PN-ABB-348
ISN 59027

614
40648
F628
WITHDRAWN

o. 122
ecember 1985

Center for Policy Studies

Working Papers

CHILD SURVIVAL IN SUB-SAHARAN AFRICA: STRUCTURAL MEANS AND INDIVIDUAL CAPACITY
[A Case Study in Burkina Faso]

Odile Frank
Mathias Dakuyo

THE POPULATION COUNCIL
One Dag Hammarskjold Plaza • New York • New York 10017 • U.S.A.

614
140672
F8v.2

Abstract

Exceptionally high levels of child mortality are particular to Africa, due in large part to diarrheal diseases. The author evaluates the limits to improving child survival through alteration of environmental conditions, such as providing clean water and sanitation, on the basis of a case study in Burkina Faso. With respect to structural means, the imported nature of water supply and sanitation activities shows up the severe shortage of available national resources, and favors inappropriate objectives. At the same time, the weaknesses in individual capacity to assure child survival, due to an inadequate knowledge base and consequently misinformed hygienic practices, explain the persistence of residual excess child mortality when even the full range of preventative health measures is introduced.

POPULATION COUNCIL LIBRARY CATALOGUING-IN-PUBLICATION DATA

Frank, Odile
Child survival in sub-Saharan Africa: Structural means and individual capacity [A case study in Burkina Faso] / Odile Frank and Mathias Dakuyo -- New York : The Population Council, December 1985.
p. -- (Population Council. Center for Policy Studies. Working paper; 122)

1. Children - Mortality - Africa, Sub-Saharan.
I. Dakuyo, Mathias. II. Title. III. Series.

HB882.P66 no. 122

12.85 hnz

Odile Frank is Associate, Center for Policy Studies, The Population Council. Mathias Dakuyo is in the Département de la Recherche Démographique, Institut National de la Statistique et de la Démographie, Ouagadougou

This analysis is based on research funded in part by the Canadian International Development Agency.

The mortality of sub-Saharan African populations is notable on two counts: the average level is the highest in the world for any aggregate population of the same magnitude, and the age pattern of that mortality is distorted by exceptional loss in early childhood. Although it may have been typical of early modern European mortality, in the contemporary world, this age pattern of mortality is exclusive to Africa. Characteristically, while African children have an unexceptionally high risk of dying within the first year of life, as few as half may survive to their fifth birthday, because of an unusually high cumulative risk of dying in the second, third, fourth, and even fifth years of life.

Undoubtedly, during the first year of life, African children are subjected to hazards very similar to those affecting infants elsewhere in developing regions, particularly those few areas with comparable levels of infant mortality. Such hazards encompass biological disadvantages and handicaps, as well as susceptibility to the gamut of infectious agents. However, it is probable that after the first year the far greater risk of dying of African children is due to a substantially higher level of exposure to noxious elements in the environment. One major reason for this difference might reside in the characteristics of the environment itself, such as a higher disease load. Another likely reason is behavioral differences, such as customarily greater exposure of small children to a variety of

Agency for International Development
Library
Room 105 SA-18
Washington, D.C. 20523
WITHDRAWN

environmental assaults. Historically, the two groups of factors were interrelated, since changes in human behavior that reduced exposure to disease eventually lead to new behaviors to change the environment, thereby lessening its potential for harm.[1] At the same time, for any given set of environmental conditions, human behavior may or may not mitigate the influence of exogenous hazards on individuals. It is these interactions of behavior and the environment that we sought to explore in an appropriate African context. In particular, we addressed the issue of the extent to which structural alteration of the environment, through the introduction of exogenous means, could be expected to have a beneficial influence on child survival. Specifically, given that the means to child survival now available to African populations are intrinsic products of the development of western societies, the question arises at what point their introduction into an African society with high mortality reaches limitations.

To address these questions, we needed to focus on a particular disease process of unusual susceptibility to environmental conditions and commonplace in Africa. In light of Africa's singular pattern of higher child mortality, we also focused our attention on the mortality of small children past infancy. Accordingly, the first aspect of the research we report here is a case study in Burkina Faso of the mechanisms of diarrheal disease morbidity among one-year olds, and of the usual pattern of maternal behavior associated with it.

In selecting for study a means to alter the environment that could be expected to modify conditions sufficiently to affect demographic outcomes, we considered that the development activity of supplying clean water and sanitation could be expected to have a direct and beneficial influence on

diarrheal disease morbidity and mortality. Consequently, the second element of our report is a review and critique of Burkina Faso's water supply and sanitation activities with respect to their potential demographic benefits. Questions of the limits to structural alteration of the environment were explored on two counts: limitations due to resource constraints or inadequate implementation, and limitations due to inappropriateness or lack of relevance to the context of maternal behaviors and practices in matters of hygiene and child care.

Our research revealed that the exogenous nature of a development activity anticipated to benefit the health and survival of small children, such as water supply and sanitation in Burkina Faso, introduces limitations of effect that can be fairly well delineated. First, there was insufficiency of material resources, because the program was not the product of an internal demand based on knowledge, choice and resources: envisaged externally, the scope of the program exceeded effective demand and dwarfed the scale of available national resources. Second, the objectives of the program and characteristics of its implementation were based on considerations quite different to benefits for the health and survival of children, again probably because the program did not arise from endogenous demand for a healthier environment. Consequently, the implementation, such as it was, proved to be misdirected and inadequate in content and thrust to achieve its potential influence on child health and survival. Third, even implemented, at some point the program becomes irrelevant to child health and survival outcomes because its influence is mediated by hygienic practices and maternal sanitary behaviors some of which clearly undermine further potential benefits.

In sum, we conclude that the individual capacity to exert control over

the survival of children, which historically was probably as much a cause of the growth in means to save and prolong life as a product of increased standards of living, can be replaced in developing societies with high mortality such as in Africa by exogenous introduction to a point. The structural means to circumvent and override the shortcomings of individual capacity can comprise certain directed preventative and curative health interventions such as immunization, prenatal care, and access to health services, as well as a range of nonhealth interventions that better the environmental conditions of housing, water supply, sanitation and so on. To the extent that the structural means are independent of individual capacity, they carry their own limitations of scope, adequacy and relevance.

The point at which structural means cease to overcome individual shortcomings may be seen perhaps for the first time in sub-Saharan Africa. Historically, and in developing regions in this century, mortality decline has been observed as a seemingly ineluctable process, robust once engaged, and resistant to reversals even when progress has been slow and imperceptible. This has been the case in Africa until recent times. However, we are now seeing that standards of living have been consistently declining in parts of sub-Saharan Africa for several years, a phenomenon that is unique to the experience of developing regions in this century. Because of this, whatever exogenous structural means are introduced to African countries, in a number of societies they are not being reinforced by income growth and its benefits as they have been elsewhere.

We have come to expect the robustness of mortality decline. In the current conditions in Africa, we are seeing constraints to the tempo and scope of Africa's mortality decline, particularly among children. We may see

the region's mortality decline arrested, if not reversed. Beyond the immediate agenda this possibility compels, lies the long-term prospect of problems evoked by further delay in the demographic transition of the African region.

The paper begins with a brief review of child morbidity and causes of death in Africa as background to our focus on diarrheal diseases. Next, we review the recent demography of child mortality in Burkina Faso, as background to the case study. We then address the two major axes of this research: individual capacity to alter exposure to disease and modify disease outcomes, and structural means to overcome individual shortcomings. The limits to individual capacity and, in turn, structural means, are the major organizing principle of this research and the connecting thread of our analysis.

Child Morbidity and Causes of Death in Africa

Diagnosis of childhood diseases and accurate determination of immediate principal causes of child deaths are extraordinarily elusive for developing countries, the more so the greater the proportion of children who become seriously ill and are exposed to higher risks of dying. This is not only because where more children die there are as a rule fewer observers of both disease and death who are medically qualified to provide such assessments, but also because children who are ill enough to die usually experience several proximate causes that contribute to an inscrutable primary cause of death. The African region as a whole is grievously deficient in all these respects. Nevertheless, it is possible to construct a profile of child morbidity and death that could be characteristic of the entire region, using

data collected during small-scale health surveys and in the course of providing frontline health care, occasionally over a period of years (see, for example, Gouvernement d'Algérie, 1980; Government of Sierra Leone, 1980; Democratic Republic of the Sudan, 1981; Government of Mauritius, 1981; Garenne, 1981; Lepage et al., 1981; Woodruff et al., 1983; Moosa, 1984; and Woodruff et al., 1984). On the whole, the findings of these and other studies might be creditable cause-of-death data had they been collected in other areas of the world and under other conditions. In the African context they relate at best to putative causes of death and to symptoms present at the time of death.

On the basis of existing research we can assert that the four illnesses most often associated with childhood deaths in sub-Saharan Africa are diarrheal disease, malaria, measles, and respiratory infections. Available detail, such as age in relation to morbidity and mortality, allows for two additional observations. First, the principal causes of mortality apply as much to infant mortality beyond the neonatal period (after the first month of life) as to deaths in the second and subsequent years. The major factors that sharply differentiate the neonatal period are prematurity, neonatal tetanus, circumstances of delivery, and other problems specific to newborns. Second, although all four diseases are the major causes of both morbidity and mortality, the order of their importance may differ for these two outcomes: even at a fairly gross level of observation, the divergent case-fatality rates of these four diseases are remarkable. Little else may be specified for sub-Saharan Africa except the tendency for both respiratory diseases and malaria to be less frequently associated with death than expected on the basis of the morbidity they occasion, while diarrhea is more often linked to

deaths than expected.

A broader level of observation of these phenomena is available in the World Health Organization's global statistics and estimates. A recent statement on the disease problems of developing countries that utilizes World Health Organization estimates finds the incidence of the same four diseases as most associated with death rates worldwide, and as responsible for the greatest part of the morbidity and mortality of children under five (Walsh and Warren, 1979). In this respect Africa's experience would appear to fit a more general, global pattern. Closer scrutiny, however, reveals that global data are disproportionately weighted by Africa's burden of disease and death: for example, estimates of worldwide malaria suggest that the proportion of all cases of malaria worldwide that is occurring in Africa ranges between 50 percent and over 90 percent, and that possibly over 80 percent of malaria-associated deaths worldwide are to African children under five years of age (Walsh and Warren, 1979; World Health Organization Malaria Action Programme, 1985). Similarly, recent surveys of diarrhea-associated mortality, morbidity, and treatment conducted under World Health Organization technical guidelines between 1981 and 1984 in 33 countries reveal Africa had the highest levels of infant and child mortality overall, the highest rate of diarrhea-associated mortality, and the highest incidence of diarrhea among children (World Health Organization, 1985). Whether or not Africa's present worst-case position is in part a reflection of the faster pace of improvement in the diarrhea situation in other regions, at even the most conservative estimates of the global magnitude of the overall diarrheal disease problem, the toll in sub-Saharan Africa is ponderous.

The diarrheal disease problem has had a low profile in Africa. This is

partly because it cannot stand out against the landscape of high morbidity and mortality, and in part because, by the same token, African public health action has been as slow in effectively addressing that problem as it has with regard to the numerous other items on Africa's heavy public health agenda. Accordingly, the African region lacks an equivalent regional organization to the Pan American Health Organization (PAHO) which benefits Latin America, or to the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) which similarly benefits South Asia. Such institutions serve effectively to group the interests and ongoing research of a public health community, maintaining a steady focus on health issues. Africa is at present endowed with only a WHO regional office in Brazzaville. A few signs suggest that this situation may change: the first African Conference on Diarrhoeal Diseases took place in Tanzania at the end of 1984, jointly organized by ICDDR,B, UNICEF, and the Tanzanian Ministry of Health with participation from 18 African countries. Obstacles must be viewed realistically, nevertheless. Recommendations of the Conference included the need for national diarrheal disease control programs and for a regional mechanism for research collaboration, both of which require basic inputs and resources that are scarce regionwide. The most specific recommendations emerged from a workshop on the development of a diarrheal disease program for Tanzania that took place after the Conference. The progress of such a program will be an indicator of the near term possibilities for the entire region, and in this regard it is an important model, given Tanzania's stress on social welfare in the face of severe economic constraints to development.

Child Mortality in Burkina Faso

Burkina Faso may have one of the highest levels of infant and child mortality in the world. To attribute a specific rank would require accurate estimates of mortality in countries that as a rule have the poorest conditions of life, a reflection of poverty and a guarantee of scarce statistics. In the case of Burkina Faso, we have three points of observation over the last quarter-century: a national sample survey of 90,000 people conducted by the French in 1960-61 (from which several series of estimates have been made over the years), a postcensal survey in 1976 carried out by the then Voltaic authorities, and, most recently, the final results of multi-round surveys of infant and child mortality in some urban areas of the country, which were modelled after the IPOMD surveys and conducted by national authorities in collaboration with the Demographic Unit of the Sahel Institute in Bamako, Mali. All other mortality estimates published for Burkina Faso are generally from projections of the 1960-61 survey produced and utilized by the United Nations or the World Bank.

Infant mortality in what was earlier Upper Volta exceeded 200 per 1000 births well into the 1970s: the adjusted estimate made by Brass on the basis of the French survey data of 1960-61 was 263 per 1000 (Brass, 1968). National authorities estimated the level in 1975 at 190 per 1000, and the postcensal survey of 1976 yielded a national average infant mortality still above 160 per 1000, while the World Bank utilizes estimates for the early 1980s of around 150 per 1000 (World Bank, 1984; 1985). Similarly, the second-year death rate was a little over 100 per 1000 around 1960 according to data from the French survey (see Page and Coale, 1972, and Adegbola, 1977) and still exceeded 70 per 1000 according to national estimates in 1975.

Using the 1960-61 survey estimates to gain an appreciation of further death rates yields a third-year rate of about 80 per 1000 and fourth and fifth year rates of about 40 per 1000. This would be equivalent to a combined death rate for children aged 1 to 4 of about 70 per 1000, a figure given for Upper Volta by the World Bank for the period around 1962 (World Bank 1984; 1985). The one to four year child death rates given for the early 1980s by the World Bank are on the order of 40 per 1000, echoing the mortality decline already evident in the infant mortality rates. This reflects a decline in the probability of dying between the first and fifth birthday from about one in five in 1960 to one in eight in the late 1970s. To summarize, a newborn child in Upper Volta in the early 1960s had a greater than forty percent risk of dying before it reached the end of its fifth year; that risk may have declined to between 25 and 30 percent by the late 1970s: a somewhat lower risk, but one that still signaled the death in infancy or early childhood of one of every three or four children born. Lastly, the most recent data on infant and child mortality in Burkina Faso, from the observation over time of children born in urban areas in the early 1980s, suggest more favorable survival prospects, reflecting probably both the improvements over time that have been noted in the survival of children countrywide as well as the urban advantage which is typical of mortality conditions in developing countries (Dakuyo et al., 1985). Accordingly, preliminary data suggest that the probability of dying in the first two years of life--estimated at greater than one in three for the country as a whole on the basis of the 1960-61 survey--stood at one in eight in urban Burkina Faso in the early 1980s.

The recent urban data are notable because the typical African pattern of a disproportionately high risk of dying in the second year relative to the

first year of life persist at lower levels of mortality. Thus the preliminary data for Bobo-Dioulasso, a sprawling township in southwestern Burkina Faso that is the focus of our research, yield an infant mortality rate of about 90 per 1000 and a second-year mortality rate of about 40 per 1000.

Individual Capacity to Alter the Risk of Disease and Disease Outcomes

To determine and understand the immediate environmental conditions of early childhood deaths, a small intensive study was undertaken of mothers whose children had died in the second year of life. Against the background of a number of larger scale enquiries into the socioeconomic determinants of diarrheal disease, we sought to examine firsthand the role of household practices in matters of sanitation, personal hygiene, and fuel use in the transmission of diarrheal disease.

The field study consisted of home visits, household observation, and in-depth interviews of women whose children had died between the first and second birthday as recorded in the Infant and Child Mortality Survey (EMIS) of Bobo-Dioulasso. This survey is one of a family of prospective, multi-round surveys originally designed and directed by the Institut de Formation et de Recherche Démographique (IFORD) in Yaoundé, Cameroon, in a number of urban areas of Central and West Africa for the estimation of levels and determinants of infant and child mortality. The Bobo survey was directed by the Demographic Research Unit of the Institut National de la Démographie in Ouagadougou, in collaboration with the Institut du Sahel's Unité Socio-Eco-Démographique (USED) in Bamako, Mali. USED provided ongoing data entry, data linkage and verification, and better general data base management

through a micro-computer system established there in 1982 (see Dakuyo et al., 1985, for a detailed discussion of the data quality of the Bobo survey).

The survey base was intended to include the entire population of women who delivered a baby in a hospital, maternity clinic, or at home with a midwife between 1 April 1981 and 31 March 1982. While the most inclusive recruitment was intended, estimates of the actual coverage suggest that some structurally inevitable categories of losses and biases occurred (particularly following from the logical associations of attrition of mothers with child deaths), although at well contained levels (see Dakuyo et al., 1985). On the basis of a very rough demographic approximation, the coverage certainly could have been quite high. Between 600 and 700 births per month were registered by the Survey in the baseline year, totalling almost 8500 births annually. Assuming that one of four women gave birth that year and that women of childbearing age represented about a fifth of the population, the total population of Bobo would have been about 160,000, yielding a crude birth rate of about 50 per 1000. The population of Bobo was estimated to be about 133,000 in December 1981, based on projections from the census of 1975, which yielded a population of around 113,000. In addition, adjusted total fertility in Bobo was estimated from the 1976 postcensal survey at 6.5 births per woman which is quite compatible with the level of fertility we have assumed (Bigot, 1981).

