Volume Contents and Author Index for Volume 5, 1981, is bound in at the end of this issue

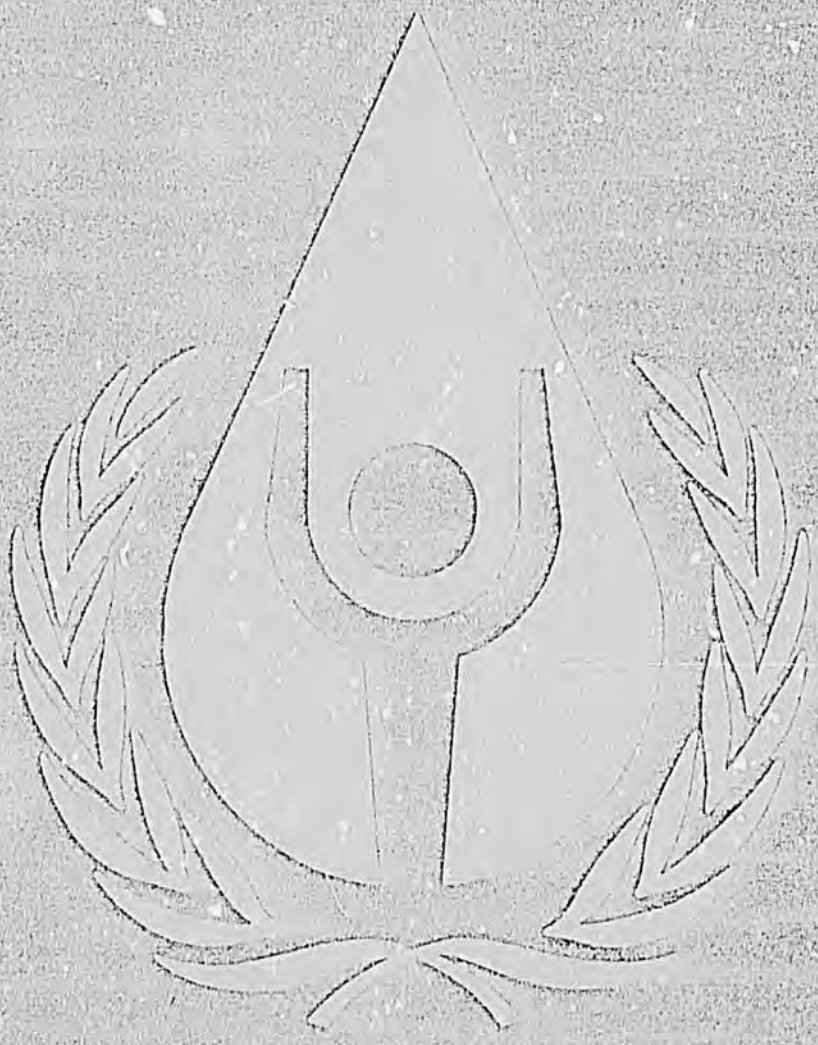
Volume 5 Number 6 1982

PN-AAT 475

41567

Water Supply & Management

Editor: Asit K. Biswas, Ottawa, Canada



Pergamon Press

PN-AAT 475

Water Supply & Management, Vol. 5, No. 6, pp. 417–424, 1981
Printed in Great Britain

0364-7714/81/060417-08$02.30/0
1981 Pergamon Press Ltd

The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health—Looking Forward to the Drinking Water and Sanitation Decade

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Women and children of the developing world are likely to be the chief beneficiaries of improvements in water supply and sanitation in the next ten years. Women will benefit because they are responsible for collecting, transporting and storing water in a vast majority of cases, all at the cost of a considerable expenditure of energy. Children stand to benefit because the heaviest burden of morbidity and mortality from water-related disease falls upon them. Many benefits will accrue to women and children alike because of the intimate biological and social bonds which link them in what Jelliffe, D. B. (1977) calls "the maternal–child dyad." The result is that benefits from improved water supply and sanitation to one affect the other with equal force. In this paper these three types of benefits will be explained and conversely the disadvantages that result from doing nothing about the present state of water and sanitation. Let us first examine the benefits to be experienced by women because of their role.

