PROFESSIONAL PRACTICE

THE USE OF HEALTH IMPACT ASSESSMENTS IN WATER RESOURCES DEVELOPMENT: A CASE STUDY FROM ZIMBABWE

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INTRODUCTION

A standard compulsory health assessment of all new water resources development projects is seen by many as a means to facilitate intersectoral collaboration and ensure the incorporation of health safeguards, as well as a means to mitigate health impacts during project planning and design. Several guidelines have been published to facilitate the assessment of health impacts for water resource projects and other types of development (Birley 1989; Bolton 1990; ADB 1992; ICID 1993). There is, however, little experience with these guidelines. The objective of this case study is therefore to present the findings of a health impact assessment **(HIA)** in order to

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increase awareness of its use and to facilitate a discussion regarding various methodologies.

This report describes the findings of a HIA for a small-scale irrigation and dam development project, the Mupfure Irrigation Project in northern Zimbabwe. The approach followed was mainly qualitative, using secondary information. Several mitigation measures were identified, but no cost-benefit analysis was undertaken. The HIA report can be obtained from the Danish Bilharziasis Laboratory (Kondradsen and Chimbari 1993).

The general methodology adopted for this HIA is Birley's (1989, 1995) and the Asian Development Bank's (1992). The assessment supplemented an earlier feasibility study that contained little reference to health (Salzgitter Consult et al. 1991).

METHODOLOGY

Project Screening

Before the decision was made to prepare a HIA of the Mupfure irrigation project, the project was the subject of a screening or initial HIA for possible health hazards and their implications. The purpose of the initial HIA was to identify the project's potential health consequences and decide whether or not a full HIA was needed. The initial HIA identified several health hazards and opportunities' that were later included in the Terms of Reference for the full HIA. The initial HIA was based on readily available information, such as project documents, general country information, national statistical yearbooks, reference handbooks, maps, and information regarding health hazards typically associated with the type of project. The initial HIA found the proposed project could potentially cause health impacts and it was decided to conduct a full-scale HIA of the project.

[2] Health opportunities are seen here as benefits created as a consequence of the development initiative that were not originally part of the project objectives. A real health opportunity should not merely be a positive health side effect of a proposed project, but should provide a prospect for further improving the health and well-being of people by making small adjustments to the design or adding new project components with a comparative advantage.

Scoping

Scoping was initiated following the initial **HIA** to decide which health concerns, health hazards, and health opportunities should be further assessed. Scoping also defined the timing and the boundaries of the **HIA** and sources of expertise required. Further data and expert opinion were gathered from nongovernmental organizations, scientific publications, and appropriate national and international agencies. No visit was made to the project site at this stage. Scoping focused the Terms of Reference of the **HIA** and helped to identify additional health hazards.

Full Health Impact Assessment

The health risk[3] associated with each identified health hazard[3] was assessed on the basis of three factors:

1. **Environmental factors** — environmental changes associated with project construction and use that could affect the potential for specific health hazards;

2. **Vulnerable communities** — groups exposed to the potential health hazard, their susceptibility to the hazard, and behavior and demographic changes resulting from the project that could affect their vulnerability; and

3. **Capabilities of health protection agencies** — their ability to detect, monitor, inform, safeguard,[4] and mitigate[4] health risks.

The same three factors were used to assess the health risk during the initial **HIA,** although more superficially since information was limited by the absence of site visits.

The information needed to carry out the full **HIA** was extracted from existing project documents, scientific papers, government and donor statistics, and by interviewing key informants at central, provincial, district, and village levels.

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[3] **A** health hazard is defined as having a potential for causing harm to people, whereas a health risk is defined **as** the likelihood that the potential is realized (Birley 1995).

[4] In this study a safeguard has been defined **as** an activity intended to prevent something **from** happening, whereas mitigating measures will only reduce **a** negative impact (Birley 1995).

A scrics of 48 interviews and five focus group discussions were conducted. Structured questionnaires were not used, but a list of questions was prepared beforehand. Visits were made to the project site.

A four-person steering committee with representatives from relevant national authorities was established to facilitate information gathering and to promote local ownership of study results. The study was organized, the steering committee was established, and data gathering was initiated in August 1992. Field work was untlcrtaken from February 15 to April 9, 1993.