The recruited population had been followed for 2 years in 7 subsequent rounds--one month and four months after the birth of the child and every four months thereafter. Thus the mother was seen at her child's birth, and when the child was one, four, eight, 12, 16, 20 and 24 months of age, assuming that the child survived. In the case of a child's death, information was

recorded retrospectively for the interval in which the death occurred, and visits then in principle ceased.

The sample of sixteen women interviewed in this study was composed of about every third mother whose child had died in the second year of the survey of all women who gave birth in the first 3 months of the baseline year (April, May and June, 1981), or of the first quarter of the survey population. This sample represents one of every fourteen or fifteen children of all those who died in their second year. In each home visit, the following topics and items were covered by interview, observation, and open-ended discussion with the mother:

- o water supply source, abundance, uses, and costs
- o personal hygiene practices among adults and children
- o mother's fertility history, and current fertility status
- o breastfeeding, supplementation, and weaning practices in relation to the last-born child's development (not necessarily the deceased child)
- o mother's mortality experience, full description of the deceased child's health problems and final illness
- o fuel sources, abundance, uses, and costs
- o observation of cooking areas, food preparation and feeding, utensils, latrines, washing areas, water supply, and general home conditions

By the time of our fieldwork in July 1983, all but three of the women in our sample had had an additional birth, thereby closing the interval that had begun with the birth of the child who died. The accurate and detailed information on the sequence and timing of events in the interval, as well as knowledge of the interval length itself, which were afforded by the survey and our re-visits, suggested a natural division of the mothers into two

groups: mothers of children who died early and mothers of children who died late in the course of their second year. The two groups of mothers experienced a different sequence of events, and that distinctiveness was helpful to the description of maternal behaviors. Table 1 displays the temporal sequence of child deaths, by age of the child, during the second year, and alongside, major characteristics of the birth interval.

It is meaningful and analytically helpful to define the mothers of children who died early as those who were still lactating at the time of their child's death. The mean age of children still being breastfed at the time of death was 13.1 months, while the mean age of weaning for all weaned children (including child 152) was 15 months. This suggests that discontinuation of lactation was truly brought on by the child's death and that the lactation status of mothers whose children died earlier was not unusual, with the notable exception of the mother of child 152. Even the eldest child to die unweaned was just short of the average age of weaning in this sample: only two of these children who died after weaning were younger than child 1173 when weaned.

Mothers of the children who died earlier may have behaved unusually with respect to supplementation, however. Thus, not only was child 152 fed in part by bottle until finally weaned prematurely in the eighth month (child 152 was the only child in the entire sample to whom a bottle was ever given), but, additionally, child 997 was not given any semisolid supplementation, customarily offered at 6 to 8 months, by the time of death, and children 1002 and 374 any solid supplementation when it would have been customarily offered by about 11 months, four to six weeks earlier. Otherwise, the remaining mothers in this group supplemented at the expected times, with the exception

TABLE 1 Sex and age at death, with interval characteristics for child and mother of children who died in the second year, Burkina Faso.

Child	Sex	Age (in months) at:				Mother:			
		Death	Weaning	Supplementation		Pregnant at time of child's death	Duration of postpartum abstinence (months)	Months postpartum at next pregnancy	Duration of the birth interval (months)
				Semi-solid	Solid				
997	M	12.3	D[a]	0	0	No	12	12.5	21.5
1002	M	12.3	D	8	0	No	13	13.6	22.6
374	F	12.6	D	6	0	No	2	15.9	24.9
152	F	13.3	8	6	11	No	14	14.3	23.3
511	M	13.7	D	8	10	No	14	14.5	23.5
297	M	13.9	D	6	14	No	6	n.a.	n.a.
143	M	14.3	D	8	12	No	16	n.a.	n.a.
1173	F	14.6	D	7	11	Yes	10	10.2	19.2
1167	F	14.6	12	7	11	Yes	4	6.1	15.1
299	F	16.3	14	6	11	Yes	2	9.7	18.7
1295	F	16.5	15	3	11	Yes	4	8.4	17.4
357	F	18.0	16	6	13	Yes	12	12.1	21.1
306	M	20.3	18	10	10	Yes	14	16.7	25.7
231	M	21.2	15	7	11	Yes	12	18.2	27.2
244	M	23.4	18	7	12	Yes	5	12.9	21.9
1415	M	24.0	19	0	12	No	24	n.a.	n.a.

[a]Child was still breastfeeding during final illness: mother was lactating at time of death.

of the mother of child 297, who began solid supplementation unusually late--as it turned out, the child died less than a month later.

The mothers in this group are further characterized by the timing of their next pregnancy. Lactation was accompanied by postpartum abstinence among most of them, and only one mother became pregnant before the death of her child (child 1173). The next pregnancy generally followed very quickly on the death of the child, suggesting that lactational infecundability was already ebbing some time before the child's death: one can suppose that suckling was impaired prior to abrupt cessation of any level of lactation at the child's death. In the last few months of these children's lives, their mothers' next pregnancies might have been averted principally by abstinence.

Again, at a general level, one can characterize the mothers of the second group of children, those who died later in the second year, with a somewhat different result. These mothers had weaned their children on average in the fifteenth month. While we know that this concerns true weaning, and not the abrupt premature cessation of lactation following the death of a breastfed child, we also know from the EMIS survey data that these mothers were all early weaners. The median age of children at weaning for the entire survey was 21 months, and only twelve percent of children were weaned by the close of the fifteenth month (van de Walle and Traoré, 1985).[2] It is quickly evident that most of these mothers were pregnant at the time of weaning and had continued to breastfeed even into the second trimester of their pregnancy. We can suppose that the early voluntary weaning by these mothers was in part due to physiological impairment of their lactation caused by pregnancy.

If lactational infecundability alone protected all the mothers in this

sample from a next pregnancy, there would be no reason to expect any difference in the timing of the next pregnancy except those due to differences in the timing of weaning. Since the mothers whose children died earlier experienced earlier onset of the imposed weaning, all other things being equal, one could have expected these mothers to have been susceptible to pregnancy earlier. In fact, the average time postpartum at which the pregnancy of mothers whose children died later occurred falls short of the average age at death of the children who died earlier, i.e. the mean duration of lactation of the mothers whose children died early, and far short of their own duration of lactation, since their pregnancies preceded weaning by several months. What appears to account for this is that while mothers whose children died earlier were infecundable due to both lactation and abstinence, postpartum nonsusceptibility of the second group of mothers depended essentially upon lactational infecundability alone. It is evident that the mothers whose children died later did not abstain from sexual relations for the entire period of breastfeeding. In addition, it is probable that they resumed sexual relations earlier than the mothers whose children deceased earlier, even though this latter group of women may have ceased abstaining only as a function of their truncated breastfeeding. Indeed, despite the possibility that these mothers resumed sexual relations only in response to and consequent to the death of their child and its imposed weaning, the mean duration of their postpartum abstinence of about eleven months approached the median duration for the entire FMIS survey population (half the sample had resumed relations shortly after the twelfth month postpartum), while the mean duration of all the mothers whose children died later, and who had become pregnant while still breastfeeding is appreciably shorter, at just over seven

months (van de Walle and Traoré, 1985).[3]

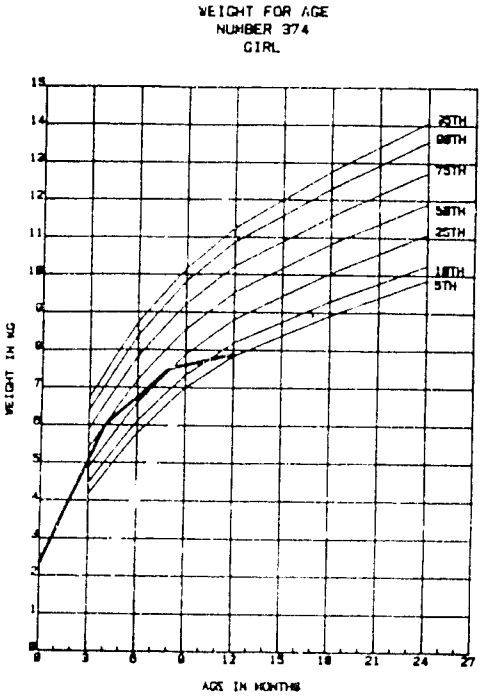
In sum, the foregoing characteristics of the mothers of the two groups of children point to the possibility that the healthy survival of the children was compromised in two ways. The behaviors of the mothers of the younger children were beneficial to the children on the whole, since these mothers protected their lactation by abstaining from sexual relations. On the other hand, they can have provided too little supplementation of the breastmilk, inadequate as sole nutritional intake certainly by 6 months of life. The behavior of the mothers of the older children differed. While there appears to be nothing unusual about their supplementation behavior, these women abstained less from sexual relations. In tandem with supplementation, which may have contributed to earlier ovulation, the sexual exposure of these women led to early next pregnancies. These pregnancies could in turn have played a large role in determining the subsequent early weaning of their children, since pregnancy physiologically impairs the volume of milk production. We may conclude, therefore, that survival of the younger children may have been compromised by inadequate total nutrition, whereas survival of the older children was jeopardized initially by foreshortened abstinence. At the ages when the older children were losing their supply of breastmilk, breastmilk can still be critically important to the child's protein requirements as well as to the supply of overall calories during illness (Gopalan, 1958; Hoyle et al., 1980; Lepage et al., 1981).[4]

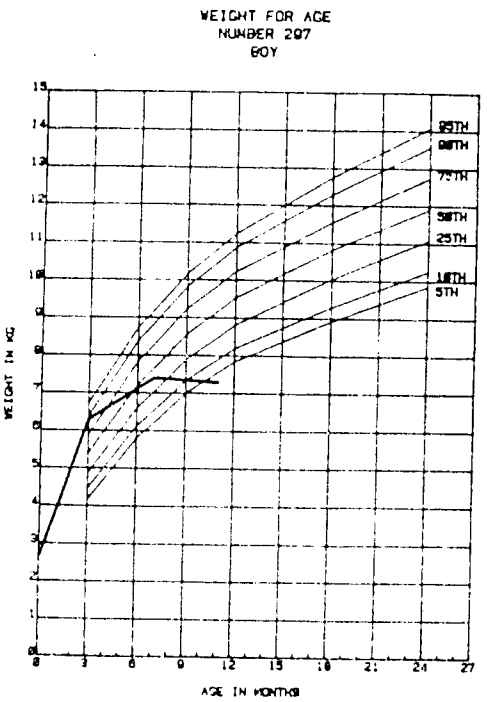
The nutritional influence of these aspects of maternal behavior must partly account for the poor growth records of the children. While not all mothers had growth records for their children, those that were available represent a cross-section of the children by age at death and by sex.[5] The

records clearly trace marked deterioration prior to death. Figure 1 displays the weight for age of three children who died early in the second year, and Figure 2 the weight records of four children who died later in the second year. With a possible exception (boy 143), at all the ages represented the children had fallen below the fifth percentile for their age by the time they died.

The essentially behavioral component of these events is highlighted by an apparent consistency in maternal experience. Figure 3 illustrates the growth curves for two children who died in the 17th month of life when their mothers were in their seventh and ninth month of pregnancy, and the growth curves of the two live-born siblings. These infants also failed to grow, and one (child 1295/2) had already fallen below the fifth percentile in her eighth month.

However much these aspects of maternal behavior may have played a role in compromising the survival of all the children who died in their second year, nevertheless we must suppose that they can have been contributing factors at most. Other contributing factors that we will now consider are resistance of the children, prophylactic health measures such as immunizations, therapeutic measures, and, finally, hygienic practices--the eventual focus of our analysis. We would argue that these latter contributing factors are similarly all influenced by maternal behavior and that in each case it is possible to gain some appreciation of that behavior from the operational and more or less objective measurement of outcomes such as we have just reviewed regarding breastfeeding and nutrition. Furthermore, all the foregoing factors together can be considered the proximate determinants of mortality in a deductive model of mortality causation (Frank,





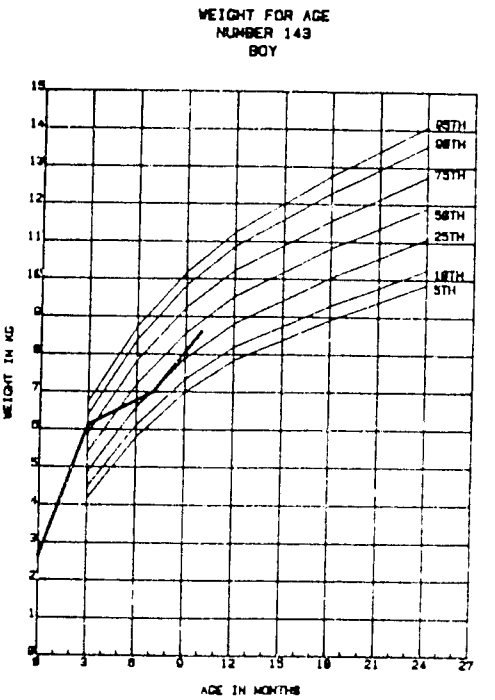


FIGURE 1 Weight for age progressions for three children (girl 374, boy 297, and boy 143) who died early in the second year.

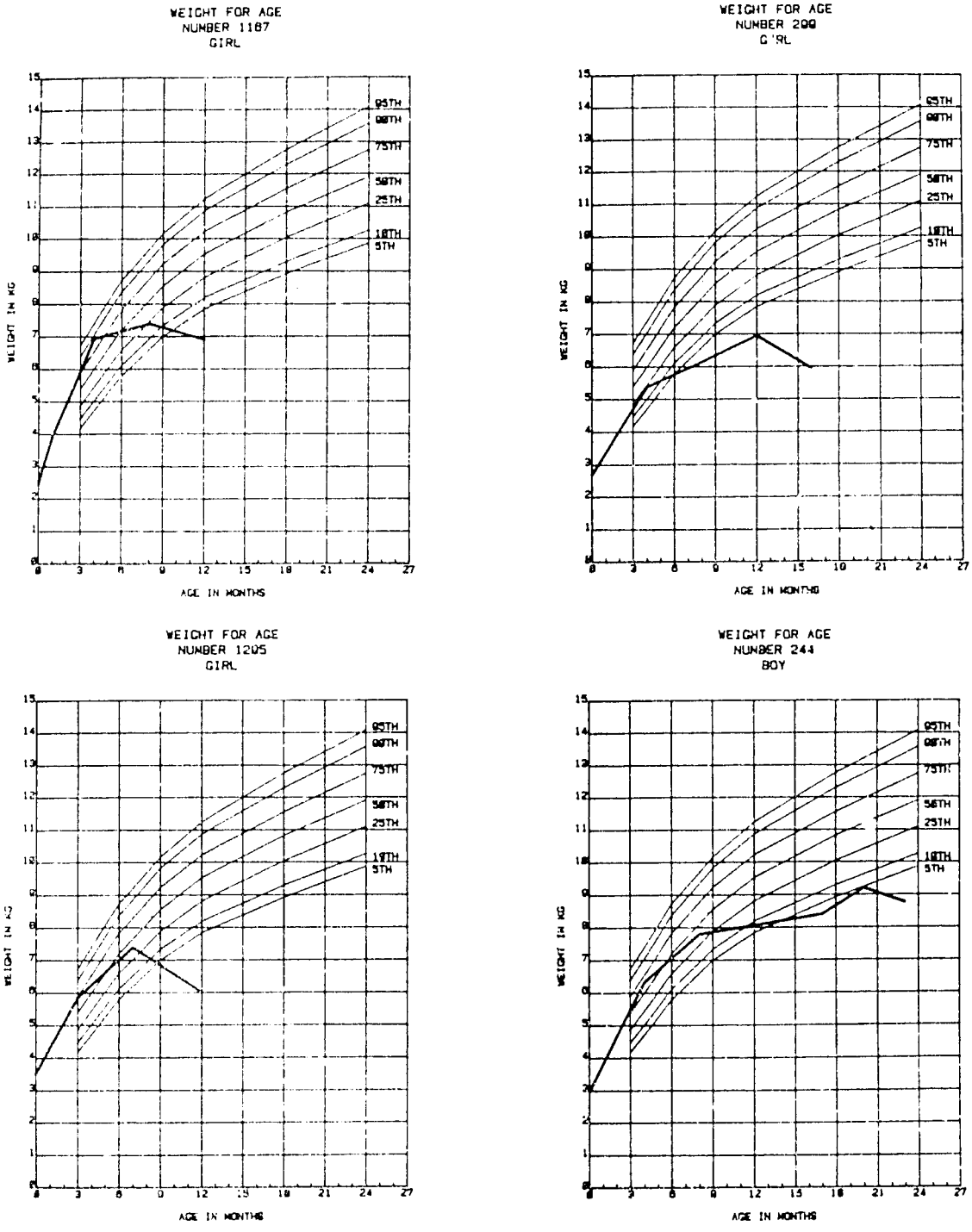


FIGURE 2 Weight for age progressions of four children (girl 1167, girl 299, girl 1295, and boy 244) who died late in the second year.