BENEFITS OF IMPROVED ACCESS TO SAFE WATER ACCRUING TO WOMEN IN THEIR ROLE AS DRAWERS OF WATER

In order to demonstrate at least one of these potential benefits, one which seems to be significant, let us consider water drawing as a form of caloric demand. White *et al.* (1972) estimated the average East African rural woman to use about 9% of her estimated 2840 Kcal. daily intake in drawing water. This proportion represents a number of calories roughly equivalent to the number of additional calories required a day during pregnancy. This figure of 9%, however, applies only to the average. Women who must traverse steep or hilly terrain may use from 15 to 27% of their caloric intake in water drawing.

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The relationships among water drawing, other household chores and childbearing and rearing are illustrated in Fig. 1. As can be seen, water collection is but one of several tasks making a demand upon a woman's energy. Table 1 summarizes what is known about the caloric demand of these tasks and estimates numbers for what is not known. Childrearing or childbearing, when combined with water drawing may account for a sizeable share of the daily caloric demand. The figure for the pregnant woman (16%) is different from that for the breast feeding woman (44%). When food gathering/cultivation and wood gathering, estimated as requiring together the calories demanded for water drawing alone* are added, the cumulative percentage for the pregnant woman becomes 25%, that for the breastfeeding woman 53% or over half her daily caloric intake. When the 30% required for nocturnal metabolism is added, the breastfeeding woman is left with only 17% of her daily calories to expend on other tasks, the pregnant woman 45%.

The overall energy equation is displayed in Fig. 2. As we have demonstrated, the net energy reserve for a pregnant woman is about 45% of her caloric intake—for the breastfeeding woman 17%, considerably less.

What do these figures mean in terms of the projected benefits for a woman of more accessible water supply? Quite simply, it stands to reason that if she can reduce the 9% or more of her caloric intake spent on water collection to perhaps 1%, then she will have that much additional energy for childbearing or rearing, other household tasks or for herself. One sometimes wonders where a rural African woman ever finds time or energy for herself in the overall economy of time and energy. A fascinating commentary on these interrelationships is found in the study of White *et al.* (1972) in East Africa, cited earlier. When rural women were asked what they would do with time saved through having water piped in, without much hesitation they agreed almost unanimously that they would prefer to spend more time on other household tasks: sewing, cooking and expressed almost no regret at the potential loss of social contact at the well or spring.

Having more energy for other things, a woman may be able to bear a larger baby, breastfeed longer, spend more time nurturing her children and more time on things she likes to do; and perhaps suffer less morbidity from parasites and infections with which she must invariably contend.

* This assumption is based on an estimate that the distance traveled for these tasks is roughly the same as that for water drawing, but that both tasks are done simultaneously.

Table 1. Caloric demands of various household tasks

Task	Demand K Cal/day	% Daily intake
Nocturnal metabolism	840	30
Childbearing	200	7*
Childrearing (breastfeeding)	1000	35*
Food gathering/cultivation	120	4.5
Wood gathering	120	4.5
Water drawing	240	9†
Other household chores	60	2
Commercial activity	60	2
Average daily caloric intake	2840‡	

* *Maternal Nutrition and the Course of Pregnancy* (1970).
† White *et al.* (1972).
‡ Gale (1960).