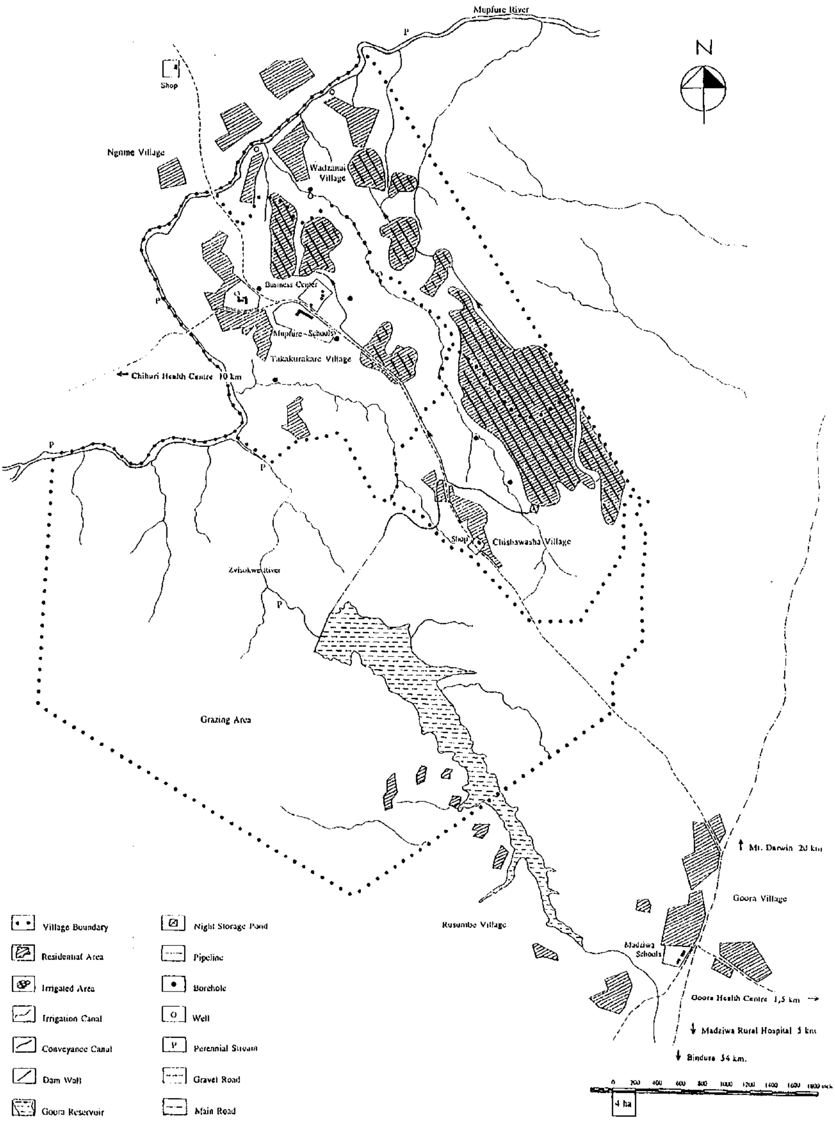
STUDY AREA AND DESIGN OF THE PROJECT UNDER INVESTIGATION

The HIA was conducted for a proposed irrigation project in Mupfure ward, Shamva District of the Mashonaland Central Province in Zimbabwe. The project site is 61 kilometers north of the provincial capital, Bindura. The project area is shown in figure 1 .

The project area is between 1,000 and 1,080 meters above sea level (Highveld region) with undulating rocky hills to the south and east. Most of the area has been cleared of vegetation and is currently used for rain-fed crop production. There are several of seasonal streams in the area immediately surrounding the three villages in the project area. The Mupfure River is the only perennial waterway. A well-organized land-use pattern with clearly defined farming areas, village sites, grazing areas, cattle dips, and boreholes is within the project area.

Mean daily temperature measured at Mt. Darwin meteorological station, 14 kilometers northeast of the project area, ranges from 21.9 "C to 23.0 "C in the rainy season (December to March) and from 14.9 "C to 24.2 "C in the dry period (April to November). Absolute temperatures vary from 1.5 °C to 38.6 "C (Department of Meteorological Services 1990). The mean annual rainfall in the project area is about 800 millimeters, with 85 percent occurring from December to March.

Figure 1. **Project area**



Approximately 3,700 people live in the five villages affected by the project. All the people in the area belong to the Shona ethnic group.

The overall objective of the planned project is to improve the living standard of the rural community through irrigation development and by increasing production of cash crops and to a lesser extent food crops.