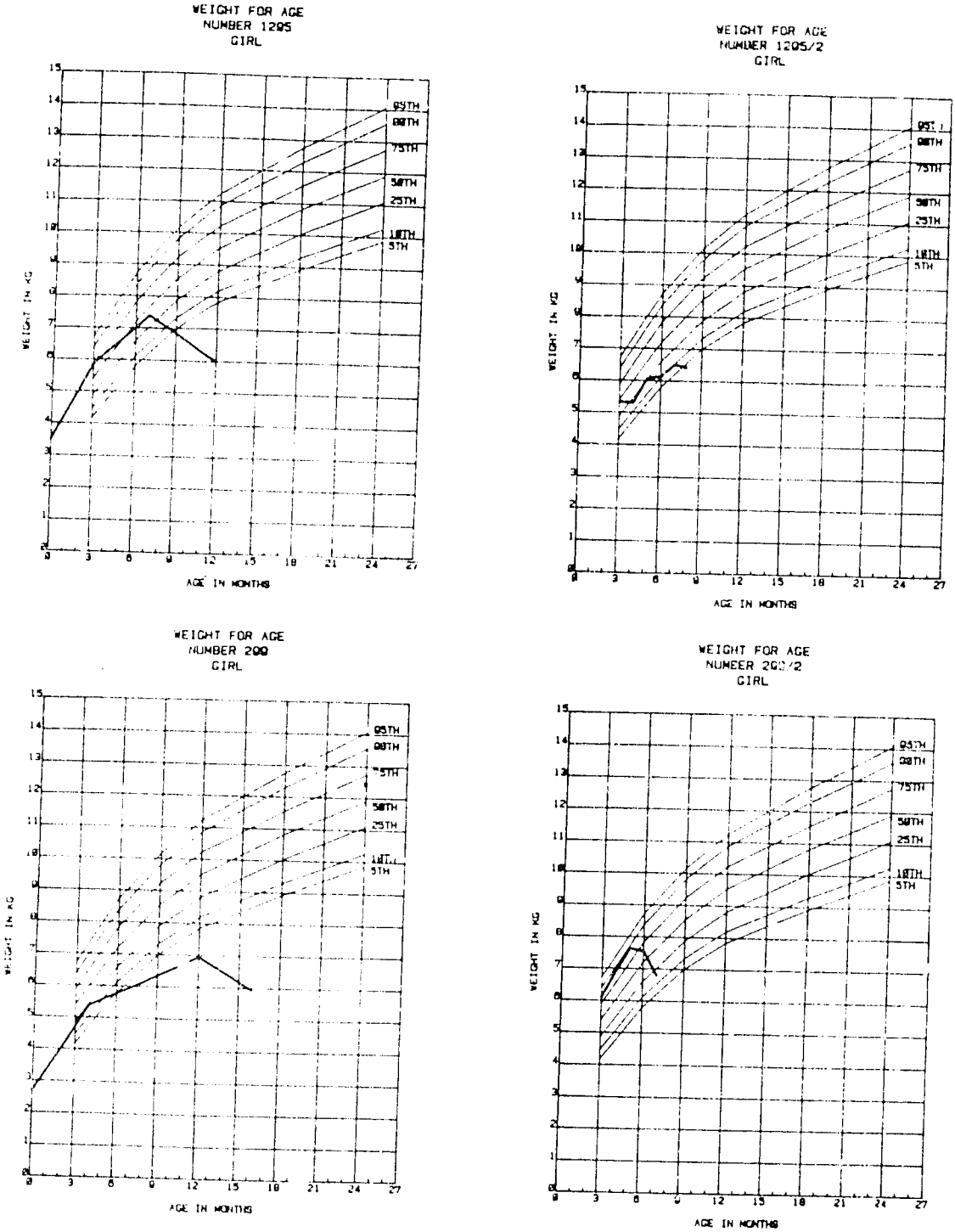


FIGURE 3 weight for age progressions of two pairs of sequential siblings (girls 1295 and girls 299).

1984; Bongaarts and Frank, 1985).

In Table 2, we have assembled all the data on the mothers' contact with and utilization of western medical services, both preventative and curative, for all the children. The data are presented in the same order for the children as in Table 1. We suppose that the child's innate resistance and survival prognosis is related to his (her) weight at birth, which is influenced to some degree by the mother's gravidity and her prenatal care. Similarly, we can presume that all preventative medical measures taken by the mothers on behalf of their children are fairly well expressed by their immunization record: none was being treated prophylactically with anti-malarial medication and no malaria eradication activities were taking place in their communities. Lastly, we utilized the record of health service visits and the type of professional consulted to represent therapeutic interventions accorded the children during morbid episodes in their lifetimes and in their final illness.

While much of the ultimate influence of health services on child survival must depend on the quality of those services that are available, in the last analysis, access to health services at least introduces the potential for a beneficial effect. Where this is concerned, the mothers had services at their disposal that could be used prenatally, at delivery, for well-baby visits, and for diagnosis and treatment of the sick child. The first comment that may be made about the mothers' experience from Table 2 is that all used services at one time or another. With respect to the early phases of care, only one mother neither had any prenatal visits nor delivered her baby in a clinic setting: all the other women who had had no prenatal visits delivered at the hospital. This suggests that a choice in the timing

TABLE 2 Contact with preventative and curative western medical services during pregnancy, at delivery, during life, and at death of children.

Child	During prenatal period and at delivery:					During the child's life:								At the time of the child's death:		
	Pregnancy order	Month of first prenatal visit	Number of prenatal visits	Place of birth	Birth weight (grams)	Immunization record[a]								Use of curative services when: Child sick	Child dying	Place of death
997	2		0	Hospital	3,000	SAT	BCG	DPT1	DPT2	DPT3	MEN	MSLS		Nurse	Hospital outpatient Traditional healer	Domicile
1002	3		0	Domicile	3,320	SAT	BCG	DPT1	DPT2					Nurse	Nurse	Hospital
374	2	4	2	Domicile	2,350	SAT	BCG	DPT1	DPT2		MEN			Nurse	Nurse	Hospital
152	5		4	Domicile	2,840	SAT	BCG	DPT1			MEN			Physician Nurse Traditional healer	Physician	Hospital
511	1	9	1	Hospital	2,460	SAT								Nurse, Hospital	Physician, Nurse Traditional healer	Domicile
297	10		0	Hospital	2,680	SAT								Nurse	Physician Traditional healer	Hospital
143	12	4	4	Domicile	2,660	SAT	BCG	DPT1	DPT2	DPT3	MEN	MSLS		Physician, Nurse	Nurse	Domicile
1173	3		0	Hospital	2,540	SAT								Nurse Traditional healer	Hospital outpatient Traditional healer	Domicile
1167	4	7	3	Hospital	2,500	SAT	BCG	DPT1	DPT2					Nurse	Hospital inpatient Nurse	Domicile
299	3		2	Hospital	2,700	SAT	BCG	DPT1	DPT2	DPT3	MEN	MSLS		Nurse Traditional healer	Nurse Traditional healer	Hospital
1295	4	3	4	Hospital	3,520	SAT	BCG	DPT1	DPT2	DPT3		MSLS		Nurse Traditional healer	Hospital outpatient Traditional healer	Domicile
357	3	6	2	Domicile	3,320	SAT								Nurse	Hospital outpatient Physician Traditional healer	Domicile
306	3	6	2	Hospital	2,820	SAT	BCG	DPT1	DPT2	DPT3	MEN			Physician, Nurse	Physician	Hospital
231	4	3	5	Domicile	3,240	SAT								Nurse	Physician Traditional healer	Hospital
244	4		0	Hospital	3,000	SAT	BCG	DPT1	DPT2	DPT3+YF	MEN		SP	Nurse	Physician, Nurse	Hospital
1415	3		0	Hospital	3,400	SAT								Physician, Nurse	Physician	Hospital
Mean					2,897											

[a]SAT=Tetanus anti-toxin; BCG=Tuberculosis immunization with Bacillus Calmette-Guérin; DPT(1,2,3)=Diphtheria, Pertussis, Tetanus plus Polio ("Tetracoq") immunization series; YF=Yellow Fever immunization; MEN=Meningitis immunization; MSLS=Measles immunization; SP=Smallpox immunization.

of contact with medical supervision may have been occurring and that if a mother had not sought prenatal care, her remaining option was to have medical supervision at least at delivery. Subsequently, no mother failed to have the child receive an SAT, even when the child was born at home, yet their follow-up behavior for the other childhood vaccinations varied substantially. Similarly, there is a wide range of maternal behaviors in response to what was in effect the final episode of serious illness. A second characteristic of the data in Table 2 is therefore that although as a group these mothers could avail themselves of health services at various times, as individuals their behaviors were not necessarily consistent nor predictable. A third and last observation is that the children were of adequate birth weight in all cases.

In sum, review of these two further sets of proximate determinants of mortality suggests that all the children had an adequate chance of survival at birth, and that their mothers had access to medical care. In short, viewed from the outside, this group of mothers and children would be considered to belong to a population served by primary health care, although of undetermined quality, because there is available prenatal care and hospital delivery, vaccination coverage is high, and well and sick baby medical consultations are accessible. We do not think it likely, therefore, that these determinants are critical to the particular death or survival of the children in this study. Certainly, they have played a role that can have been very important in the decline of mortality in Bobo-Dioulasso, and they probably go far in explaining the difference between mortality in Bobo and in the surrounding countryside.

In order now to examine our last set of proximate determinants,

environmental factors such as hygienic practices, it is useful to take a look at the symptoms reported to have accompanied the declining health and death of the children.

Table 3 displays the health problems reported by mothers during the preceding period at each re-interview, the mother's report of the cause of death when she reported it, and the child's symptoms as reported by the mother in the death narrative elicited at the time of our re-interview. All the reports are thus retrospective. The period of recall for episodes of illness and for the child's death during the original survey ranged from zero to three months, so that women were recalling events that occurred on average six weeks previously. Three-quarters of the mothers reported the exact day and the remaining women the month and week of the child's death. At the time of our re-interview, the children had died between one and fourteen months earlier, since our study focused on deaths in the second year to children born 27 to 25 months previously. The average recall period was therefore over half a year, and about six months on average separated the two retrospective reports of each child's death.

Although these conditions were less than optimal for recall, there is good consistency between reporting of the earlier morbid episodes of the children and the symptoms reported at two intervals after their deaths. The mothers' reports are credible on two further accounts. First, those mothers reporting that their children had measles and those reporting that their children were vaccinated for measles are mutually exclusive, an outcome that is clinically probable but unlikely to have been contrived by these mothers.[6] Second, the mothers were very specific in their narratives and were consistent during follow-up probes, confidently denying symptoms that they

TABLE 3 Symptoms of disease reported by the mothers

Child	Symptoms reported								
	During episodes of illness:							At time of death[a]	During death narrative
	End month 1 (first round)	End month 4 (second round)	End month 8 (third round)	End month 12 (fourth round)	End month 16 (fifth round)	End month 20 (sixth round)	End month 24 (seventh round)	(end of round report)	(retrospective report)
997			diarrhea	X				fever, diarrhea	diarrhea, fever, vomiting, weight loss, chronic diarrhea
1002			measles	X				diarrhea	complications of measles, sores, diarrhea, vomiting
374				measles, diarrhea, vomiting	X			measles	measles, diarrhea, vomiting, weight loss, fever, poor suckling after measles recovery
152			measles	diarrhea, fever, vomiting	X			diarrhea, vomiting	diarrhea, vomiting, weight loss
511			cough	measles	X			fever, weight loss	vomiting, fever
297		teething	cough	fever, measles	X			fever, measles, cough, cold	convulsions, fever, rigidity
143			boils	fever, cold	X			diarrhea	diarrhea, fever, weight loss
1173			fever	diarrhea	X			hemorrhoids	fever, diarrhea, sores, weight loss
1167			diarrhea, cough	diarrhea, cough	X			diarrhea, fever	diarrhea, swollen feet, weight loss
299			diarrhea, vomiting	fever, malaria, diarrhea	diarrhea, fever	X		hemorrhages	diarrhea, vomiting, fever, weight loss
1295	stomachache		anal sores	diarrhea, fever	diarrhea, cold, cough	X		edema	fever, diarrhea, edema, anal fissure

TABLE 3 Symptoms of disease reported by the mothers (continued)

Child	Symptoms reported								
	During episodes of illness:							At time of death[a]	During death narrative
	End month 1 (first round)	End month 4 (second round)	End month 8 (third round)	End month 12 (fourth round)	End month 16 (fifth round)	End month 20 (sixth round)	End month 24 (seventh round)	(end of round report)	(retrospective report)
357			diarrhea		cold, cough, malaria	X		edema	edema, diarrhea
306		cough	fever	measles		X		"kwashiorkor"	measles, diarrhea, fever, vomiting, sores, weight loss
231	pimples	wound, diarrhea	diarrhea, flushing	malaria, measles		X		hemorrhoids, chronic diarrhea, measles	anal sores, bloody diarrhea, weight loss
244	headwound	boils, cough	cough, fever	cough, fever	cough, fever		X	meningitis	sudden death, fall, could not hold head, meningitis, treated for cerebral malaria
1415			diarrhea, teething	body rash		measles, diarrhea, malaria, chickenpox	X	"kwashiorkor", diarrhea	diarrhea, sores, edema, swollen belly

[a]Round in which the death was reported is marked with an "X."

had indeed not previously reported.

Against this, the reservations cited earlier regarding cause-of-death information must be recalled here: these women are reporting generally the condition that impressed them, that they recognized when the child was dying, and that they remembered later. The possible exceptions relate to symptoms reported for children who were seen in a hospital or by a physician before death, since their mothers may have been given a clinical diagnosis or cause of death.

Notwithstanding the need for cautious interpretation, a pattern of decline visibly emerges from these disconnected and laconic traces of the children's deaths. Most particularly, these accounts together convey the codetermination of death by malnutrition and infection, a complexity not evident to the individual mother. The malnutrition and progressively retarded growth of the children is documented by the mothers' reports and by the weight-for-age records illustrated in Figures 1 and 2 (we would submit that the records lend further support for the credibility of these mothers' observations). The mothers' reports demonstrate recognition not only of the weight loss but also of the edema (swollen belly, swollen extremities) and the mucosal ulcerations (sores, anal sores, and fissures) that are clinical signs of severe protein-energy malnutrition. Simple diarrhea is itself also an unequivocal entity that is clearly identified, although by several different local names, while the recognition of diarrhea with mucus and blood is less evident and probably accounts for reports of hemorrhoids and hemorrhages.

On the basis of research on the interrelations of malnutrition and infection, we may surmise that for this group of children, the increasing

level of their malnutrition was associated with a reduced resistance to disease and greater severity of infection--most particularly with diarrheal disease, but also with measles--while infectious episodes of diarrhea or measles were associated with the children's progressively retarded growth. Research that has focused on disentangling this mutual causation suggests that the process may begin when a highly insalubrious environment fosters infections that then occasion declines in nutritional status due to reduced appetite, reduced intake, and reduced uptake of foods.[7] Diarrhea and vomiting are most directly implicated in this process, but studies have shown that measles can also lead to growth retardation due to declining nutritional status and the frequent presence of diarrhea as a symptom of measles in developing countries, whereas respiratory infections have not been found to have the same effects (see van Balen et al., 1981; Feachem et al., 1983; Martorell and Ho, 1983; Lepage et al., 1983; Kaartinen, 1984; and Halsey et al., 1985). The predominant role of diarrheal disease or measles in triggering the decline in health of children is fairly well profiled in Table 3. Subsequently, children who are malnourished and fail to grow are at higher risk for more severe, although not necessarily more frequent, infection, again with measles or diarrhea especially: the measles case fatality rate is higher among malnourished children in Africa (Morley, 1969), and diarrheal episodes are lengthier to recovery once children are nutritionally compromised. It is against these considerations and the light they cast on the pattern that emerges from the seemingly disattached elements of Table 3 that questions regarding the child's immediate environment and the mother's hygienic practices become especially pertinent. The nature of the mother's contact with her child and the level of hygiene in

her personal care and household activities consumed a large part of our attention in the field interviews. This focus and the determination of which elements of the environment to evaluate were informed by our assumption that the largest proportion of diarrheal episodes among these children who died would have been caused by infection from rotavirus or various types and strains of Escherichia coli (Feachem et al., 1983; Carpenter, 1982; Black, 1984). The transmission of both is related to hygiene, since rotavirus transmission is through fecal-oral contamination and that of E-coli similarly from fecal contamination of hands, food, and water (Blacklow and Cukor, 1981; Feachem et al., 1983; Black, 1984; Echeverria et al., 1984). However, whereas rotavirus is very successfully transmitted even under good hygienic conditions, it is likely that a very large number of bacteria are needed for E-coli infection. By implication, E-coli transmission requires that water, food, and hands be grossly contaminated by fecal material from infected individuals as well as conditions of lengthy, improper food storage (Taylor et al., 1982; Feachem et al., 1983). Finally, both E-coli and rotavirus are clearly associated with dehydration, the major indicator of severity of diarrheal disease.