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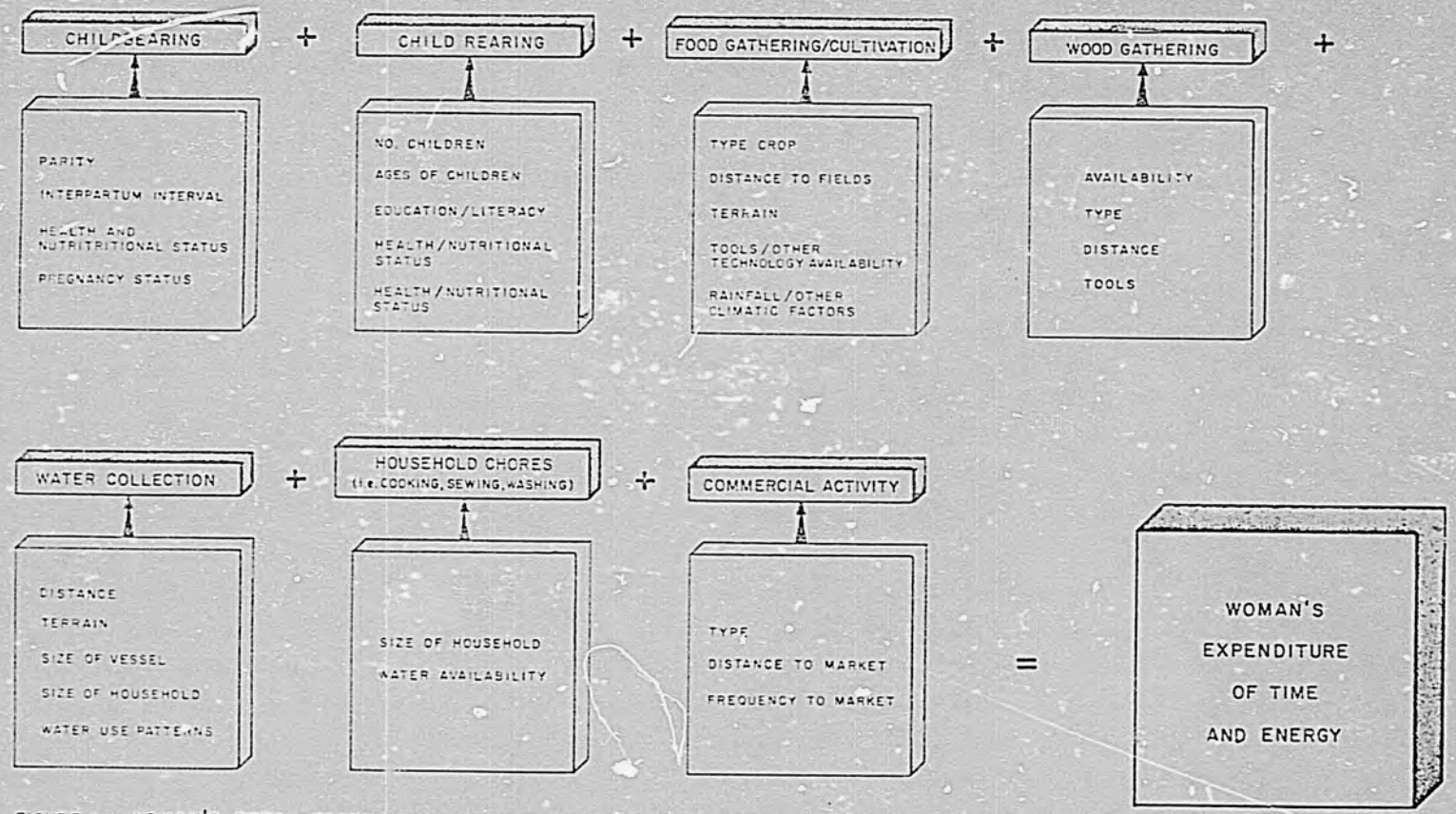

FIGURE I: WOMAN'S TOTAL EXPENDITURE OF TIME AND ENERGY AS A FUNCTION OF CHILDBEARING/REARING AND VARIOUS TASKS.

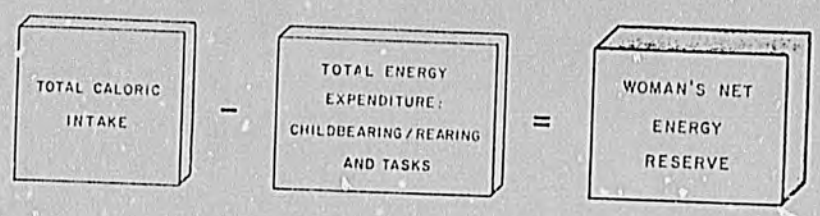

FIGURE 2: WOMAN'S NET ENERGY RESERVE AS A FUNCTION OF CALORIC INTAKE AND TOTAL ENERGY EXPENDITURE FOR CHILDBEARING/REARING AND VARIOUS TASKS.

BENEFITS OF IMPROVED QUANTITY AND QUALITY OF WATER AND ADEQUACY OF SANITATION THAT ACCRUE TO CHILDREN BECAUSE OF THEIR INORDINATE SENSITIVITY TO MORBIDITY FROM WATER AND EXCRETA-RELATED DISEASES

Children under five, especially infants, bear the brunt of morbidity from most diseases related to water and excreta. Among these diseases are the following:

Diarrhea and dehydration (multiple etiologies); typhoid fever; cholera; poliomyelitis; infective hepatitis; malaria; trachoma; scabies and hookworm infection.

Diarrhea and dehydration will be discussed as a representative of the entire group of diseases.

The cycle of diarrhea and dehydration, in fact, plagues the infant and young child population of the Third World. Approximately 30% of deaths in children 0–4 years of age may be attributable in some societies to this single syndrome (Satgé, 1970). In a recognized synergistic relationship with undernutrition (Scrimshaw *et al.*, 1968) diarrhea contributes to malnutrition through anorexia, increased catabolism, and caloric loss through both ends of the gastrointestinal tract; and undernutrition leaves the gastrointestinal tract in a more vulnerable state (Suskind, 1975).