An earth-filled dam called Goora will be constructed on the Zvisokwe River, a tributary of Mupfure River. The dam will be 23 meters high and the estimated storage capacity of the reservoir is 4.3 million cubic meters. Water from the reservoir will be pumped into a conveyance canal and the water will flow by gravity into a night storage pond. The water will then be distributed to secondary and tertiary canals through a main canal. All canals except the tertiary canals will be concrete-lined. Approximately 170 hectares of land will be irrigated and 170 farm families will directly benefit from the irrigation project.

HIA RESULTS

Several health hazards were interpreted as health risks during the HIA. They are described in table 1 and below.

Schistosomiasis

Surveys conducted within a few kilometers from the project area in the period from 1985 to 1988 have consistently showed the presence of *Bulinus globosus* and *Biomphalaria pfeifferi,* the respective hosts of *Schistosoma heamatobium* and *S. mansoni* (Taylor et al. 1989). This was confirmed by a nonquantitative snail search conducted in the project area as part of the HIA.

Parasitological surveys conducted at Mupfure Primary School, as well as the records from the local health centers, show a high prevalence especially of *S. haematobium* and to a lesser extent *S. mansoni.* A prevalence of 68.5 percent, 31.3 percent, 38.7 percent, and 85 percent for *S. haematobium* in the student population was recorded at Mupfure Primary School in January 1986, September 1986, October 1987, and mid-1992 respectively. The corresponding prevalence for *S. mansoni* was 22 percent, 7.5 percent, 21.4 percent, and 20 percent (Taylor et al. 1989; Madhina, in preparation).

The development of the Mupfure irrigation project is likely to lead to environmental changes that would increase the intensity of schistosomiasis transmission. Changes in the transmission season are less likely to occur since temperatures in winter are low enough to reduce or even completely suppress the development of intramolluscan larval stages of schistosomes (Shiff et al. 1975). The most important snail breeding sites are likely to be created in the drainage, tertiary, and secondary canals where the water velocity may be conducive for snail breeding. Furthermore, the colonization of the Goora Dam by snails is expected to be rapid since the snails are already present in Zvisokwe River and the aquatic environment created by the dam is likely to favor extensive snail breeding. Breeding of snails within the fields is unlikely since the planned crops will not need standing water for long periods of time.

Increased schistosomiasis transmission is likely to occur close to human settlements neighboring irrigation canals and the Goora Dam, where domestic and recreational water contact will be intense. Members of the Apostolic Faith Church constitute approximately one-third of the total population in the project area and are a very vulnerable community since most of its members refuse to use the formal health system, avoiding health education or medical treatment. Members of this church associate water with holiness and they are frequently in contact with natural water sources because their religious rituals are performed using water.

The most important reasons for the existing high prevalence of schistosomiasis in the project area are frequent water contact activities in natural water bodies intensified by (1) a lack of facilities for diagnosing *S. mansoni;* *(2)* a lack of drugs for treating *S. mansoni* infections; (3) an absence of a snail control program; (4) an absence of a safe water supply and sanitation program that has been adversely affected by a general shortage of cement and other materials; and (5) a lack of a well-coordinated health education and disease monitoring program.

It is difficult to differentiate the project impact on the two forms of schistosomiasis present in the area. However, it is likely that an increase in prevalence and intensity of *S. mansoni* will be the most extensive because no drugs and diagnostic facilities are available locally and because it is more difficult for the population to make a self diagnosis of *S. mansoni* than for *S. haematobium.*

Table 1. **Summary of health impacts**

Health Hazard	Environmental Change	Community Vulnerability	Capability of Protective *Agencies*	Health Risk
Schisto- somiasis	Increased **number** of snail habitats close to domestic areas and in the working environments	**Children** swimming in **the canals, women** doing laundry and fetching water, fishermen and **farmers working** in the water	**Curative:** moderate., **drugs only** available for **S. *haematobium*** Surveillance: moderate, **no** regular surveys **and no** microscopist **Vector control:** none	Increased risk, especially in the *case* of *S. **mansoni***
Malaria	Increased **number** of mosquito-breeding habitats close **to** human settle-ments; approximately 2-month extension of the transmission **season**	Susceptibility is **high** for **all** groups, but under-fives and pregnant women **are** especially vulnerable; bednets are **not** used and houses **are** not being mosquito proofed	**Curative:** chloroquine available at health centers but **no** second line drug, chloroquine widely available in local shops Surveillance: poor, long delays **in** processing information and no monitoring of drug resistance **Preventive:** poor Vector control: moderate, some provision for chemical control in **case** of epidemics but **no** control by environmental management	Increased risk
Agrochemical poisoning	Intensified production and increase in **cash** crops will lead to increased **use** of chemicals	High **occupational risk** for irrigation **farmers,** increased risk of accidental poisoning of children around the households, generally poor educational level **regarding** the use of chemicals	**Curative: very** limited **Preventive:** limited, **poor** storage and disposal facilities, some training **of** farmers	Increased **risk**