Enquiry on environmental determinants of the children's diarrhea-related morbidity and mortality focused on three considerations: quality of the water supply, sanitation, and hygienic practices.

Generally, research has demonstrated that the purity of the water supply bears little relationship to diarrheal morbidity and mortality. One reason is that true waterborne diseases, such as cholera, contribute few cases to overall morbidity on a continuing basis.[8] The more influential aspect of the water supply seems to be its relative abundance. Water abundance would allow

for wastage in all its household uses, in the form of drenching, multiple soakings or rinsing, frequent re-washing, and low re-use. In line with this, aside from the source of water, its ease of collection, and price, we sought information on washing practices and order of water use.

Sanitation, on the other hand, has been associated with reduced childhood mortality, and aside from representing an income effect, cleaner disposal of human waste may have a direct bearing on the transmission of enteropathogenic organisms. Accordingly, we enquired not only about the sanitation facilities but also about the patterns of their use.

Hygienic practices are less known, less understood, and certainly less well identified. Following on several indications that soap and handwashing directly reduce the transmission of organisms, we enquired about body and handwashing (see Khan, 1982; Samadi et al., 1983; and Echeverria et al., 1984). With the mothers, however, we pursued other lines as well: the use of their hands, their handling of food, their disposal of children's feces, and the frequency and nature of their handwashing and that of their children.

Responses to a few of the items in the enquiry are presented in Table 4. It is immediately apparent that the abundance of water supply and of "modern" facilities for human waste disposal presented few problems in this sample. For only six women was water not entirely available in unlimited quantities inside her compound, and two of them fetched only drinking water outside (1167, 244), while at least one other woman could afford to have the water delivered (299). Only two women reported having to make multiple trips to fetch water on the outside (297, 1173). Similarly, all the compounds in which these women lived had latrines: typically, a compound with tapped water also had two latrines (997, 374, 306). Furthermore, latrines were equipped

TABLE 4 Characteristics of water supply, fuel and sanitation facilities in the households of children who died in the second year, Burkina Faso.

Child	Water				Sanitation		
	Source[a]	Quantity utilized per day	Fuel used	Price per bundle (CFA)	Number of latrines	Number of adult users	Children's age at use (years)
997	tap	unlimited	wood		2	7	6
1002	well	unlimited	wood		2	9	10-14
374	tap/well	unlimited	wood	25	2	6	7
152	tap	unlimited	wood	60	1	8	8
511	well	unlimited	wood		1	6	8
297	pump	1 barrel[b]	wood	free	1	3	9
143	well	unlimited	wood		1	3	7-10
1173	pump	1 barrel[b]	wood	60	1	14	7
1167	pump (drinking) well (all other uses)	2-4 pails unlimited	wood	70	1	6	9
299	pump	1 barrel[b]	wood	50	1	7	8
1295	pump	2 barrels[b]	wood	300[c]	1		6-7
357	well	unlimited	wood	50	1	12	8
306	tap	unlimited	wood		2	12	9
231	well	unlimited	wood	70	1	6	7-9
244	pump (drinking) well (all other uses)	1-3 pails unlimited	wood	50	1	12	10
1415	tap	unlimited	wood	60	-	-	-

[a]Tap or well refers to a source inside the compound. Pump relates to communal water point outside the compound.

[b]1 barrel or oildrum is generally equivalent to 18 pailfuls.

[c]Exceptionally large bundle, providing fuel for 5 to 6 days. All other bundles were comparable, providing fuel for about one day's needs.

most often with an adjoining "washroom" which had provision for evacuation of gray water. As regards fuel availability, from all the women's reports, the type (wood), amount, and cost of fuel used by these women were uniform, adequate to their needs, and a manageable expense.

On the basis of these material conditions, for most purposes basic hygienic criteria could be considered as met. Certainly, few of these homes would be graded poorly in any large-scale survey that included routine water supply and sanitation questions. Water use, latrine use, and the personal hygiene habits of mothers and children presented a somewhat different picture: several very weak elements in the repertory of hygienic practices quickly became evident.

First, children are not expected to use, and indeed are barred from using, the latrines. The reported age at which children are allowed to use the latrines is given in Table 4. The modal age range for the transition is 7 to 9 years, and ages as high as 10 and 14 years are reported. The age reported relates to tolerance of the children's using the latrine: use of the latrine is essentially unmonitored once the mother is assured that the child knows how to wash after latrine use. In practice this means that only the very youngest children and toddlers use potties in the compound under the supervision of their mothers, while the next to youngest children go outside the compound under the supervision of older siblings, all these children returning only irregularly to the compound to use a pot, ask for assistance in washing, and later, to use the latrine. Several mothers expected their children to defecate in the fields, on garbage heaps, and otherwise away from the compound.

Second, although soap was present in every compound, its use was

specialized and not objectively related to hygienic goals. Several qualities of soap are manufactured locally (blocks of white and of black soap, and bars of toilet soap) and while more than one quality was available in several homes, in no home where only one quality of soap was available was it the lowest quality. Typically the roughest, unrefined soap was purchased to wash kitchen pots and utensils, and blocks of white soap were used for personal washing and laundry. Whatever the soap, however, it was located invariably in the kitchen area: soap was not observed in the latrine in a single compound for the duration of any visit. Similarly, soap was not evident in the area of the tap or the well. Nor was soap stored between times in the washroom, which was maintained empty. Enquiry about use of soap for personal washing revealed that soap is used for bathing, even twice a day, but is not utilized between bathings for handwashing. Outside of bathing, soap is used essentially for kitchen duty. Following defecation, the mothers do utilize water, but with an ablution bowl intended for ritualistic, not hygienic, purposes. Indeed, washing after defecation is assimilated to the series of daily ablutions that are religiously prescribed in tandem with the very well observed practice of reserving one's left hand for that purpose. No soap-washing of the hands then follows. It is this ablution that mothers require their children to learn before they are allowed to use the latrine. Until they do, their mothers may wash them. In addition, this soapless style of washing extends to other circumstances: mothers empty and rinse potties without using soap, on the potty or their hands.

Third, urination was tolerated in the washroom, and washroom run-off was frequently through the compound. Since the washroom was also used for ablution after use of the latrine, the run-off from the washroom might

contain fecal matter from all its uses.

Fourth, we were able to document two behavioral phenomena, geophagia and giving of infant enemas, that can have deleterious health effects. From the age at which an infant can sit up, through the crawling stages, and until the time when a toddler is able to run about in the care of someone other than the mother, small children spend a large part of the time in the compound on the ground. During this time, the mother can go about her chores, particularly food and meal preparation, without the usual load on her back, since outside the compound the child is constantly piggy-backed about. Inside the compound, the child may spend long stretches of time on the ground, to be picked up briefly, nevertheless, at the slightest whimper. It is during these times that the small children eat dirt (geophagia) from the compound floor. The floor of the compounds is very probably contaminated with fecal matter, if not from run-off from the washroom, then from foot traffic from the latrine or from use of the same broom for sweeping the latrine (the latrines were, with few exceptions, impressively broom-clean) and the courtyard, which was earthen in all but one case. Geophagia was unremarkable to the mothers, and a few even offered that it helped children become strong. Infant enemas similarly evoke little response from mothers, although it was more difficult to gauge the extent of its practice. It is generally carried out by grandmothers on the very youngest children--infants less than a year old--by insufflating concoctions of leaves and plants that are macerated by chewing.

We viewed these four areas of behavior as betraying an extraordinary potential for fecal-oral transmission of infective agents to the youngest children from older children, from mothers, and directly from a contaminated

environment. The apparent inconsistency between these behaviors and the overall favorable material conditions for a sanitary environment prompted us to ask about rationales and beliefs regarding various practices. Three themes focused our attention and enquiry: why children did not use the latrines, the causes of sickness and death in small children, and whether one could prevent a small child from dying.

Children were not allowed to use the latrines for a number of reasons, some of which expressed concern for the child (a small child can fall in), others concern for keeping the latrine tidy for the adults (children miss the hole, children dirty the latrine), and for other esthetic concerns (children look inside the hole). By implication, a major concern was the inability of small children to wash themselves, since the age at which they were tolerated in the latrine was linked to independent ablution.

With respect to enquiry about disease and dying among small children, some remarkable distinctions emerged from the mothers' answers. Whereas the mothers confidently reported a range of realistic causes of death in small children--the majority of them citing diarrhea, vomiting, and fever as well as measles, meningitis, or "the diseases of childhood" as the causes of childhood deaths--these syndromes were disembodied, spontaneous events whose origin they strove ineptly to understand, let alone explain. Thus responses to the cause of illness fell into a disarray of unfounded and very individual items, ranging from environmental conditions--the climate, winds, the temperature, the sun--to real possibilities such as vectors (flies, mosquitoes), but in the absence of feasible connection to a disease process or outcome (such as mosquitoes as carriers of malaria). Moreover, in practice, attempts to discourage vectors were not consistent: while latrines

were typically broom-clean, lids were most often absent or off, and very large maggot and fly populations were observed in these sites. Essentially, these mothers do not attribute deaths of children to the possible range of external agents (gods, bad or evil spirits) but still have no rudiments of disease transmission. Furthermore, the death of children or the fact of children dying is quite detached for these women from their understanding of the immediate causes of child deaths. Indeed, when asked whether one can prevent the deaths of children (i.e., cure measles, diarrhea, and so on), the mothers insisted that death was not preventable. To a few women, the notion was laughable, while others carefully explained the argument that many children are born, and some children are born not to remain. Yet others explained that one cannot overcome death or that if adults cannot be prevented from dying, then there is all the more reason that children cannot be prevented from doing so.

Finally, we enquired about the frequency of their experience of child deaths, by asking about deaths to the women they knew best (mothers, sisters, co-wives, compound co-residents), as well as their own past experience. Table 5 assembles a few basic elements of background information on these women, including their age, parity, and number of dead children.[9] Seven of the women had had a child die before this one, and four, more than one other child: in one case, the woman had lost twins as well as the child in our study (1295) and in two further cases, the women were among the oldest of the group (297,143).

Despite their reluctance to discuss deaths to families in other compounds out of respect for privacy, and their very scant knowledge of their mothers' losses of children except among younger siblings whom they were old

TABLE 5 Characteristics of the mothers, maternal histories, and characteristics of the husbands (fathers) of children who died in the second year, Burkina Faso.

Child	Characteristics of the mother											Maternal history				Characteristics of the husband (father)	
				At the time of the survey (April - June 1981)				At the time of re-survey (July 1983)				Report at re-survey (July 1983)					
	Ethnic group[a]	Years of schooling	Literacy	Age	Marital status	Gravidity	Parity	Age	Marital status	Gravidity	Parity	Number of child deaths	Number of children away	Number of children in her care	Net number of children present	Ethnic group	Years of schooling
997	Mossi (Voltaic-Mole)	0	no	20	single wife	2	2	22	single wife	3	3	1	0	0	2	Mossi (Voltaic-Mole)	0
1002	Bobo (Voltaic-Habe)	0	no	24	single wife	3	3	26	polygamous wife	4	4	2	1	0	1	Bobo (Voltaic-Habe)	0
374	Peul (Fulani)	0	no	19	polygamous wife	3	2	21	polygamous wife	4	3	1	0	0	2	Peul (Fulani)	5
152	Birifor (Voltaic-Moli)	5	yes	26	single wife	5	5	28	single wife	6	6	3	1	0	2	Mossi (Voltaic-Mole)	5
511	Peul (Fulani)	0	no	15	unmarried	1	1	17	polygamous wife	2	2	1	0	0	1	Bobo (Voltaic-Habe)	n.a.
297	Bobo Dioula (Mande)	0	no	36	polygamous wife	11	10	38	polygamous wife	11	10	6	1	1	4	Bobo Dioula (Mande)	0
143	Samogho (Mande)	0	no	42	polygamous wife	12	12	44	polygamous wife	12	12	5	0	0	7	Peul (Fulani)	0
1173	Bobo Dioula (Mande)	0	no	26	single wife	3	3	28	single wife	4	4	1	0	0	3	Dioula (Mande)	0
1167	Dioula (Mande)	3	no	25	single wife	4	4	27	single wife	5	5	2	1	1	3	Mossi (Voltaic-Mole)	0
299	Samo (Mande)	0	no	25	polygamous wife	3	3	27	polygamous wife	4	4	1	0	0	3	Peul (Fulani)	0
1295	Samo (Mande)	0	no	25	polygamous wife	4	5	27	polygamous wife	5	6	3	1	0	2	Samo (Mande)	0
357	Samogho (Mande)	3	yes	23	unmarried	3	3	25	single wife	4	4	1	2	0	1	Senoufo (Voltaic-Senufo)	0
306	Mossi (Voltaic-Mole)	0	no	25	single wife	5	3	27	single wife	6	4	1	0	0	3	Mossi (Voltaic-Mole)	0
231	Bobo (Voltaic-Habe)	0	no	23	single wife	4	4	25	polygamous wife	6	5	2	0	0	3	Bobo (Voltaic-Habe)	4
244	Bobo (Voltaic-Habe)	5	yes	23	single wife	4	4	25	single wife	5	5	1	1	0	3	Gourounsi (Voltaic-Grusi)	0
1415	Semble (Mande)	5	yes	21	unmarried	3	3	23	unmarried	3	3	1	0	0	2	Mossi (Voltaic-Mole)	5

[a]The reported ethnic group of each parent is followed by the people and cluster of the group according to Murdock (1959).

enough to remember, twelve of the women offered further information on child deaths and related the ages and circumstances of more than twenty-two deaths that had occurred to women whom they knew closely. Their general impression of the frequency of child deaths was that it was high and they provided supporting arguments for their opinions, remarking the frequent sudden appearance of women at the market without their usual piggy-backed bundles.

To summarize, we reconsidered the strange juxtaposition of an operational adequacy of the usual environmental health indicators in this sample (abundant potable water supply, satisfactory sanitation, presence of soap) with the lapses in hygienic practice in the light of these insights on the root causes of disease and death that we gleaned from our discussions with the mothers. What became apparent is that the mothers' overall behavior with respect to hygiene and health was informed by several different, often competing, knowledge structures (see Frank, 1985). In the absence of a guiding theory that serves to organize elements of knowledge about illness and death, particularly with respect to causality, these women have atomistic, fragmentary pieces of knowledge drawn from different belief systems. In this way, behaviors are variously informed by esthetic preference (sweeping latrines, keeping children out of latrines, body washing with soap), religious prescription (the daily schedule of soapless ablution rites, in association with the dedicated uses of the two hands), customary or traditional practice (breastfeeding and abstinence durations, and supplementation/weaning patterns), or the newer material goals (having a latrine, a washroom, and running water in the courtyard). Yet other discrete behaviors not attached to these major rationales are determined idiosyncratically and superstitiously, while the cause of residual events is

attributed, by default, to a powerful external agency. All these different sources of informed judgment can be quite independent of each other, with no conceptual links between them. As a result, motivation to take action among these mothers is not necessarily attached to the most beneficial measures, while salience is accorded to measures which may be quite inadequate: the cause of a disease may be attached to one information stream, while treatment derives from another knowledge system, and acceptance of death from yet a third.

Finally, a further and quite different insight into the disjunctive body of concepts that inform these women's appreciation of hygiene, disease, and death is provided by even a casual review of their childbearing and childrearing histories. We would speculate on the basis of those histories, which are outlined in Table 5, that a tolerance for the substitutability of individual children must coexist along with a high fertility norm. We suppose this because there is a loss in equivalence between the sum of biological own children and the actual family raised. Indeed, overall, these women have first experienced the death of 40 percent of their live-born children.[10] They have then fostered out together eight children and fostered in two. Counting that the mothers have together 50 surviving own and foster children, a full ten percent of these are not with their biological mothers. In essence, having begun with an average number of live-born children of 5 (ranging from 2 to 12), these women at the time of our re-survey were raising half as many, the modal family size being 3 for a range of from 1 to 7. This reduction and convergence in the actual number of children raised follows mostly from child deaths. However, a portion of this smoothing occurs as a result of the fostering arrangements, since before fostering is counted, the

actual number of surviving children who were being raised on average by the women who fostered out children was slightly higher than the number of children being raised by women who did not make any fostering arrangements (3.1 vs. 2.9). After all fostering is taken into account, the average number of children in the case of the women who participated in these arrangements fell below that of the women who did not (2.3 vs. 2.9).

We consider that the discontinuity between parity and actual composition of family being raised translates into a will for child survival that applies to all children, but is not necessarily attached to specific children. We would speculate that to maximize surviving family size, this tolerance for substitutability of children must operate to allow for loss of children due to death as well as due to child mobility. In effect, this means that efforts to treat individual children, the ability to recall in detail the course of a child's final illness, and mourning for individual children can coexist with an overarching acceptance of and reluctance to tamper with the fact of child death.

Structural Means to Improve the Conditions for Child Survival

In the light of the circumstances of these child deaths, we sought to determine the possible influence on child survival that could be brought to bear by a national water supply and sanitation program.