Diarrhea and dehydration, in fact, constitute a major threat to the life and health of children 0–4 years in most developing countries, with case fatality rates of from 1–4%,

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during the first two years of life. In older children death rates are less. Small infants of low birth weight have frequently a higher rate. The mortality of hospitalized young children may be as high as 30-40% (Morley, 1973).

McGregor (1970) describes how the prevalence of diarrhea and vomiting in the Gambia increases each wet season, affecting mainly children aged 6-24 months. In the same population Rowland and McCollum (1977) report that infants between 7 and 13 months have, on the average, diarrheal symptoms for 6 days of each month, with a peak prevalence at age 9 months.

Thus, the syndrome we have selected as a marker of the potential benefits to infants and children from improved quantity and quality of water supply and adequacy of sanitation is a pervasive one in many societies, responsible for a large share of the infant and child mortality, and having a profound and intimate relationship to nutritional status. How is this syndrome related to water supply and sanitation and consequently to water supply and sanitation improvements?

First, it should be realized that simply improving the quality of water is probably not enough to produce significant health effects. Typhoid fever and cholera may be prevented in this way, but these diseases occur sporadically and account for very little of the total diarrhea in infants. What is most important is to improve the accessibility of safe water and thereby increase the quantity available to each household.

The source of the infection causing diarrhea, whether a specific identifiable organism or not, is fecal in origin. Intermediate between this fecal origin and the ultimate contamination of a child's intestine is a cycle of transmission via contaminated fingers, food and water.

As soon as an infant begins to crawl and to be able to grasp objects the cycle begins. Even before this time food may be contaminated by soiled fingers during the preparation, and after cooking the organisms in food multiply rapidly (Rowland and McCollum, 1977). Food left overnight is a particular risk.

Water may be contaminated at several points including the source itself (spring, well or pond), the receptacle, the domestic storage vessel or the cup (White *et al.*, 1972). If the infant is artificially fed, contaminated water may lead to rapid multiplication of organisms in an unhygienically-prepared formula (Jelliffe, 1977).

Prevention of diarrhea, therefore, requires more than simply improving the quality of water at the source or even the accessibility, but imvolves protection of water and from the source in transport vessels, in storage vessels, and during handling. It involves using safe water to wash hands, vessels, and containers and using proper sanitary means of waste disposal such as pit latrines and garbage pits. It is more than a question of water alone but of water use and all associated human behavior. If the health benefits to children of the Drinking Water and Sanitation Decade are reached, it will be only by this comprehensive approach to diarrhea prevention.

BENEFITS OF IMPROVED WATER SUPPLY AND SANITATION THAT ACCRUE TO WOMEN AND CHILDREN TOGETHER BECAUSE OF THEIR UNIQUE BIO-SOCIAL RELATIONSHIP

There is a sense in which one cannot speak of women and children as separate bio-social units, but rather as a single entity. Nowhere is this interrelationship more

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poignantly illustrated than in the picture of an African woman with a sleeping baby on her back. In actual fact, counting pregnancy children under five spend 39% of their time in intimate contact with their mothers. Through this relationship flow many of the benefits of improved water supply and sanitation. Three among several unique benefits of this maternal-child dyad will be considered.

Through more accessible water women can expend more of their energy on childbearing and child rearing roles. We have already demonstrated in pregnant women that reducing the caloric demand of water collection (9–27% of the daily intake) can make a considerable difference in caloric reserve. It is estimated that the majority of the weight gained by the fetus in the third trimester of pregnancy is composed of subcutaneous fat transferred actively across the placenta. An 8–26% increase in available calories could make a difference in birthweight.

In the lactating woman also, the gain in calories could mean an enhanced production of milk and perhaps a prolonged period of breastfeeding, especially in women initially undernourished (Jelliffe, E. F. P. 1977). Lastly, the saving in both time and caloric energy could mean more of each available to care for children in the sense of nurturing, clothing and showing affection. Thus, a benefit which accrues primarily to the woman herself extends to her children born and unborn in manifold measure. But what of benefits primarily to the child which extend to the woman?