Sexually transmitted diseases (STDs)	Increased immigration during construction period **and** change in social environment	High among construction workers and prostitutes **but will spread to the** surrounding community	**Curative:** adequate for most wmmon **STDs** but none for **H N** **Preventive: poor** Surveillance: poor	Increased **risk,** *espe-*cially during construction period
Malnutrition	Increased income and agricultural output leading *to* greater food security for project beneficiaries	High among under-fives **and landless;** reduced vul-nerability with increasing income but **unequal** entitlement to cash earnings **are** expected	**Curative**: limited, but active child supple-mentary feeding programs **Preventive:** moderate, mother and child health program and active education and awareness programs	**Reduced risk,** possibility **for** improved nutritional **status** among the project beneficiaries
Skin and eye diseases	Increased amounts **of** read-ily available **water** will improve hygienic **status** for the population at large	High prevalence, especially **among** the groups with the poorest living conditions	**Curative:** limited **Preventive:** limited, but health education and small-scale community-based water supply projects under implementation	Project will lead to a reduced **risk** and provide a health oppor-tunity for the population at large
Enteric diseases like diarrhoea and typhoid	Increased amount of readily available water could improve personal hygiene; contaminated *canal* water **used as** drinking **water** will have a negative impact	High prevalence, especially for under-fives **and** groups with poor living conditions	**Cmative:** fair **Preventive:** health education and small-scale community-based sanitation **and** water supply projects under implementation; problems with maintenance **of** wells and pumps	Moderate **risk**

Malaria

Malaria is a prominent disease in the project area. At the nearby health facility, it was the third most common diagnosed disease from 1990 to 1993. Almost all cases were because of *Plasmodium falciparum*. The project area is defined as an area of unstable malaria transmission and active parasite surveys carried out in the region estimate the malaria prevalence to be about I percent of the total population (Cress and Mhlanga 1985).

Surveys undertaken in the project area show *Anopheles arabiensis* as the principal vector for malaria transmission (Taylor and Mutambu 1986). *An. gambiae* is found in the province but only in very small numbers (Zahar 1984).

The anticipated environmental changes of the Mupfure irrigation project will lead to an increased number of malaria transmitting mosquitoes throughout the year, except for June and July when temperatures are probably too low for extensive breeding. The present malaria transmission period lasts from December until May and is mainly limited by the availability of breeding sites outside the rainy season and the low temperatures in June and July. The increased mosquito breeding sites created by the project are likely to expand the malaria transmission period by about two months, mainly October and November. A further expansion of the malaria transmission period from May to August will have marginal impact because the low temperatures experienced in this period inhibit parasite development in the mosquito.

The villagers living close to the drains and the Goora Dam are likely to be a group highly vulnerable to increased exposure to mosquito bites. Finally, the extended human migration associated with the project would increase the likelihood of chloroquine-resistant strains of *Plasmodium* being introduced into the project area.

The ability of the local health services to deal with the present malaria problem is hampered by a lack of an effective system for reporting malaria outbreaks, inefficient mosquito control, and the long distance from the project area to the health centers. Furthermore, preventive measures for personal protection against mosquito bites are often expensive and not easily available.

Generally, environmental changes associated with the development of the Mupfure irrigation project may result in malaria outbreaks because of the increased number of vectors and the lack of protective immunity in the human population that results from the unstable malaria situation.

Agrochemical Poisoning

The implementation of the Mupfure irrigation project likely will lead to increased use of agrochemicals. A large number of new types of chemicals will be introduced as a result of an increased focus on cash crops and intensified production.

The most vulnerable group to health risks likely will be the farmers carrying out chemical spraying. Furthermore, the increased use of agrochemicals inevitably will lead to an increase in the number of accidental poisonings because of unsafe storage facilities and general environmental contamination.

The capacity of the established health system to deal with this risk is limited. The local health staff lack experience and training in dealing with chemical poisoning. Furthermore, the lack of systematic collection of data on pesticide poisoning makes it difficult to establish an effective monitoring program to identify vulnerable groups.