We considered that the potential benefits to child survival of any general development initiative would depend on three characteristics: the degree to which child survival was considered in the design of projects, the level of implementation, particularly with respect to components most critical to child health, and the extent to which objectives regarding child

survival fed the expectations of success for the overall program. In this vein, "Water Decade" program and projects could be elaborated in objectives, design, and level of implementation by many other criteria than the potential health and demographic effects. These other criteria include technical considerations (feasibility of projects, technological limitations), esthetic and political imperatives (providing infrastructure to the more clamorous urban sector, eliminating public fouling), expressions of income and wealth (preference for the labor-saving aspects and amenity of modern conveniences), and so on. Indeed, it is not necessary for health considerations to figure at all in the impulse to develop the infrastructure of drinking water supply and sanitation. The earliest European public works enterprises of water supply and sanitation were foremost urban embellishment projects, designed essentially for esthetic and political purposes that preceded knowledge of their potential health effects.[11] Evaluation of Burkina Faso's Water Supply and Sanitation program along these lines of analysis reveals that the program, as first elaborated and subsequently carried out, does not omit child health and survival concerns so much as fail to integrate them in any but a perfunctory way.[12] This shortcoming is notably evident on four scores:

- Explicitly defined objectives at the outset of the program plan regard only quantifiable targets of water supply and sanitation infrastructure, such as bore holes to be drilled, liters of water per person per day to achieve, proportion of the population to be served, and so on. Demography figures prominently only to illustrate and back up the rates of growth of service needs.

- Alongside specific service objectives, which are quite detailed, human health is recognized as a principal objective of the entire "Water Decade," but with no further qualification.

In particular, there is no attempt to outline objectives relating to targets of mortality decline in counterpart to the service objectives.

- In parallel with the lack of integration of demographic objectives, the lines of evaluation that the program provides for are elaborately and clearly spelled out in terms of service objectives, but fail to include any demographic monitoring.[13] The health sector effects are to be evaluated alone through a proposed epidemiological surveillance of water-related diseases.

- The conceptualization of water-related diseases that informs the Water Decade plans and programs is too broad and non-specific to highlight the potential influence of water supply and sanitation on mortality, particularly in childhood, and does not form a sound basis for monitoring demographic effects.

Indeed, diseases that are considered water-related include guinea worms (dracontiasis),[14] schistosomiasis (bilharzia), cholera, malaria, onchocerciasis (river blindness), bacillary and amoebic dysenteries, typhoid and paratyphoid fevers, hepatitises, and intestinal parasites, as well as diarrheal diseases. It is fundamentally true that all of these pathologies are water-related. Moreover, the prevalence of each could be reduced in one way or another by a water supply and sanitation program, since new clean water-supply outlets also attract people away from natural sites that may be a health hazard (guinea worm, bilharzia, onchocerciasis) or reduce the need for water storage, which promotes mosquito-breeding (malaria), in addition to providing water free of diseases that may be waterborne (cholera, dysenteries, hepatitis, typhoid fever, and so on). However, the list fails to attribute any priorities to diseases with a high incidence, to diseases that are associated with high mortality rather than morbidity, and to diseases that take an exceptional toll among children.[15] Epidemiological surveillance, even if it were conducted aggressively with resulting high

coverage, would yield little evidence of success of the water supply and sanitation program on reducing the majority of the "water-related" diseases of low incidence that are debilitating, but not fatal, to adults. At the same time, one would be reluctant to evaluate the progress of the water program on the basis of rate of decline in the incidence of malaria, even though it is, along with diarrhea, the most serious in terms of both incidence and mortality of the pathologies listed, since the reduction of malaria incidence as a principal goal is inadequately and incompletely addressed solely by means of reducing household water storage.

As a result, those demographic and health-related objectives most sensitive to water supply and sanitation improvements and most attainable through such programs are poorly profiled against the overall objectives of the program, figuring only incidentally. Furthermore, the absence of well formulated demographic and health objectives translates into an equivalent lack of demographic criteria in the design, implementation, and evaluation of the program's projects.

A review of the Water Decade program's structure provides a few indications of the reason for the weak demographic component of the plan. While a number of government agencies and various ministries have been important actors in the plan's design and implementation,[16] at no time was there more than an informational or consultative status accorded to any essentially demographic agency, such as the National Institute for Statistics and Demography, providing no point-of-entry and little leverage for the promotion of the demographic potential of the plan and the means to evaluate it. Indeed, the role of that demographic agency was undermined even in the provision of a legitimately demographic input, urban growth rates, by equal

consideration being given to estimates from two other sources, the Ministry of Public Works (MTP) and the National Bureau of Water (ONE), to define the Decade's goals, whereas both of these sets of estimates were unrealistically low and demographically unlikely. The one other ministry that might have introduced a demographic outlook was the Ministry of Health, but its role was strictly nonconceptual and nonanalytic, limited to responsibility for maintenance of drinking-quality standards of water and for overseeing the projects of the National Center for Health Education on water supply use and sanitation education.

In the light of an initial absence of a demographic perspective in the Water Decade activities of Burkina Faso, we had to search elsewhere to gauge its demographic influence. We concluded that the pattern and characteristics of the implementation of service objectives would delimit the range of feasible effects. The two predominant criteria in the implementation of service objectives quickly proved to be technical and political. Midway through the Decade, these criteria have influenced the course of the water supply program for urban and rural areas in opposite ways.

The National Bureau of Water (ONE - Office national des eaux), earlier under the Ministry of Rural Development (Ministère du développement rural) and since 1984 under the Ministry of Water, a publically regulated utility company, is responsible for the commercial provision and maintenance of water supply in urban centers through piping to individual households, which are billed for usage, or to pump points in the smaller towns.[17] In principle, the ONE is financially autonomous and was to raise private investments for urban water supply, returns to which were to follow from user charges. In practice, the ONE has raised only 5.5 percent of the necessary investments

and is now largely financed by external European public and private development loans from Germany, Denmark, the Netherlands, France, and the European Development Funds. In 1984, service coverage was in place for 18 urban centers, which included about one-half million people, or seven percent of the country's population, and about 70 percent of the entire urban population of the country. Financial resources were in hand for the service needs of a further 10 urban centers, totalling one further percent of total population and a further nine percent of urban population. Proposals for funding had been submitted to the banks and development agencies for the remaining 38 urban areas that they plan to service by 1990 and that include the balance of Burkina Faso's urban population--in all, two percent of the country's total population. In sum, present coverage of urban areas with clean water supply is high and promises to be nearly complete by the close of the Decade, in 1990.

Notwithstanding a determined emphasis having been placed on the provision of services to the rural areas, the rate of progress of rural water supply has been markedly slower. In parallel with the ONE, the Ministry of Rural Development's Directorate for Hydraulic [Affairs] and Rural Equipment (HER) was in charge of rural water supply until the creation of the umbrella Ministry of Water in 1984. The objectives of the rural water supply program were to provide about 10,000 water-supply points, wells, and pump stations by 1985 and about 18,000 by 1990. In rural Burkina Faso, there were 3,450 points at the outset of the program implementation in 1981, and 5,890 privately bored wells and pumps. By mid-1984, the number of public wells had risen to 5,355 with the addition of some 600 points per year, reaching a volume about midway through the decade that was 50 percent short of

objectives and still exceeded by privately drilled water-supply points that are being added to at a rate of between 90 and 140 per year (Direction de l'hydraulique et de l'équipement rural, 1983a, 1983b, 1984). Even accounting for additional well sites that are considered in process of construction (which may refer only to demarcated or otherwise selected sites), objectives are far from met at mid-decade and are a fortiori off-target relative to the 1990 objectives. The principal reason for this poor performance has been financial constraints. Indeed, at mid-1984, no new funding of the rural water supply had been obtained since before the inception of the decade program when promises were made that subsequently materialized to fund the growth in wells that did occur by mid-decade. One exception was a promise by UNDP to fund, through development grants, a further 4,500 wells, which alone could double rural water supply capacity. Otherwise, no systematic search for public and private loans equivalent to that undertaken by ONE to finance urban water supply could be undertaken by HER, since HER has no capacity to repay them beyond its own budget, inadequate to the task.

In effect, the country has limited borrowing power in this sector and borrows first for the commercial urban component of water supply, relying on residual grants and other development assistance for the rural component. Furthermore, the rural water supply is very largely assured privately, although not necessarily commercially. Moreover, maintenance of pumps and wells, because of the drain on scarce resources that these recurring costs occasion, is increasingly devolving on rural users (see World Water, 1983). Lastly, a strategically important unknown is the volume of water points bored by NGOs and PVOs. On one hand, there is no bureaucratic process for the registration, approval, or monitoring of this type of development activity,

which encourages nongovernmental water supply projects. At the same time, the government agencies learn of projects when they run into trouble, experience major equipment failures, or need assistance of some type. Importantly, because they are carried out on shoestring budgets, often no provision for maintenance is allowed, and responsibility for breakdowns and upkeep then falls to the national authorities, devolving once again to the community, which can assure some servicing but cannot purchase spare parts or engineering advice. Unfortunately, standards for water points cannot be enforced under these circumstances, and projects that meet the standards are inventoried only after the fact, on an occasional basis.[18]

As a result of these conditions and constraints of the water supply program, the essentially private and commercial provision of water in urban areas has acquired the character of a subsidized public undertaking, while the social intentions of public rural water supply provision are thwarted by the absence of funding and are being progressively displaced by a form of de facto privatization by default. The pace of urban water supply growth is consequently adequate while the growth of rural water supply is painstakingly slow.

The third component of Burkina Faso's Water Decade plan concerns sanitation, which, aside from rainwater effluence and garbage removal for urban areas, translates into latrines for the removal and disposal of human waste in both rural and urban areas. The urban latrinization project has in effect been reduced to a public convenience project, with latrines provided for marketplaces, hospitals, and schools (with UNICEF monies). The rural project, under which it was intended to build over 100,000 simple latrines to achieve 40 percent coverage of the rural population, has not been implemented

at all. At present, with no funding from any source, the only extant activity under the program is a project in the National Center for Health Education (CNES - Centre national de l'éducation pour la santé) to set up demonstration latrines in rural health facilities, where technical advice on construction can be given to interested individuals. As a result of the inertness of the rural sanitation project, all sanitation activities have been shunted under the oversight and executory authority of the ONE, in charge of commercial urban water supply. There is thus no longer any pretense of undertaking the rural sanitation program. The sanitation program is now reduced to a will to deal with the disposal of household garbage in only the major urban centers, which is most frequently simply amassed at customary locations, and to improve rainwater evacuation through new construction of drainage ditches and sludge removal from existing ones (Burkina Faso has not one sewer).

In view of the ways in which the implementation of the Water Decade program has unfolded in Burkina Faso, some observations regarding its potential influence on child survival can be advanced. At the outset, no component or project under the program directly addresses or is aimed at the potential demographic benefit to children. Furthermore, overall benefits to public health are not so much manifested in the modalities of execution that the program protocol provides for, as held up to be an overall guiding objective, nonspecifically linked to the practical side of things. The activities that are being successfully undertaken by the program are a product of political and technical considerations. In this way, urban services of a quasi-commercial character[19] are receiving the most attention. Urban water supply is attaining remarkable coverage, and it is possible that

urban household refuse removal may become a commercially viable economic activity. Remaining efforts and resources are focussed on unprofitable public facilities, but still in urban areas, such as public conveniences and maintenance and enlargement of the urban drainage-ditch network.

As a result, we would speculate that child survival will continue to improve in urban areas, but haphazardly so, because the improvement would derive from beneficial expansion of water availability and reduction in exposed fecal matter that serendipitously benefits small children by ameliorating the entire health environment. The potential influence on child survival of the same inputs, it could be argued, would be even greater if that objective played a large role in defining the program, because of the emphasis that would necessarily be given to mechanisms of transmission to children. For example, a much stronger health education component could be imagined that would focus on the nexus of diarrheal disease transmission, hygiene in the household, water use, and sanitation. Even better, since the success of health education so heavily depends on general education, which is still in the future for the Burkinabé, is the design of sanitation technology that is usable by children, accompanied by vigorous encouragement of enrolled children to use latrines properly, both in the teaching programs and physical facilities of schools.[20]

At the same time, little influence on child survival, if any, would be anticipated from the Water Decade activities outside the urban areas. Creeping privatization of well-drilling due to default in the provision of water supply for social reasons reflects essentially the options of a minority of the rural population who can make consumption choices: as an income effect it consolidates better chances of survival of children born

into these families. Outside of a very slowly growing stock of water points, the only other publically funded effort is the small-scale health education project of training villagers in upkeep of well sites and maintenance of pump equipment. With, in addition, abandonment of sanitation objectives in rural areas, we are left with the overall picture of an entire water supply and sanitation sector that is least developed in areas where its potential influence on child morbidity and mortality is greatest.

Overview and Prospects

From a broad perspective, the Water Decade goals represent a development effort that is exogenous to Burkinabè society. It is not in any sense a product of endogenous demand deriving from income growth, as it was for the majority of western societies in the nineteenth and early twentieth centuries, except in the case of a small minority of the population. At the same time, the very high cost of water supply and sanitation and consequent short funding of this sector from external sources means that the spread of clean water and latrines will in effect depend far more on growth of national income than will comparatively inexpensive counterparts in exogenous health intervention such as vaccination campaigns, which bilateral and multilateral donors are willing to assume. Indeed, while 80 percent of the children in developing countries might be vaccinated and immunized against a number of diseases at an estimated cost of about one dollar per child[21] in the early 1970s (this included measles, polio, tuberculosis, pertussis, tetanus, diphtheria and, still at the time, smallpox also), clean water supplied in Africa between 1970 and 1975 was estimated to have cost $67 per additional person served in the urban areas and $12 in the rural areas. For all African

countries, under half of the urban investment and a third of the rural investment in improved water supplies came from external aid. For the whole region, in the same period, excreta disposal was estimated to have cost $19 per additional person served in the urban areas, with only 15 percent of the investment coming from external aid, and to have cost $7 in the rural areas, with practically no external assistance (World Health Organization, 1975 and 1976). As a result, the level of clean water supply service coverage in African countries appears to be highly related to national investment (see Figure 4), while the magnitude of external funds, principally investments, very generally follows suit rather than compensates (see Table 6).

Because national coverage in water supply and sanitation neither is based on endogenous demand nor is affordable to the Burkinabè economy, it is in practice of low priority on the governmental agenda, even though officials who determine expenditures and allocate resources and those who are charged with executing Water Decade activities have themselves of course an informed net preference and more effective demand for clean water and sanitation facilities. As a result, while Burkina Faso subscribes to Decade goals and the appropriate government agencies have carefully elaborated a national program, in practice its politicians and administrators are cognizant of the obstacles to its full implementation, and manage it accordingly.

Ironically, at the level of the priorities for multilateral assistance, the goals of the Water Decade are remarkably poorly positioned, notwithstanding its exceptional treatment at the inter-agency level and its potentially high visibility. The International Drinking Water Supply and Sanitation Decade was designated for 1981 to 1990 by resolution of the United Nations at their Water Conference in Mar del Plata, Argentina, in early 1977.

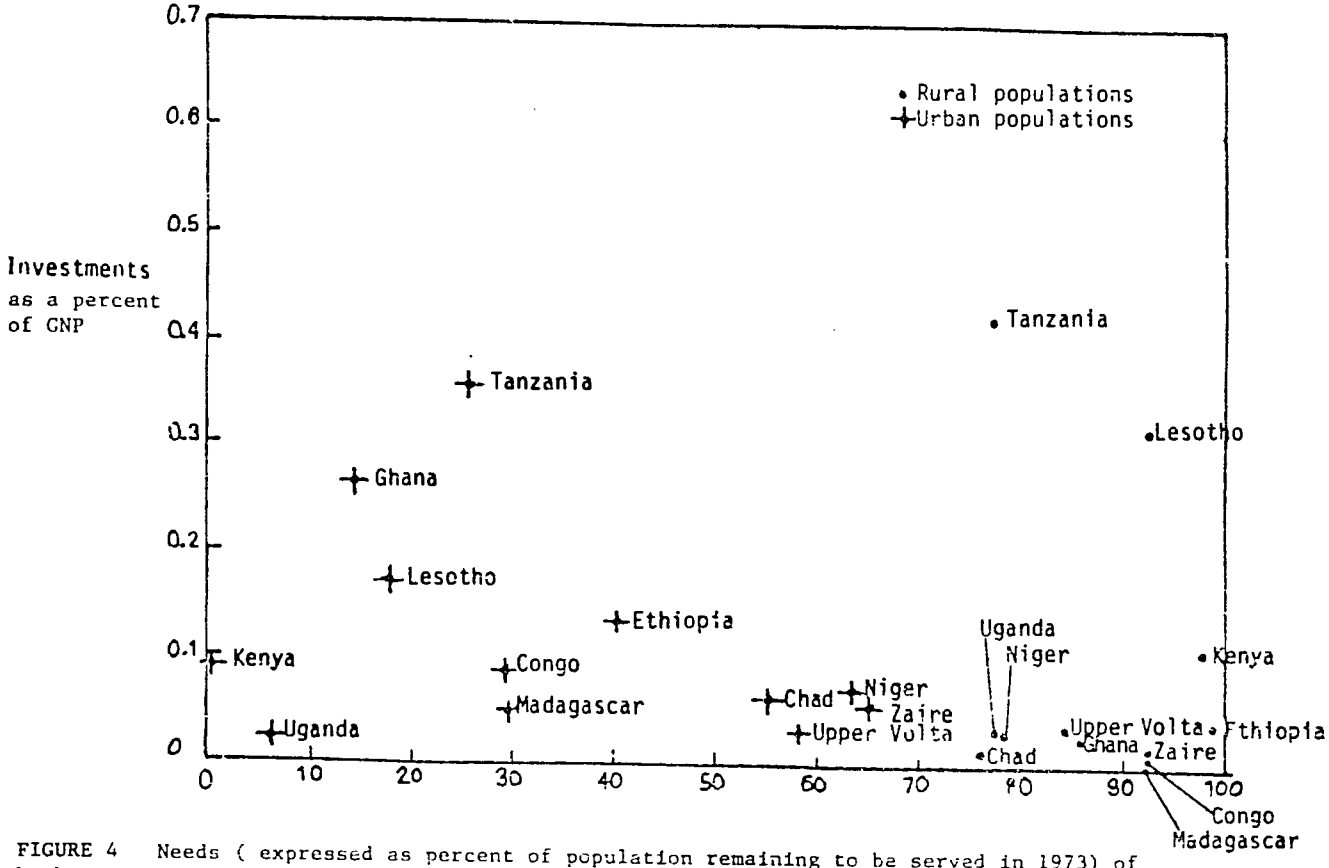


FIGURE 4 Needs (expressed as percent of population remaining to be served in 1973) of both rural and urban populations of twelve African countries.

