob and Walker conclude, time savings may result in gains in long-term productivity, but these gains cannot be readily devoted to water sector investments nor do they necessarily generate immediate cash revenues to pay for water supply interventions (Yacoob et al 1991).

Projects can raise false expectations among villagers if the potential economic benefits are exaggerated in order to "sell" the project. There is also a tendency among planners and practitioners to consider women as the major receivers of the economic benefits (especially in relation to time gains) and to presuppose that women's ability to pay will increase and they will be better able to pay water rates. This can put an unfair burden on women. Projects may formalize a responsibility for women which does not correspond to traditional practice. This problem was raised at an IRC workshop in 1984, but is generally neglected in the literature (IRC, 1984). In general there seems to be an important shortage of insight into the gender roles and responsibilities in the provision of water, payment of tariffs, community management etc. (Cf. UNDTCD, 1990; Hoffman 1990).

User participation and sustainability

The literature supports the assumption that if the goals of the users and the project match, there is a greater chance that the users will give full support. Economic benefits are one of the factors influencing people's motivation for community management and willingness to pay. Often, however, the objectives of donors are more health oriented, while the objectives of the users are more socially and economically oriented. Emphasizing quantity and accessibility of supply, however, does not exclude health benefits. On the contrary, they may well be complementary (Feachem et al, 1977; Esrey et al, 1986; Isely et al, 1986).

Socio-economic benefits can be optimized by including them more explicitly as a secondary goal in water supply projects. By linking water interventions more to the users' perceived needs and by integrating them more into the community's production systems, people's active participation and the sustainability of the water supply systems can be enhanced. Women, especially poor women, should be considered as a major target group, since changes in water supply affect them most profoundly and the whole household is likely to profit from improving women's working conditions, extra time and new economic opportunities.

Making water interventions more multi-purpose and user-oriented has important technical, economic, financial, social, institutional and environmental implications, which have to be carefully assessed.

Recommendations

1. Information collection

There is a relative lack of systematic information on economic benefits related to water supply. Very little material was found on the possible economic costs of malfunctioning or inappropriate use of improved water systems. There seem to be several reasons for this gap:

- a) most "domestic" water supply projects aim at providing safe drinking water to improve health conditions;
- b) water for production has been considered the domain of irrigation and livestock projects;
- c) the productive role of women has been insufficiently understood and undervalued, and
- d) measuring of economic benefits is hampered by methodological problems.

Research in the following areas could enhance understanding of the meaning and potential role of economic benefits for sustainable water supply improvements, and assist in developing guidelines for future projects:

- quantified data on time gains, income generation and use of income;
- the consequences of malfunctioning and breakdowns of water supplies for women's income;
- the relationship between economic benefits and the long term sustainability of water supply systems;
- the advantages and disadvantages of including income generating activities in water supply interventions;
- the implications for project planning, design and implementation of including economic benefits as an explicit goal;
- the possibilities and constraints of including income generation as a component in water supply projects;
- the technical possibilities (including more effective use of waste water, rainwater harvesting, and traditional sources) for developing water supply for production on a cost effective base;
- the effects of new water supply on the use of traditional sources;
- the possibilities and implications of a more holistic approach towards community water resources;
- assessment of the economic value of water and the implications of recognition of water as an economic good;
- local and externally proposed payment systems. How is the use of water for production accounted for? How does this affect different user groups?

2. Planning and implementation of water supply projects

There appears to be a sufficiently strong case for encouraging the more systematic inclusion of user-defined economic benefits as an explicit goal in water supply interventions. The purpose of doing so, however, must be made clear, and the positive and negative implications assessed. Water supply improvements can be designed with different levels of economic goals (see Figure 1):

1. The creation of positive pre-conditions for increasing economic productivity by optimizing time and energy gains and/or access to water for production.
2. Increasing economic output or income generation.

Multi-purpose water supplies can be developed by specialized water projects, or as an integrated component of other projects. Logical linkages can be made with other sectors such as health, agriculture, livestock, environment and income generation. The intervention should match the multiple needs and priorities of the defined user groups. All community water resources should be included. The feasibility of proposed water improvements and economic activities should be assessed in relation to their costs, expected revenues, and the perceived value of water. It will be necessary to develop a project policy towards financing and subsidization of water for basic needs and/or production. Environmental, institutional and gender implications should also be assessed (Cf. Feachem et al, 1978; Carr, 1985; Hannan, 1985; Isely et al, 1986; Churchill, 1987; Cairncross, 1988; Therkildsen, 1988; Narayan-Parker, 1989).

If an ultimate goal is to increase income, constraints for income generation will have to be assessed and auxiliary measures (skills training, provision of credit facilities, etc.) identified. An explicit strategy should be developed to support income generation activities, to be implemented either inside or outside the framework of the water project.

Investigations on the precise economic benefits are only worthwhile, when a) substantial time and/or water gains take place and b) the conditions (with or without external support) are such that these extra resources are utilized for increasing incomes. Quantitative research in such cases can give more insight into the occurrence, scope and distribution of these benefits.