Sexually Transmitted Diseases (STDs)

During the three to four years of project construction, 60 to 80 engineers and specialized workers will be brought to the area, and an additional 150 to 200 local workers will be recruited. It is expected that prostitutes and traders hoping to make a living by servicing the construction workers will settle down in or around the new temporary settlement created for construction workers. Thus, the social environment of the temporary settlements will be conducive for sexual transmitted diseases (STDs). There is a risk that an influx of people with a high prevalence of STDs to the project area may lead to an increased number of cases among the local population since these groups will not live in isolation.

The capability of the local health services to monitor the spread of STDs in the project area is currently limited, especially in the case of HIV infections, for which no diagnostic facility is available. Furthermore, the resources available to the local health centers will make it difficult for the permanent staff to carry out a coordinated health promotional campaign aimed at protecting the local population and the temporary settlers from the increased risk of contracting STDs.

Water-Washed Diseases

Water-washed diseases, like skin, eye, and enteric diseases, are highly prevalent in the project area. Scabies was the fourth most common reason for outpatients treatment among children under five at the Goora Health Centre, and diarrhoeal disease was the ninth most common disease in the same age group in 1992.

During the dry period of the year, the reliability and accessibility of water are poor for three of the villages in the project area, which are mainly served by shallow wells. The construction of irrigation canals and the creation of the dam, however, will make the water supply more reliable and easily accessible throughout the year. Provided health education is supplied, this likely will lead to an improved hygienic status among the communities living close to the irrigation canals and the Goora Dam. The number of hygiene-related skin and eye diseases could therefore decrease and thus is seen a health opportunity of the project. Enteric diseases will, however, continue to be significant because of a lack of safe drinking water. Furthermore, the risk of epidemics may increase if people use contaminated canal water for drinking instead of water from shallow wells—a realistic situation for villagers whose access to shallow wells will be cut off by the new canal.

Malnutrition

Expected maize production under irrigation will be sufficient to satisfy the staple food requirements of even the larger families among the project beneficiaries. The total production of vegetables and meat is expected to remain unchanged. Increased household income will make it possible for the project beneficiaries to allocate more money for food and improve the diet for their families. However. unequal entitlement to cash earnings are expected within the families.

While the project has the potential to improve the nutritional status of project beneficiaries, it is difficult to forecast how it will influence the rest of the population in the project area. The project may have a negative effect on other groups if the future land use plan deprives others of arable land. An especially vulnerable group will be the approximately 13 families that will lose their farm land to the planned reservoir behind the dam.

Generally, the project will improve food security and limit the consequences of dry spells and pests on the agricultural production. However, if the project turns out to be less productive than expected or if the area used for cash crops increases beyond that expected, then the nutritional impact of the project could change. During the construction phase, food production could decrease because of work on structures in the fields. It might be necessary for the population in the project area to import food during this period.

SAFEGUARDS AND MITIGATING MEASURES

Based upon the findings of the HIA and follow-up discussions with specialists from government departments, universities, private consulting firms, and NGOs, several safeguards and mitigating measures were identified. These can be integrated into the project design in order to reduce the negative health impacts and optimize the health opportunities. Table 2 summarizes the recommended safeguards and mitigative measures.

The total cost of recommended safeguards and mitigating measures that should be included in the budget for Mupfure Irrigation Project is Z$240,000, or to roughly 1.8 percent of the total project cost. Additionally, the Water Department will need to invest Z$40,000 to reduce the risk of STDs during the construction phase. Furthermore, the Ministry of Health and Child Welfare (MOHCW) will have to allocate an estimated Z$40,000 annually to cover the cost of upgrading health services.

When selecting mitigation measures for an HIA, high priority should be given to interventions with a positive impact on the general health status and less emphasis should be given to disease specific interventions. The investment in basic health services is likely to have a greater long-term effect than costly independent disease-specific control interventions. This approach will improve the cost-benefit ratio of the proposed control measures and improve on their long-term sustainability (WHO 1993). Interventions with a positive effect on both the health status and agricultural production, e.g. good water management and consistent canal maintenance, will likewise improve the cost-benefit ratio.

The inclusion in project design of measures to mitigate disease problems will be the responsibility of the implementing agency. Collaboration with other government departments, however, will be necessary to achieve successful results. Furthermore, links will need to be established with NGOs to institute cooperation in areas of mutual interest, including issues beyond primary project objectives, e.g. promotion of safe water supply and sanitation, family planning, and small scale business.