Source: World Health Organization, 1976.

TABLE 6 Investment (millions of U.S. dollars) in community water supplies and excreta disposal facilities, sub-Saharan Africa, 1971-1975.

Country	Source and destination of investment											
	Community water supplies:						Excreta disposal facilities:					
	Internal			External			Internal			External		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Chad	0.9	0.1	1.0	3.1	0.0	3.1		n.a.			n.a.	
Congo	1.8	0.1	1.9	2.5	0.0	2.5		n.a.			n.a.	
Ethiopia	16.1	5.8	21.9	4.0	1.0	5.0	3.4	0.0	3.4	1.0	0.0	1.0
Ghana	36.6	4.1	40.7	16.8	1.9	18.7	0.0	0.0	0.0	0.0	0.0	0.0
Kenya	10.1	12.1	22.3	8.0	2.0	10.0	21.6	0.0	21.6	0.9	0.0	0.9
Lesotho	1.0	1.9	3.0	1.0	1.3	2.3	0.1	0.0	0.1	0.5	0.0	0.5
Madagascar	3.1	0.2	3.3	0.5	2.5	3.0		n.a.		0.5	0.0	0.5
Niger	1.6	0.7	2.4	16.6	4.8	21.4	0.6	0.2	0.8	0.0	0.0	0.0
Uganda	1.7	2.9	4.6	8.0	2.0	10.0	2.6	0.0	2.6	1.0	0.0	1.0
United Republic of Tanzania	33.2	37.9	71.1	26.0	25.0	51.0		n.a.			n.a.	
Upper Volta (Burkina Faso)	0.6	0.5	1.1	9.0	4.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0
Zaire	10.0	2.0	12.0	7.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: World Health Organization, 1976.

With coordination assured by UNDP, Decade goals encompass activities of WHO, UNICEF, FAO, ILO, UNDTCD, and UNESCO, along with the World Bank, the principal actors being UNDP, WHO, UNICEF, and the World Bank. In spite of the high potential relevance of the activities of each of these organizations to the demographic importance of the Water Decade--UNDP because of the basic developmental aspects of such infrastructural expansion; the WHO because of the large health benefit from clean water and excreta disposal; UNICEF because of its pivotal concern with children; and the World Bank because of its critical financial and technological capabilities--these organizations individually do not give the Water Decade activities a high profile. Indeed, in the order of WHO's program to control diarrheal disease (Diarrhoeal Diseases Control Programme), water supply and sanitation ranks third among four strategies to combat diarrheal diseases, with management of acute diarrhea and nutritional improvements as the first and second strategies (epidemic control is the fourth) (World Health Organization, 1982). While no one would question the urgent and indisputable importance of treating a child who is acutely ill with a diarrheal disease, in effect the means of treatment--oral rehydration therapy--is so successful, and mobilizes efforts so effectively, that it has acquired the aura of an end in itself, diverting attention and will away from the enduring structural and underlying causes of diarrheal disease in the environmental conditions. Consequently, oral rehydration promotion and dissemination has a disproportionately greater heft as foremost of four strategies, while water supply and sanitation receive somewhat less than third-place emphasis. Critically, the World Health Organization does not fund water supply and sanitation projects, its role being reserved for its specialized capability in coordination and technical

cooperation, whereas the organization does provide "financial and advisory support for planning, implementing, and evaluating national control programmes, including the local production of Oral Rehydration Salts [and] financial support for health services and biomedical research projects on diarrheal diseases" (World Health Organization, 1982). Similarly, while active in supporting water supply and sanitation projects, the visible and compelling thrust of UNICEF's focus on the health of children is through quite other means. The "Child Survival and Development Revolution," a main program of UNICEF's activities in child health and nutrition, stresses monitoring of children's growth, oral rehydration therapy, breastfeeding and improved weaning practices, and immunization as the four principal tracks to improved child survival, the core "GOBI" program. In fact, UNICEF disbursements for water supply and sanitation projects exceeded those for their basic child health projects, as well as all their other sectors of expenditure by 1984, despite the much higher profile of the GOBI promotion (UNICEF, 1985a). The promise of true priority suggested is nevertheless offset by two sobering observations. First, despite the obvious dominance of concerns for child health in all UNICEF sectors, the salient criteria in its water supply and sanitation activities are technical and neither demographic nor epidemiological. Thus, "beneficiaries" of these activities are not estimated numbers of children whose lives are saved, despite UNICEF's own classification of "safe water supplies and sanitation" as a community-based service for children," but such indicators as persons serviced by new water supply systems and sanitation installations, and numbers of wells dug and pumps installed (UNICEF, 1985a). This emphasis is not due to the difficulty of estimating demographic or epidemiological impact, since such estimates are

advanced in the case of oral rehydration therapy, for example. UNICEF's 1985 report on "The State of the World's Children" opens: "In the last twelve months, the lives of an estimated half a million children have been saved by oral rehydration therapy (ORT)," whereas cautionary notes on the use of mortality data are provided in a footnote and in a prefatory comment (UNICEF, 1985b). Second, the thrust of UNICEF's expenditure in the water and sanitation sector, potentially of much greater relevance because it could be justifiably aimed at child survival, is in effect weakened by its very small share in the overall level of financing of the sector. Together with UNDP, UNICEF and the entire UN system provide 6 to 7 percent of the total external funding for the sector worldwide (United Nations, 1985).

In regard to UNDP, the organization's priorities in economic structural problems and, with respect to Africa, the drought crisis, understandably dwarf the organization's activities in water supply and sanitation. Thus, despite holding the UN coordination responsibility for the Water Decade, UNDP's major involvement in the sector is principally through two joint programs with the World Bank, a global handpump development and testing project and a Technical Advisory Group, which disseminates low-cost sanitation technology through publications and an advisory network. Along with several other research and advisory functions in this sector, the UNDP expends only a few percent of its total budget on water supply and sanitation (although fully a third of it is disbursed in Africa) (UNDP, 1985).

Similarly, loans for water supply and sanitation are a commensurably low part of World Bank financing in developing countries, typically about 5 percent of total IBRD and IDA lending worldwide from 1983 to 1985, although it is recently a higher proportion of all loans to the African regions (9

percent in 1985) (World Bank, 1985). World Bank loans are nevertheless one of the largest sources of external financing of Water Decade projects, accounting for over a third of the total (UN, 1985). Loans from the World Bank are not of course dependent so much on the salience or profile of the water sector activities as much as on the creditworthiness of borrowing governments. Despite the larger proportion of loans in Africa for water and sanitation, the access to this funding is not in keeping with the region's needs in the sector so much as to its ability to carry debt, generally of a piece with the status of its infrastructure. Moreover, despite a research and publications program that duly stresses the important potential health benefits related to sector activities,[22] Bank loans to the sector are probably negotiated with governments far more in terms of achievable borrowing schedules than realizable epidemiological and demographic goals. Consequently, African nations fare poorly in regional competition for World Bank water and sanitation funds (see Figure 5).

To complete the funding picture, it should be noted that the volume of bilateral assistance is on a par with that of the World Bank loans, with European and North American donors accounting for over a third of all external resources to the sector. Surprisingly, this aggregate fact is not necessarily reflected in response to regional level of infrastructural adequacy. For example, the USAID, which easily accounts for thirty to forty percent of total bilateral assistance in water supply and sanitation, disburses only about five percent of these resources in sub-Saharan Africa, albeit on rural rather than urban projects. Interestingly, the proportion of bilateral assistance dedicated to the sector, at about 5 to 7 percent on average, is in line with the proportion of development loans to the sector,

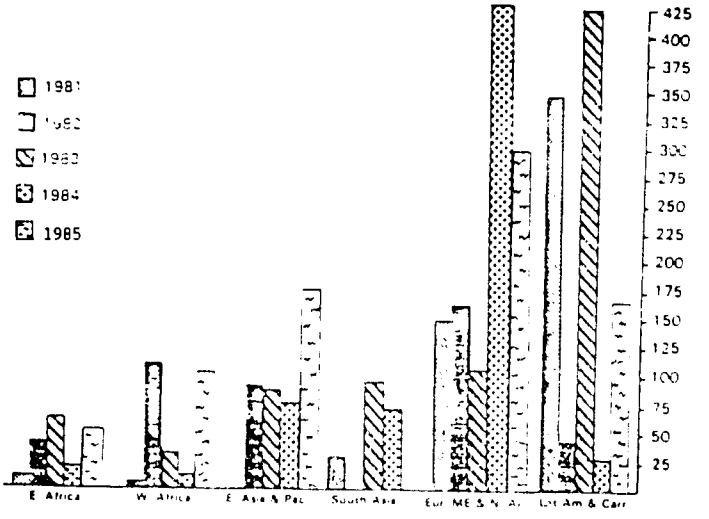


FIGURE 5 World Bank lending for water and sewerage projects 1982–1985 with regional lending as a percentage of the total.

	1982		1983		1984		1985	
	$M	%	$M	%	$M	%	$M	%
Eastern	41.0	9.3	63.7	7.9	22.0	3.4	49.0	6.3
Western Africa	110.0	24.9	31.5	3.9	10.9	1.7	101.0	12.9
East Asia & Pacific	90.0	20.4	88.5	10.9	78.5	12.2	175.0	22.4
South Asia	—	—	97.0	12.0	73.0	11.4	—	
Europe, Middle East & N Africa	159.6	36.2	106.0	13.1	427.8	66.8	292.0	37.4
Latin America & Caribbean	40.6	9.2	424.2	52.3	28.6	4.5	163.8	21.0
Total	441.2	100.00	810.9	100.0	640.8	100.0	780.8	100.0

Compiled from World Bank annual reports

suggesting that sector priorities tend to be similarly institutionalized across development finance structures, which tend to duplicate rather than complement each other.

To summarize, provision of water supply and sanitation intrastructure for a nation such as Burkina Faso is in effect an exogenous development activity that nevertheless will depend in largest part on national income growth. This is because such systems are expensive; their claims on external development resources are a function of broad financial and political decisions, which are largely uninformed by demographic and epidemiological considerations.

As a result, whereas most direct health interventions (even those that are totally exogenous, such as immunization and oral rehydration) are specifically directed at countries with poorest health conditions, this is not necessarily an important criterion in water supply and sanitation assistance. Indeed, absorptive capacity for this sector concerns criteria of a financial and technical nature rather than the potential for improved health and child survival, a criterion that otherwise explicitly directs health initiatives in international assistance.

Accordingly, the prospects for the improvement of water and sanitation facilities are in line with those for a broad range of other mainstream development activities rather more economic than social in character. No remarkable surge forward in this sector need follow the Decade emphasis, although the stress provided will at least have put the item on national agenda.

Regrettably, the foregoing prompts us to suppose that activities to improve water supply and sanitation will not be stepped up to achieve

noticeable demographic and epidemiological results in those regions where potentially they could have the largest benefit. Consequently, it is likely that sub-Saharan Africa will be the most adversely affected region, since the region is particularly strapped for means and so will be heavily dependent on the configuration of external resource expenditures for some time, whereas the survival prospects for children past infancy are the poorest for any region. At the same time, while in most of Africa any level of implementation of water supply and sanitation programs would be a significant improvement, we expect that it is rather the deployment of resources for child health interventions (such as GOBI elements) that will be targeted to countries with the greatest need.

Despite the potential benefit to African children of such programs as immunization and oral rehydration, in the light of our observations of admittedly very few child deaths, it is difficult to see how such interventions alone will avert the larger portion of child deaths, associated with diarrheal disease. While some shortcomings of the individual capacity to make children survive may be overcome by oral rehydration of acutely sick children, a larger part of those individual shortcomings could be compensated by alteration of the child's risk of exposure to dehydrating diseases at the outset. We have seen that the total means to alter that environment is probably inadequate for the large majority of children born in rural sub-Saharan Africa. Even so, there is a signal lack of direction of the means that are available toward their best uses to achieve the epidemiological and demographic objectives of reduced morbidity and enhanced child survival.

Nevertheless, the potential effects of even a fully implemented program

of water supply and sanitation would then be subjected to numerous limitations. This is because the individual capacity to ensure child survival with even a full repertory of instrumentalities such as immunizations, available modern health care, clean water, latrines and soap, and so on, is limited by inadequate knowledge structures and consequently irrelevant or detrimental behaviors. We have seen earlier that even when routine objective basic health indicators are good, there are notable weaknesses in individual capacity to assure child survival, which derive from fragmentation of knowledge and practice in matters of hygiene and sanitation, health, disease, and death.

Although parents in Burkina Faso naturally have a net preference for child survival, this preference may not be attached to specific living children. Nor are parents necessarily able to select specific means to improve the survival of children, since the mechanisms of disease processes elude them. Left to their own devices, without adequate personal income and informed preferences, a population such as Burkina Faso's cannot muster the resources to assure a clean water supply, sanitary facilities, and, especially, sanitary practices.

For water supply and sanitation improvements to have the fullest direct and beneficial demographic consequences, in all likelihood they need to be the product of, and to build upon, improved living standards. As a by-product of income growth and increased effective demand, improvements such as clean water supply and sanitation would be utilized and adopted by individuals with significantly modified knowledge structures as a result of evolving components of income growth such as formal education. In general, public health interventions in Africa, such as packaged programs of water

supply, sanitation, vaccination, and so on, have not been introduced into a context of improved living standards as they were in the settings where they were originally developed; to the contrary, their independence has been a major factor in their promotion and deployment. The success of such programs elsewhere, as in countries of Asia and Latin America, has probably depended on the presence of mutually supportive improvements in other domains that created strong internal demand and rapid effective utilization of their benefits, a situation not yet evident in Africa.

Notes

1. An example is the progression of shelter in parallel with destruction of predators, household pests, other disease vectors, and eventual environmental vector control.

2. It should be noted that as a group the sub-sample of mothers in this study may nevertheless not be atypical of the larger sample in terms of breastfeeding behaviors. Duration of breastfeeding was biased downwards by two events in the sub-sample--death of the suckling child and pregnancy-induced weaning. These observations mitigate against easily assuming that these mothers are different in fundamental ways from the whole sample and are "bad apples" with respect to their risk of child death (see also footnote 10).

3. The differences in these mothers' behaviors result in an unanticipated reversal of interval lengths: mothers whose children died earlier in the second year have a longer birth interval than mothers whose children died at later months of the second year of life (23 and 21 months respectively).

4. From the moment of weaning, these children also lose the immunological properties of maternal milk, critical to infants, but which may still influence the health and survival of one-year-olds (see World Health Organization, 1979; Cunningham, 1981; Lepage et al., 1981; Gillin et al., 1983; Glass et al., 1983; Narayanan et al., 1984; Feachem and Koblinsky, 1984; and Hambraeus et al., 1984).

5. The weight progressions for the children are plotted on National Center for Health Statistics/Centers for Disease Control growth curves. See Hamill, 1977 and Lancet, 1984.

6. Measles vaccination is recommended at 9 months worldwide. In sub-Saharan Africa, as many as 30 percent or more of children can have contracted measles before 9 months, because maternal antibodies begin to decline after the first few months of life. At the same time, maternal antibodies will neutralize attenuated measles virus vaccine in still immune children at unacceptable levels in populations of children below 9 months. The competing needs to protect those infants who are at risk early and to ensure a high level of successful vaccination have implications for vaccination policy and type of vaccine utilized. (See Heymann et al., 1983; Lancet, 1983; Whittle et al., 1984; Halsey et al., 1985; and Katz, 1985.) Apparently, none of the children in this study was vaccinated too early and subsequently ill with measles.