Target groups for enhancing economic benefits could be the whole community or specific categories within the community. The more interests community members have in their public, group or individual water supply, the more likely they are to care for the system and take responsibility for proper use, maintenance and financing. Women should be considered as a primary target group. They should be involved in decision making in all phases of the project, and obtain a strong influence on the actual and future management of community water sources.

Annex A

ASSESSMENT OF ECONOMIC BENEFITS

In this annex some methodological guidelines are given of how in a particular community time gains and economic use of water resulting from water supply improvements can be measured and their economic impact assessed.

I. *Measuring of time and water gains*

There are various *methods*:

- a. to compare water collection and water use patterns before and after the project intervention in the community,
- b. to compare water collection and water use patterns of the community with a nearby village without an improved water supply, and
- c. to compare actual water collection patterns in the community with the assumed pre-project situation.

Method a. is the most reliable. It requires, however, a baseline study before the water supply is improved. Ideally the situation of the same individuals in the same households is compared before and after the intervention.

Method b. can be reliable, if it is applied properly. A condition is that the traditional water sources (pre-project situation) in both communities are similar. Quite often, however, access to water varies greatly from one community to another, even when they are located on a very short distance from each other.

Method c. is the least reliable, but most likely to be used. It requires good researchers, who are well prepared and motivated, and have a good rapport with the community.

After selection of the most suitable method a *household survey* is prepared and executed:

- * In each community a random sample of households is taken: 5% of the total number of households with a minimum of 8 households. It is assumed that this sample will be more or less representative for all ethnic groups, user groups and socio-economic strata in the community, and that the households are geographically equally distributed over the village territory. If the community is extremely heterogenous a stratified sample must be taken to ensure that all groups are represented.
- * In each sample household the principal water collectors (probably women and children) are interviewed and their water related behaviour observed. A structured questionnaire with closed and open questions is used to gather data on water collection patterns and use (where, how often, by whom, for which purpose) and the perception of time savings and extra water availability. Structured observations are applied during a minimum of 2 or 3 days to record for each interviewed person the time used for water collection (lifting, waiting, transport etc. included); the amount of water collected, and the amount used at various places (at the source, at home, etc.). For each household the distance to its water sources is measured in meters and the time to reach them recorded.
- * Depending on which method is followed the collected data are compared with: the baseline data (method a.), comparable data from a neighbouring community (method b.) or with the data derived from a reconstruction of the pre-project situation (method c.). In the last case the sample

households are asked to recall where they collected their water before the project took place, how often, how much and for which use. With this information an assumption can be made about the time allocation and water use patterns before the project.

- * If the time gains for individual water collectors (not for the household as a unit) are significant, for example an hour a day, questions can be asked about people's awareness of these time savings, how regular (reliable) these gains are and how the saved time is used. If significantly more water is collected and used than before, questions can be asked about the purpose of the extra water use and the reliability of the supply.
- * In drier areas it is recommended to approach the sample population twice: once during the wet season and once during the dry season.

Analysis of the data can produce a good estimation of the time and water gains derived, and how these are used by various categories of water collectors. If time and/or water gains are significant, the following steps can be taken to appraise their actual and potential economic impact.

II. Assessment of the economic impact of time and water uses

While it is already difficult and time consuming to measure time and water gains, it is even more difficult to measure their economic impact in terms of derived income or resource value. Not, only quantitative, but also qualitative data are needed to make valuable assessments.

Interviews and discussion with community members at the water source and production sites, and interviews with key informants are the most appropriate techniques.

- * Key informants can be chosen among teachers, women's leaders, village authorities, etc. Spontaneous interviews and group discussions can be held at the improved water source(s), the traditional sources still in use and at sites where water is used for production (vegetable gardens; compounds where beer is made etc.).
- * Information must be gathered on the following topics: people's opinions on the economic and other benefits derived from the water project; the amount of time and water gains and their importance; the value of the time and water as a resource; income generation possibilities and constraints (for example reliability of the supply, lack of a market); the use of the derived income; ideas to maximize the benefits.
- * If very concrete economic activities, such as vegetable growing or dairy farming, are developed as result of the extra water availability and/or time savings, it must be tried to collect data on precise earnings. Existing bookkeeping records can be a good source of information. A cost-benefit analysis must be done taking into account issues such as the reliability of the water supply and seasonal fluctuations in income.
- * It is important to acquire insight into water as a productive input for economic activities in a wider cross-sectoral approach. For example, what are the possibilities and constraints for sustaining and/or increasing incomes in the short and long term? What are the implications for the renewable nature of water? What distributional impacts will the possible alternatives contain in terms of equity, especially for poorer groups and women?
- * Discussing the preliminary results and conclusions of the study with the participating community members - or at least some of the key informants - can greatly enhance the quality of the research. Such participation is also likely to contribute to a better mutual understanding between community members and project personnel, and to the creation of ideas for the enhancement of economic benefits.

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