Table 2. Safeguards and mitigating measures

Summary of recommendations that must be implemented concurrent with development of the Mupfure irrigation project. The total estimated additional expenses that must be included in the budget for the Mupfure irrigation project amount to Z$240,000. Water department will have to allocate an additional Z$40,000 for health promotional measures and MOHCW an additional Z$40,000 annually to the area as part of project development.
WD = water department, MIP = Mupfure irrigation project, MOCW = Ministry of Health and Child Welfare, EHT = environmental health technician, NSP = night storage pond, KABP = knowledge, attitude, beliefs, and practices, STD = sexually transmitted diseases. US$1.0 = ZS6.0 in June 1993.

Safeguards and mitigating measures	Estimated cost	Agency responsible for implementation	Impact on—
Free draining hydraulic structures	No additional cost	MIP	Schistosomiasis
Deweeding and desilting of irrigation structures	Minimal additional cost, increased farmer input	MIP	Malaria and schistosomiasis
NSP bypass structure and spillway	Z$ 3,400	MIP	Schistosomiasis
Training of farmers in water management	No information	MIP	Malaria and schistosomiasis
Pipelining of conveyance canal	Z$ 50,000	MIP	Water-washed diseases and schistosomiasis
Foot bridges	Minimal	MIP	Schistosomiasis
Reducing eutrophication of the Goora Dam	No additional cost	MIP/WD	schistosomiasis
Promotion of water supply and sanitary facilities	Z$ 113,000	MIP	Water-washed diseases and schistosomiasis

KABP survey to improve design of health protective interventions	Minimal, part of project preparation	MIP	General health status
Storeroom for agrochemicals	No additional cost	MIP	Agrochemical poisoning
Protective clothing for canal maintenance workers	Covered by the farmers	MIP	Schistosomiasis
Support to community based health education during five years of project implementation	Z$ 20,000 (4,000 annually in five years)	MIP/MOHCW	General health status
Improved drug supply to local health center during a 10-year period	Z$ 54,000	MIP	Malaria and schistosomiasis
Leveling of borrow pits following construction of the Goora Dam	Minimal	WD	Malaria and schistosomiasis
Measures to reduce number of STDs during construction of the Goora Dam	Z$ 40,000 (10,000 annually in four years)	WD	STD
One additional EHT stationed in the project area	15,000 per year (salary), facilities provided during the construction phase will be used for accommodation	MOHCW	General health status
One microscopist and one microscope	25,000 per year (salary + microscope), facilities provided during the constructionphase will be used for accommodation	MOHCW	Malaria and schistosomiasis
Improved intersectoral cooperation during project implementation	No information	MOHCW/MIP/WD	General health status

CONCLUSIONS

The Mupfure irrigation project case study showed that—

- Adequate data are available for a sound HIA;
- Integration **of** HIA into project feasibility studies is prudent;
- Complexity and methodological problems exist, but a systematic evaluation of health impacts yields valuable results; and
- Benefit-cost analysis should be used to prioritize mitigation measures.

The Mupfure irrigation project case study showed that in Zimbabwe there are sufficient meteorological, demographical, epidemiological, and ecological base-line data available to form the basis for an HIA. Furthermore, the research community within the country is actively involved in research relevant to the health implications of water resources development.

Project feasibility studies provide an opportunity to assess the economic, technical, social, environmental, and health implications of a project in a holistic manner. Constructive follow-up on recommendations given and opportunities identified would stand a much better chance of implementation if the HIA was carried out as an integrated part of a feasibility study, and **not** as in the present case study as an appendix to a feasibility study. Furthermore, the collection of base-line data may be less time and resource consuming if it is coordinated as part of a feasibility study. If the HIA approach became an integrated part of the normal project planning procedure at the national level, then the different government agencies would be confronted with health problems and opportunities related to their specific sector. This could be an important step towards increased inter-sectoral collaboration on health promotion.

The Mupfure irrigation project case study showed the complexity and problems associated with forecasting the ecological consequences of a water resource development project and their possible impacts on public health. Furthermore, the study illustrated the importance and difficulty of estimating the socio-economic and human behavioral changes resulting from the project and its potential impact on the health status of the population. This complexity shows that a HIA is “a best guess” and that a reasonable degree of skepticism should be used in the interpretation of the results. However, the major advantage of the method applied in the Mupfure irrigation project case study was the systematic approach by which the risk assessment was undertaken. Standardizing the assimilation and presentation of data made the **HIA** procedure easier to complete.

A thorough cost-benefit analysis should be carried out in order to prioritize the various mitigating measures. The costing of proposed measures does not substitute for further economic evaluations but can be seen as a minimum required output when developing a mitigation program..

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