7. This is rarely due to true malabsorptive syndrome, since the syndrome is highly infrequently observed in Africans (see Cook, 1984).

8. See White and Seviour, 1974, and Briscoe, 1977. The greater contribution to childhood diarrhea of organisms with fecal-oral transmission relative to truly waterborne diseases is sufficiently

evident that lack of pure water is not a contraindication for preparing rehydration solutions. (See World Health Organization, 1984.) In multivariate studies, clean piped water often shows up poorly, or largely reflects an income effect (see, for example, Anker and Knowles, 1977; Butz et al., 1982; and Butz et al., 1984; but also see Merrick, 1983).

9. Miscarriages (gravidity less parity) are clearly underreported, and a fraction of stillbirths could be attributed to the group on statistical grounds. We do not address either here, not only because there are so few data but also because we do not expect a priori extraordinary experience with miscarriage or with stillbirth in any population (see Bongaarts et al., 1984).

10. It should be noted that two factors serve to inflate the experience of child deaths in this sample, precluding the use of this datum as a "rate." First, the women are a select group, selected precisely on the basis of their having had a child die. Second, two women's children's deaths are genuinely historical in terms of mortality trends, whereas for other women, although cumulated, their children's deaths clearly must refer to recent periods. Excluding the recent death to all women and the historical deaths of mothers of 297 and 143, the death "rate" of all the children born to these women (aged 17 to 28) is 120 per 1000, quite in line with infant and child death rates most recently estimated for Bobo-Dioulasso. This is a further element that points to the fundamental similarity of this sub-sample to the overall sample. It is not likely that these women differ systematically from the sample in their behaviors, or that they place children at greater risk of death (see footnote 2).

11. For example, construction of reservoirs for Paris and the city's sewer system were laid down between 1853 and 1869, under Haussmann's term as Prefect of the Paris Department (Seine), certainly before the waterborne transmission of a disease-causing organism was confirmed and even well before the germ theory of disease was proved (while John Snow demonstrated circumstantially [in London] that cholera was waterborne in 1854, Robert Koch did not identify the cholera vibrio until 10 years later in 1883, whereas "germs" of any type had not been seen until the late 1870s, by Louis Pasteur).

12. The Water Decade Plans of Burkina Faso are summarized in three volumes and is the published product of a joint program between the Government of Upper Volta, the Federal Republic of Germany, and the World Health Organization under the cooperation program between WHO and GTZ, the German Office of Technical Cooperation. See Programme de Coopération ... 1982, Tomes I to III.

13. It should be noted that this emphasis in evaluation does not differ with World Health Organization guidelines on evaluation for the International Drinking Water Supply and Sanitation Decade (see World Health Organization, 1983), which devotes a very small fraction of attention to

what World Health Organization terms evaluation of impact in contrast to programmatic criteria, such as evaluation of projects, of functioning, and of utilization (of water supply and sanitation facilities).

14. Indeed, one of the only immediate practical measures that is frequently recommended in the Water Decade literature is the use of a cloth or muslin filter to remove the vector, a crustacean called Cyclops which is parasitized by infective guinea worm larvae. While an unequivocally desirable health objective, removal of guinea-worm occupies a more visible place and an apparent higher priority than other water-related diseases, due merely to the clarity and simplicity of the means to achieve it (see Programme de Coopération ... 1982, Tome II, and Marshall, 1983).

15. Confusion of pathologies that disable or are fatal at differing levels and which affect different age groups can be found in the International Water Supply and Sanitation Decade literature, where the essential goals and priorities are often difficult to specify. A UNICEF flyer titled "Water Means Life" (no date) is a case in point. In one UNDP publication, "typhoid, cholera [and] dysentery" [sic] are cited as diseases accounting for high infant mortality in developing countries (see UNDP, 1985).

16. From February 1982 to 1984, the Water Decade activities of then Upper Volta were coordinated by the Direction de l'Hydraulique et de l'équipement rural, or HER (Directorate for Hydraulic and Rural Equipment) of the Ministry of Rural Development (Ministère du développement rural). During that time, the Director of HER presided over a national working party (Groupe national de travail pour la Décennie) which was then the third organizational modality to administer the Decade activities that the government of Upper Volta had tried since 1976. To achieve its organizational role, the Directorate for Hydraulics had acquired the functions of a State Secretariat (Secrétariat d'Etat), already by 1981. After the two years of national coordination assured by HER, in 1984 those functions became properly the mandate of a newly created full-fledged Ministry of the government of Burkina Faso (Ministère de l'Eau), (Sidawaya, September 3, 1984).

17. Specific objectives provided for 100 percent coverage of all urban areas by 1990, through a ratio of private piping to public wells of 60:40 in the two largest towns, Ouagadougou and Bobo-Dioulasso, 50:50 in Kédougou, and 40:60 in all remaining settlements.

18. The volume of PVO input is probably quite small, in any case, in the water sector. U.S. PVO assistance in developing countries in 1984, for example, totalled $1.2 billion, 40 percent of which was expended in Africa ($460 million). At the same time, only 6 percent of overall PVO activity was in water systems, a relatively new sectoral priority for PVOs, and Burkina Faso did not receive a disproportionate share of assistance in either geographic or sectoral terms (see Short, 1985).

19. There is also some understandable resistance to pay for water in the urban areas, with which the ONE must contend. This is a particular problem where clean water has been available free, but where billing is now being introduced.

20. See, for example, Kalbermatten et al., 1982 (page 21); Feachem et al., 1983 (pages 46-47); Simpson-Hébert (1983) and World Health Organization, 1983 (page 35) for some comments on appropriate technology for children. It must be noted that very little research has addressed the problem. Indeed, sanitation "behavior" is barely recognized in all the literature on the World Water Decade. With respect to sanitation behavior in Burkina Faso, one study was found of the behaviors and preferences of 468 villagers: see Martin-Samos and Lalanne (no date).

21. In the mid-1980s that cost is estimated at $5.00 per child. We can assume, but could not document, commensurate increases in the cost of water supply and sanitation.

22. It should be noted nevertheless that the major publication issued by the World Bank on health, water and sanitation is a detailed and exhaustive encyclopedia whose organization, nevertheless, does little to underscore priorities, providing no guidance for policy (see Feachem et al., 1983).

References

Adegbola, O. (1977). "New Estimates of Fertility and Child Mortality in Africa, South of the Sahara." Population Studies 31, no. 3.

[Gouvernement d']Algérie, Ministère de la Santé Publique, et Organisation Mondiale de la Santé (1980). Mortalite Infantile et Juvenile en Rapport avec les Tendances de la Fecondite. Rapport d'une enquête Ad-hoc dans le quartier d'El-Medania (Alger) et les communes de Birtouta et Chebli (Wilaya d'Alger) Algérie 1974-1975. Alger: Ministère de la Santé Publique, Direction de l'Action Sanitaire (INSP).

Anker, Richard and Knowles, James C. (1977). An Empirical Analysis of Mortality Differentials in Kenya at the Macro and Micro Levels. Population and Employment Working Paper No. 60. Geneva: International Labour Office. Mimeo.

Bigot, Catherine (1981). "Fécondité en Haute-Volta: Enquête post-censitaire 1976." DRD/INSD, République de Haute-Volta. Mimeo.

Black, Robert E. (1984). "Diarrheal Diseases and Child Morbidity and Mortality." In Child Survival: Strategies for Research. Mosley, W. Henry and Chen, Lincoln C. (eds.). A Supplement to Population and Development Review, Volume 10.

Blacklow, Neil R. and Cukor, George (1981). "Viral Gastroenteritis." The New England Journal of Medicine 304, no. 7, February 12.

Bongaarts, John and Frank, Odile (1985). "The Proximate Determinants of Infant and Child Mortality." Unpublished agenda for research.

Bongaarts, John; Frank, Odile and Lesthaeghe, Ron (1984). "The Proximate Determinants of Fertility in sub-Saharan Africa." Population and Development Review 10, no. 3, September.

Booth, Christopher (1984). "Tropical Sprue." The Lancet I, no. 8384, May 5.

Brass, William (1968). "The Demography of French-Speaking Territories Covered by Special Sample Inquiries: Upper Volta, Dahomey, Guinea, North Cameroon, and Other Areas." In The Demography of Tropical Africa. Brass, William; Coale, Ansley J.; Demeny, Paul; Heisel, Don F.; Lorimer, Frank; Romaniuk, Anatole and van de Walle, Etienne. Princeton (New Jersey): Princeton University Press.

Briscoe, John (1977). "The Role of Water Supply in Improving Health in Poor Countries (with special reference to Bangladesh)." Paper presented to the U.S. National Academy of Science Workshop on "Effective Interventions to Reduce Infection in Malnourished Populations," held in Haiti, June 13-16.

Butz, William P.; DaVanzo, Julie and Habicht, Jean-Pierre (1982). Biological and Behavioral Influences on the Mortality of Malaysian Infants. Santa Monica (California): The Rand Corporation.

Butz, William P.; Habicht, Jean-Pierre and DaVanzo, Julie (1984). "Environmental Factors in the Relationship between Breastfeeding and Infant Mortality: The Role of Sanitation and Water in Malaysia." American Journal of Epidemiology 119, no. 4.

Carpenter, Charles C.J. (1982). "Oral Rehydration: Is It as Good as Parenteral Therapy?" The New England Journal of Medicine 306, no. 18, May 6.

Cook, G.C. (1984). "Aetiology and Pathogenesis of Postinfective Tropical Malabsorption (Tropical Sprue)." The Lancet I, no. 8370, March 31.

Cunningham, Allan S. (1981). "Breast-feeding and Morbidity in Industrialized Countries: An Update." In Advances in International Maternal and Child Health. Volume 1. Jelliffe, D.B. and Jelliffe, E.F.P. (eds.). Oxford: Oxford University Press.

Dakuyo, Mathias; Ouaidou, Nassour and van de Walle, Etienne (1985). "Réflexions Méthodologiques sur une Enquête à Passages Répétés: L'Emis de Bobo-Dioulasso." Unpublished paper.

Direction de l'hydraulique et de l'équipement rural (1983a). Nombre de Points d'Eau, Octobre 1983. Ouagadougou (Burkina Faso): Direction de l'hydraulique et de l'équipement rural, Ministère du développement rural.

Direction de l'hydraulique et de l'équipement rural (1983b). Evaluation du Nombre de Points d'Eau Restant à Réaliser pour Compléter les Besoins Définis dans le Cadre de la Décennie de l'Eau, Fin 1983. Ouagadougou (Burkina Faso): Direction de l'hydraulique et de l'équipement rural, Ministère du développement rural.

Direction de l'hydraulique et de l'équipement rural (1984). Evaluation du Nombre de Points d'Eau Restant à Réaliser, Juin 1984. Ouagadougou (Burkina Faso): Direction de l'hydraulique et de l'équipement rural, Ministère du développement rural.

Echeverria, Peter; Seriwatana, Jitvimol; Leksomboon, Udom; Tirapat, Chalard; Chaicumpa, Wanpen and Rowe, Bernard (1984). "Identification by DNA Hybridisation of Enterotoxigenic Escherichia Coli in Homes of Children with Diarrhoea." The Lancet I, no. 8368, January 14.

Feachem, Richard G.; Bradley, David J.; Garelick, Hemda and Mara, D. Duncan (1983). Sanitation and Disease: Health Aspects of Excreta and Wastewater Management. World Bank Studies in Water Supply and Sanitation 3. Washington (D.C.): John Wiley & Sons for the International Bank for Reconstruction and Development/The World Bank.

Feachem, R.G. and Koblinsky, M.A. (1984). "Interventions for the Control of Diarrhoeal Diseases among Young Children: Promotion of Breast-Feeding." Bulletin of the World Health Organization 62, no. 2.

Frank, Odile (1984). "Issues for the Development of the Health Module (Demographic and Health Surveys)." Unpublished background note.

Frank, Odile (1985). "Cultural Determinants of Receptivity to Fertility Regulation: A Cognitive Social Learning Perspective." Paper presented at the IUSSP/CCAFFP Seminar on Societal Influences on Family Planning Program Performance, Jamaica, 10-13 April.

Garenne, Michel (1981). The Age Pattern of Infant and Child Mortality in Ngayokheme (Rural West Africa). African Demography Working Paper No. 9. Philadelphia: University of Pennsylvania Population Studies Center.

Gillin, Frances D.; Reiner, David S. and Wang, Chi-Sun (1983). "Human Milk Kills Parasitic Intestinal Protozoa." Science 221, no. 4617, September 23.

Glass, Roger I.; Svennerholm, Ann-Mari; Stoll, Barbara J.; Khan, M.R.; Belayet Hossain, K.M.; Huq, M. Imdadul and Holmgren, Jan (1983). "Protection against Cholera in Breast-fed Children by Antibodies in Breast Milk." The New England Journal of Medicine 308, no. 23, June 9.

Gopalan, C. (1958). "Studies on Lactation in Poor Indian Communities." The Journal of Tropical Pediatrics, December 1958.

Halsey, Neal A.; Boulos, Reginald; Mode, Frantz; Andre, Jean; Bowman, Linda; Yaeger, Robert G; Toureau, Serge; Rohde, Jon and Boulos, Carlo (1985). "Response to Measles Vaccine in Haitian Infants 6 to 12 Months Old: Influence of Maternal Antibodies, Malnutrition, and Concurrent Illnesses." The New England Journal of Medicine 313, no. 9, August 29.

Hambraeus, Leif; Fransson, Gun-Britt and Lonnerdal, Bo (1984). "Nutritional Availability of Breast Milk Protein." The Lancet II, no. 8395, July 21.

Hamill, Peter V.V. (1977). "NCHS Growth Curves for Children: Birth-18 Years, United States." Vital and Health Statistics Series 11, Number 165. [Hyattsville (Maryland): U.S. Department of Health, Education, and Welfare Public Health Service Publication No. (PHS) 78-1650.]

Heymann, David L.; Mayben, Georges Kesseng; Murphy, Kevin R.; Guyer, Bernard and Foster, Stanley O. (1983). "Measles Control in Yaoundé: Justification of a One Dose, Nine Month Minimum Age Vaccination Policy in Tropical Africa." The Lancet II, no. 8365/6, December 24/31.

Hoyle, Bruce; Yunus, Md. and Chen, Lincoln C. (1980). "Breast-feeding and Food Intake among Children with Acute Diarrheal Disease." The American Journal of Clinical Nutrition 33, pp. 2365-2371.

Kaartinen, Leena (1984). "Measles Epidemic." The Lancet I, no. 8367, January 7.

Kalbermatten, John M.; Julius, DeAnne S.; Gunnerson, Charles G. and Mara, D. Duncan (1982). Appropriate Sanitation Alternatives: A Planning and Design Manual. World Bank Studies in Water Supply and Sanitation 2. Washington (D.C.): The Johns Hopkins University Press for the International Bank for Reconstruction and Development/The World Bank.

Katz, Samuel (1985). "Measles--Forgotten but Not Gone." The New England Journal of Medicine 313, no. 9, August 29.

Khan, Moslem U. (1982). "Interruption of Shigellosis by Hand Washing." Transactions of the Royal Society of Tropical Medicine and Hygiene 76.

The Lancet (1983). "Measles Mortality and Malnutrition." Volume II, no. 8351, September 17.

The Lancet (1984). "Measles and Primary Health Care." Volume I, no. 8389, June 9.

Lepage, Philippe; De Mol, Patrick and Hennart, Philippe (1983). "Measles Mortality and Malnutrition in Rwanda." The Lancet II, no. 8356, October 22.

Lepage, Philippe; Munyakazi, Christophe and Hennart, Philippe (1981). "Breastfeeding and Hospital Mortality in Children in Rwanda." The Lancet II, no. 8243, August 22.

Marshall, Ian (1983). "Defining the Guinea Worm." In World Water. Water Decade: 2nd Year Review. London: Thomas Telford Ltd.

Martin-Samos, F. and Lalanne, M. (n.d.). "Les Questions Sanitaires en Milieu Rural Africain." In Séries Techniques de l'Eau. Ouagadougou: Comité interafricain d'études hydrauliques (CIEH).

Martorell, Reynaldo and Ho, Teresa J. (1984). "Malnutrition, Morbidity, and Mortality." In Child Survival: Strategies for Research. Mosley, W. Henry and Chen, Lincoln C. (eds.). A Supplement to Population and Development Review, Volume 10.

[Government of] Mauritius, Ministry of Health, and World Health Organization (1981). Infant Mortality in Mauritius: 1975-1976. Port Louis (Mauritius): World Health Organization and Government of Mauritius Ministry of Health.

Merrick, Thomas (1983). The Effect of Piped Water on Early Childhood Mortality in Urban Brazil, 1970-1976. World Bank Staff Working Paper No. 594. Washington (D.C.): The International Bank for Reconstruction and Development/The World Bank.

Moosa, A. (1984). "The Health of Children in South Africa: Some Food for Thought." The Lancet I, no. 8380, April 7.

Morley, D. (1969). "Severe Measles in the Tropics. I and II." British Medical Journal 1, pp. 297-300 and 363-365.

Murdock, George Peter (1959). Africa: Its People and Their Culture. New York: McGraw-Hill.