It is reasonable to suppose that if fewer infants and children die from diarrhea and dehydration, there may be less of an impetus to bearing a large number of children in anticipation of losing some. That there is probably a lag between a drop in the mortality and an increase in interpartum interval and subsequently a reduction in parity (Liu, 1972) there seems little doubt. When one considers what the threshold may be to improving diarrheal mortality through improved water and sanitation, it may indeed be a long time until fertility shows a detectable response. It is nonetheless reasonable in the face of the findings in the Punjab (Taylor *et al.*, 1975) and elsewhere to justify interventions in water supply and sanitation using a population argument.

Intermediate to the eventual goal of fertility reduction is the possibility of longer breastfeeding to the child that survives, more time for the mother to recover her nutritional status before the next pregnancy, and most probably a healthier baby the next time. Thus, the benefits pass back and forth across the relationship.

Women as the chief beneficiaries of more accessible water and sanitary education in terms of their own personal health and hygiene may also pass these benefits along to their children. If food and water are more hygienically handled as a result of improved personal practices, the morbidity and mortality from diarrhea and dehydration may improve as much as from the direct effects on the child of more accessible water. In Guatemala, Shiffman *et al.* (1978) found that water quality, while good at the tap, deteriorated in the transfer from the tap to domestic containers. Half the samples from the latter had fecal coliform bacteria, and three quarters had some coliform bacteria.

We can conclude from these cursory observations a crucial role for women and children in the benefits derived from improved water supply and sanitation. The effects experienced by one extend invariably to the other in multiple ways. Women and children also contribute much to these improvements. Figure 3 illustrates the principal contributions at the community level essential to achieving an adequate supply of safe water. The same principles would apply to installing and maintaining sanitation facilities and practices. Consider how many of these contributions can be made by women or children or

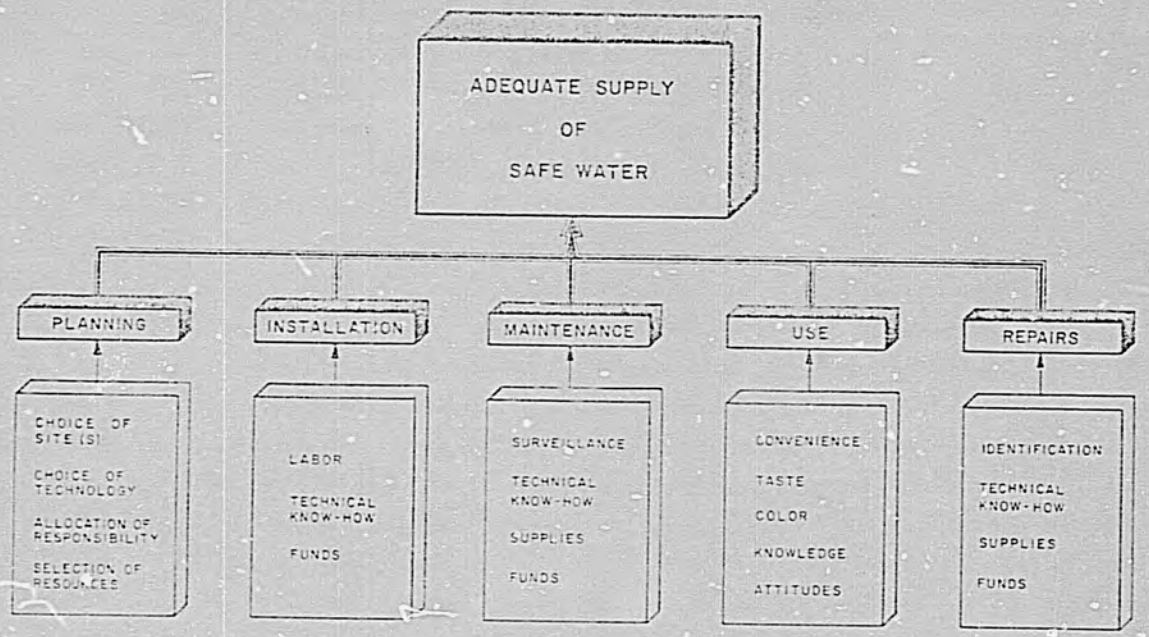

FIGURE 3: ESSENTIAL COMMUNITY-BASED ELEMENTS FOR THE PROVISION OF AN ADEQUATE SUPPLY OF SAFE WATER.

both. Little wonder it is that the Drinking Water and Sanitation Decade falls fast on the heels of the Year of the Child and starts in the midst of the Women's Decade. With so much to contribute to water and sanitation improvements and so much to gain in benefits, this 65% of the human race must figure importantly in the plans and programs of the next few years.

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