Narayanan, Indira; Prakash, K.; Murthy, N.S. and Gujral, V.V. (1984). "Randomised Controlled Trial of Effect of Raw and Holder Pasteurised Human Milk and of Formula Supplements on Incidence of Neonatal Infection." The Lancet II, no. 8412, November 17.

Page, Hilary J. and Coale, A.J. (1972). "Fertility and Child Mortality South of the Sahara." In Population Growth and Economic Development in Africa. Ominde, S.H. and Ejiogu, C.N. (eds.). London: Heinemann in association with The Population Council.

Programme de Coopération entre la Haute-Volta, la République Fédérale d'Allemagne, et l'Organisation Mondiale de la Santé (Programme OMS/GTZ) (1982). Plan Décennal du Secteur Eau Potable et Assainissement de la Haute-Volta. Tome I. Ouagadougou: Décennie internationale de l'approvisionnement en eau potable et de l'assainissement 1981-1990.

Programme de Coopération entre la Haute-Volta, la République Fédérale d'Allemagne, et l'Organisation Mondiale de la Santé (Programme OMS/GTZ) (1982). Etude sur la Planification du Secteur Eau Potable et Assainissement (AEPA) Haute-Volta. Tome II. Ouagadougou: Décennie internationale de l'approvisionnement en eau potable et de l'assainissement 1981-1990.

Programme de Coopération entre la Haute-Volta, la République Fédérale d'Allemagne, et l'Organisation Mondiale de la Santé (Programme OMS/GTZ) (1982). Fiches de Projets du Plan Décennal du Secteur Eau Potable et Assainissement de la Haute-Volta. Tome III. Ouagadougou: Décennie internationale de l'approvisionnement en eau potable et de l'assainissement 1981-1990.

Samadi, Aziz R.; Huq, Mohammed I. and Ahmed, Quazi S. (1983). "Detection of Rotavirus in Handwashings of Attendants of Children with Diarrhoea." British Medical Journal 286.

Short, Joseph (1985). Diversity in Development: U.S. Voluntary Assistance to Africa. Summary of Findings. New York: InterACTION: The American Council for Voluntary International Action.

Sidawaya No. 99, September 3, 1984.

[Government of] Sierra Leone, Ministry of Health, and World Health Organization (1980). Infant and Early Childhood Mortality in Relation to Fertility Patterns. Report on an Ad-Hoc Survey in Greater Freetown, the Western Area and Makeni in the Northern Province, Sierra Leone, 1973-1975. Freetown: Government of Sierra Leone Ministry of Health.

Simpson-Hébert, Mayling (1983). Methods for Gathering Socio-cultural Data for Water Supply and Sanitation Projects. Technology Advisory Group (TAG) Technical Note No. 1. A joint United Nations Development Programme and World Bank Contribution to the International Drinking Water Supply and Sanitation Decade. Washington (D.C.): The International Bank for Reconstruction and Development/The World Bank.

[Democratic Republic of the] Sudan, Ministry of Health, and World Health Organization (1981). Infant and Early Childhood Mortality in Relation to Fertility Patterns. Report on an Ad-Hoc Survey in Greater Khartoum and in the Blue Nile, Kassala and Kordofan Provinces, 1974-1976. Khartoum: Democratic Republic of the Sudan Ministry of Health.

Taylor, William R.; Schell, Wendy L.; Wells, Joy G.; Choi, Keewhan; Kinnunen, Dale E.; Heiser, Patrick T. and Helstad, Arlan G. (1982). "A Foodborne Outbreak of Enterotoxigenic Escherichia Coli Diarrhea." The New England Journal of Medicine 306, no. 18, May 6.

United Nations (1985). Progress in the Attainment of the Goals of the International Drinking Water Supply and Sanitation Decade. Report of the Secretary-General. New York: United Nations. Report of the Economic and Social Council, second regular session of 1985, to the General Assembly, fortieth session (A/40/108 E/1985/49).

United Nations Children's Fund (UNICEF) (1985a). UNICEF Annual Report. New York: United Nations Children's Fund.

United Nations Children's Fund (UNICEF) (1985b). The State of the World's Children 1985. Part I. Statement by James P. Grant, Executive Director. New York: United Nations Children's Fund, Communication and Information Division.

United Nations Development Programme (UNDP) (1985). Annual Report of the Administrator for 1984. New York: United Nations Development Programme (DP/1985/5).

van Balen, H.; Mercenier, P.; Daveloose, P.; De Bruycker, M.; Grosdene, J.; Kanamugire, F.; Meloni, R.; Monet, F.; Pangu, P.; Storme, B.; Van Den Bulcke, W. and Van Lerberghe, W. (1981). "Influence of Measles Vaccination on Survival Pattern of 7-35-Month-Old Children in Kasongo, Zaire." The Lancet, April 4.

van de Walle, Francine and Traoré, Baba (1985). Unpublished communication of preliminary data.

Walsh, Julia A. and Warren, Kenneth S. (1979). "Selective Primary Health Care: An Interim Strategy for Disease Control in Developing Countries." The New England Journal of Medicine 301, no. 18, November 1.

White, Anne U. and Seviour, Chris (1974). Rural Water Supply and Sanitation in Less-Developed Countries: A Selected Annotated Bibliography. Ottawa: International Development Research Centre.

Whittle, H.C.; Rowland, M.G.M.; Mann, G.F.; Lamb, W.H. and Lewis, R.A. (1984). "Immunisation of 4-6 Month Old Gambian Infants with Edmonston-Zagreb Measles Vaccine." The Lancet II, no. 8407, October 13.

Woodruff, A.W.; Adamson, E.A.; El Suni, Asma; Maughan, T.S.; Kaku, M. and Bundru, N. (1983). "Infants in Juba, Southern Sudan: The First Six Months of Life." The Lancet II, no. 8344, July 30.

Woodruff, A.W.; Adamson, E.A.; El Suni, Asma; Maughan, T.S.; Kaku, M. and Bundru, N. (1984). "Infants in Juba, Southern Sudan: The First Twelve Months of Life." The Lancet II, no. 8401, September 1.

The World Bank (1984). World Development Report 1984. New York: Oxford University Press for the International Bank for Reconstruction and Development/The World Bank.

The World Bank (1985). The World Bank Annual Report 1985. Washington (D.C.): The International Bank for Reconstruction and Development/The World Bank.

World Health Organization (1976). World Health Statistics Report 29, no. 10.

World Health Organization (1982). Diarrhoeal Diseases Control. Geneva: World Health Organization.

World Health Organization Diarrhoeal Diseases Control Programme and the Environmental Health Division (1983). Minimum Evaluation Procedure (MEP) for Water Supply and Sanitation Projects. Document ETS/83.1 - CDD/OPR/83.1. Geneva: World Health Organization Diarrhoeal Diseases Control Programme and the Environmental Health Division in cooperation with the Ross Institute of Tropical Hygiene, London.

World Health Organization Malaria Action Programme (1985). "World Malaria Situation 1983." World Health Statistics Quarterly 38, no. 2.

World Health Organization Programme for Control of Diarrhoeal Diseases (1979). "Child Care Practices Related to Diarrhoeal Diseases." Report of a Scientific Working Group (Geneva, 17-20 April 1979). Scientific Working Group Reports 1978-1980. Geneva: World Health Organization Programme for Control of Diarrhoeal Diseases.

World Health Organization Programme for Control of Diarrhoeal Diseases (1984). A Manual for the Treatment of Acute Diarrhoea for Use by Physicians and Other Senior Health Workers. Geneva: World Health Organization Programme for Control of Diarrhoeal Diseases.

World Health Organization Programme for Control of Diarrhoeal Diseases (1985). Fourth Programme Report 1983 - 1984. Geneva: World Health Organization Programme for Control of Diarrhoeal Diseases.

World Water (1983). "Badié Villagers Show the Way in Upper Volta Maintenance Scheme." Water Decade: 2nd Year Review. London: Thomas Telford Ltd.

No. 1985

116 Mead Cain, "The Fate of the Elderly in South Asia: Implications for Fertility," November.

117 Odile Frank, "The Demand for Fertility Control in Sub-Saharan Africa," November.

118 Constantina Safilios-Rothschild, "The Status of Women and Fertility in the Third World in the 1970-80 Decade," November.

119 Mead Cain, "Consequences of Reproductive Failure: Dependence, Mobility, and Mortality among the Elderly in Rural South Asia," November.

120 Geoffrey McNicoll, "Economic Growth under Non-Replacement Fertility," December.

121 Paul Demeny, "Pronatalist Policies in Low-Fertility Countries: Patterns, Performance, and Prospects," December.

122 Odile Frank and Mathias Dakuyo, "Child Survival in Sub-Saharan Africa: Structural Means and Individual Capacity [A Case Study in Burkina Faso]," December.

Agency for International Development
Library
Room 105 SA-18
Washington, D.C. 20523
WITHDRAWN

CENTER FOR POLICY STUDIES WORKING PAPERS ISSUED IN 1982-1985

No.

1982

79 Geoffrey McNicoll and Moni Nag, "Population Growth: Current Issues and Strategies," February.

80 Paul Demeny, "International Aspects of Population Policies," March.

81 Mead Cain, "Perspectives on Family and Fertility in Developing Countries," March.

82 Dorothy L. Nortman, "Estimating Potential Contraceptive Demand: An Improved Method of Measurement," April.

83 Samuel S. Lieberman "Issues of Population and Development Planning in Nepal," May.

84 Moni Nag, "Modernization and Its Impact on Fertility: The Indian Scene," May.

85 Veena N. Thadani, "Social Relations and Geographic Mobility: Male and Female Migration in Kenya," June.

86 Michael P. Todaro, "Intergenerational Income Fertility Linkages in Developing Countries: A Conceptual Framework," July.

87 Christopher Tietze and John Bongaarts, "Repeat Abortion: New Insights," July.

88 Constantina Safilios-Rothschild,"The Persistence of Womens Invisibility in Agriculture: Theoretical and Policy Lessons from Lesotho and Sierra Leone," September.

89 John Bongaarts, "The Proximate Determinants of Natural Marital Fertility," September.

90 Paula E. Hollerbach,"Fertility Decision-Making Processes: A Critical Essay," September.

91 Mead Cain and Samuel S. Lieberman, "Development Policy and the Prospects for Fertility Decline in Bangladesh," October.

92 Geoffrey McNicoll and Masri Singarimbun, "Fertility Decline in Indonesia. I. Background and Proximate Determinants," November

93 Geoffrey McNicoll and Masri Singarimbun, "Fertility Decline in Indonesia. II. Analysis and Interpretation," December.

94 Paula E. Hollerbach, "Factors that Determine the Appropriateness of New Technologies to Consumer Needs," December.

1983

95 John Bongaarts and Jane Menken, "The Supply of Children: A Critical Essay," April.

96 Moni Nag, "The Equity-Fertility Hypothesis as an Explanation of the Fertility Differential between Kerala and West Bengal," May.

97 Odile Frank, "Infertility in Sub-Saharan Africa," June.

98 Geoffrey McNicoll, "Notes on the Local Context of Demographic Change," June.

99 Tomas Frejka, "Induced Abortion and Fertility: A Quarter Century of Experience in Eastern Europe," July.

100 Mead Cain, "Fertility as an Adjustment to Risk," October.

101 Geoffrey McNicoll, "The Nature of Institutional and Community Effects on Demographic Behavior: An Overview," November.

102 Paula E. Hollerbach and Sergio Diaz-Briquets with Kenneth H. Hill,"Fertility Determinants in Cuba," December.

103 Susan Greenhalgh,"Is Inequality Demographically Induced? The Family Cycle and the Distribution of Income in Taiwan, 1954-1978," December.

1984

104 Paul Demeny, "A Perspective on Long-Term Population Growth," February.

105 Geoffrey McNicoll, "Consequences of Rapid Population Growth: An Overview and Assessment," May.

106 Mead Cain, "On the Relationship between Landholding and Fertility," May.

107 Moni Nag, "Constraints on the Use of Fertility Regulating Methods," September.

108 Geoffrey McNicoll, "Adaptation of Social Systems to Changing Mortality Regimes," September.

109 Samuel S. Lieberman, "Field-level Perspectives on the Administration of Maharashtra's Employment Guarantee Scheme," September.

110 Mead Cain, "Women's Status and Fertility in Developing Countries: Son Preference and Economic Security," October.

1985

111 Susan Greenhalgh, "Sexual Stratification: The Other Side of 'Growth with Equity' in East Asia," April.

112 Constantina Safilios-Rothschild, "Socioeconomic Development and the Status of Women in the Third World," May.

113 Dorothy L. Nortman, "Family Planning Program Funds: Sources, Levels, and Trends," August.

114 Anrudh K. Jain and Moni Nag, "Female Primary Education and Fertility Reduction in India," September.

115 John Bongaarts and Susan Greenhalgh, "An Alternative to the One-Child Policy in China," October.

CENTER FOR POLICY STUDIES WORKING PAPERS ISSUED IN 1979, 1980 AND 1981

No. 1979

39 Paul Demeny, "On the End of the Population Explosion," March.

40 Bernard Berelson and Robert H. Haveman, "On Allocating Resources for Fertility Reduction in Developing Countries," March.

41 Samuel S. Lieberman, "Prospects for Development and Population Growth in Iran," May.

42 John Bongaarts, "The Fertility Impact of Traditional and Changing Childspacing Practices in Tropical Africa," May.

43 Mead Cain, Syeda Rokeya Khanam, and Shamsun Nahar, "Class, Patriarchy, and the Structure of Women's Work in Rural Bangladesh," May.

44 Bernard Berelson, W. Parker Mauldin, and Sheldon J. Segal, "Population: Current Status and Policy Options," May.

45 Paul Demeny, "Research in Population and Development: Issues and Comment," May.

46 Geoffrey McNicoll, "Technology and the Social Regulation of Fertility," June.

47 Veena N. Thadani and Michael P. Todaro, "Female Migration in Developing Countries: A Framework for Analysis," August.

48 Bernard Berelson and Jonathan Lieberson, "Governmental Intervention on Fertility: What Is Ethical?" October.

49 Moni Nag, "How Modernization Can Also Increase Fertility," November.

50 Michael P. Todaro, "Urbanization in Developing Nations: Trends, Prospects, and Policies," November.

51 John Bongaarts, "Malnutrition and Fecundity: A Summary of Evidence," December.

1980

52 Charles B. Keely, "Asian Worker Migration to the Middle East," January.

53 Paula E. Hollerbach, "Power in Families, Communication and Fertility Decision-Making," January.

54 Tomas Frejka, "Fertility Trends and Policies: Czechoslovakia in the 1970s," February.

55 Samuel S. Lieberman, "Rural Development and Fertility Transition in South Asia: the Case for a Broad-Based Strategy," March.

56 Mead T. Cain and A.B.M. Khorshed Alam Mozumder, "Labor Market Structure, Child Employment, and Reproductive Behavior in Rural South Asia," May.

57 John Bongaarts, "The Fertility-Inhibiting Effects of the Intermediate Fertility Variables," May.

58 Samuel S. Lieberman, "Afghanistan: Population and Development in the 'Land of Insolence,'" June.

59 Geoffrey McNicoll, "Institutional Determinants of Fertility Change," June.

60 Dorothy L. Nortman, "Sterilization and the Birth Rate," August.

61 Paula E. Hollerbach, "Recent Trends in Fertility, Abortion, and Contraception in Cuba," September.

62 Veena N. Thadani, "Property and Progeny: An Exploration of Intergenerational Relations," November.

63 John Bongaarts and Sharon Kirmeyer, "Estimating the Impact of Contraceptive Prevalence on Fertility: Aggregate and Age-Specific Versions of a Model," December.

64 Dorothy L. Nortman, "Empirical Patterns of Contraceptive Use: A Review of the Nature and Sources of Data and Recent Findings," December.

1981

65 Paul Demeny, "The North-South Income Gap: A Demographic Perspective," January.

66 Tomas Frejka, "World Population Projections: A Concise History," March.

67 Mead Cain, "Risk and Insurance: Perspectives on Fertility and Inequality in Rural India and Bangladesh," April.

68 Christopher Tietze and Sarah Lewit, "Abortion in the Seventies," May.

69 Dorothy L. Nortman, "Measurement of Family Planning Program Inputs in Different Program Structures," May.

70 John Bongaarts, "Simulation of the Family Life Cycle," May.

71 Mead Cain, "Landlessness in India and Bangladesh: A Critical Review of Data Sources," May.

72 Tomas Frejka, "World Population Growth Prospects," June.

73 Jonathan Lieberson, "Peasant Values and Rural Development: An Unresolved Controversy," June.

74 Tomas Frejka, "Population Dynamics and Prospects: A 1981 Assessment for Jamaica," June.

75 Paul Demeny, "Population Research, Prediction, and Policy: Issues and Comments," July.

76 Samuel S. Lieberman, "Accommodation and Control of Population Growth: Some Demographic Perspectives on Pakistan's Development," October.

77 John Bongaarts and Mead Cain, "Demographic Responses to Famine," November.

78 Moni Nag, "Impact of Social Development and Economic Development on Mortality: A Comparative Study of Kerala and West Bengal," December.