

Planning and management of irrigation in sub-Saharan Africa: reducing the environmental and health costs

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Abstract

Development of irrigation can result in negative environmental and human health impacts. Irrigation undertaken without full consideration of these impacts can have serious adverse repercussions, not only undermining the investment but also worsening poverty and contributing considerably to peoples' suffering. The impacts are strongly inter-linked because it is changes in the environment that cause changes in health. Furthermore, mitigation measures that reduce environmental damage often improve health outcomes. In the past, research into impacts, and the development of impact assessment methodologies, has focused primarily on large scale, capital intensive, schemes. However, small scale and less formal water management interventions, which are increasingly prevalent in sub-Saharan Africa, can also have significant environmental and health impacts. This paper summarizes the findings of a study of environmental and health issues associated with all scales of irrigation in sub-Saharan Africa. It is not a compendium of data, but rather provides an overview and framework for understanding policy and programming issues. It is recommended that a pragmatic approach to address current environmental and health planning includes three levels of implementation: i) strategic planning at the national and regional level; ii) full environmental and health assessment for government and donor funded projects; and iii) development of simplified tools for

impact assessment relevant to community led, NGO and small private projects.

1. Introduction

It is widely acknowledged that irrigation can play a major role in improving food productivity, reducing poverty and sustaining rural livelihoods (Hussain and Hanjra, 2004; Smith, 2004). However, over the past two decades, investments in irrigation in sub-Saharan Africa have declined significantly (Kikuchi *et al.* 2005). There are a number of reasons for the decline, but the poor performance of irrigation, especially with respect to capital-intensive schemes, has undoubtedly contributed. Although not the sole reason, environmental factors and adverse health impacts have been a prominent cause for the disappointing performance of many schemes (Oomen *et al.*, 1990). Inadequate consideration of environmental and health issues in the planning and implementation of projects is widely perceived as a key cause of project failure (Moradet *et al.*, 2005).

The environmental and human health aspects of irrigation schemes need to be considered in tandem, because they are strongly inter-linked. It is changes in the environment, in conjunction with associated socio-economic change, which results in changes in the health of local populations (Figure 1). Environmental and health impacts of irrigation are generally site specific and are multiple, varied and complex. They depend on a range of factors, including the scale of development, bio-physical conditions, management and operation, as well as the extent to which safeguards are implemented.

The potential negative environmental impacts of large capital-intensive irrigation schemes are extensively documented (e.g., Adams 1992; Dougherty and Hall 1995; Kay, 1999). Modification of river flow regimes, depletion of groundwater, sedimentation effects, soil salinization, waterlogging, water contamination and biological effects²⁴, have all been responsible for undermining the sustainability of schemes. Often farmers on irrigation schemes are fully aware of many environmental problems. However, because small incremental changes can take a long time to have a significant impact on productivity, often nothing is done until it is too late. It is estimated that in the southern region of Ethiopia, approximately 50% of irrigation scheme failures and below capacity performance are due in part to technical (as opposed to institutional and social) reasons, many of which are environmental in nature (e.g., soil salinization, sedimentation in headworks and channels, and drying up of rivers) (Robel, 2005).

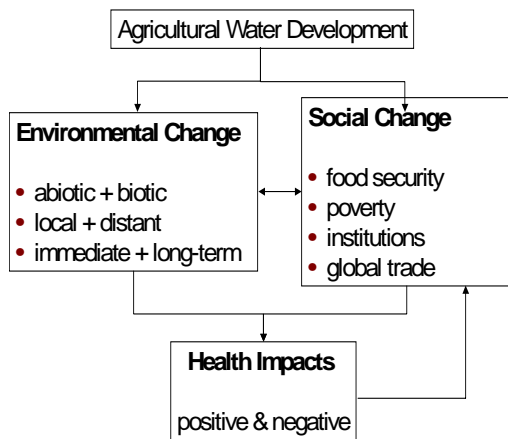


Figure 1: Influence of agricultural water

²⁴ Examples include agricultural pests and weeds and the establishment of aquatic vegetation in the water storage, distribution and drainage systems.

Although investment in irrigation is supposed to bring health benefits, through improved nutrition and income, it can have adverse impacts through the extension of water-related vector-borne diseases (e.g., malaria, schistosomiasis, liver flukes, filariasis, onchocerciasis, dengue fever, yellow fever, Rift Valley fever and encephalitis (Oomen *et al.* 1990). For example, malaria has been closely associated with the Gezira Irrigation System, in Sudan since it began in 1924. Severe outbreaks in the mid-1970s were linked to changes in irrigation management practices and the onset of pesticide resistance in malaria mosquitoes (Hunter *et al.* 1993).

Contrary to widespread belief, community-based and small-scale agricultural interventions also have environmental and health impacts (Konradsen *et al.* 2000; Mutero *et al.* 2004). These impacts are often disregarded and in many instances, there is almost no knowledge of the cumulative environmental and health impacts arising as a consequence of up-scaling. For example, small earth dams are being widely promoted throughout much of sub-Saharan Africa for multiple uses of water including irrigation and livestock watering. In many places, these dams have resulted in increased household income through improved agriculture. However, the potential environmental impacts and health consequences are rarely considered and the impacts of many thousands of dams are unclear. In Cameroon, the development of hundreds of small agro-pastoral dams led to a rapid spread of schistosomiasis (Ripert and Raccurt 1987) Similarly in Ethiopia, the construction of small dams in Tigray has led to outbreaks malaria, where previously there were none (Ghebreyesus *et al.* 1999).

2.Environmental and Health Planning in Irrigation Projects

The need to take environmental and health considerations into account as part of ensuring sustainable development is now widely recognized. Many countries in sub-

Saharan Africa have national policies, strategies (e.g., National Environment Action Plans) and legislation that stipulate the need for appropriate environmental planning and management of projects. Most international financing institutions (e.g., The World Bank, ADB and IFAD) as well as many bilateral donors (e.g., CIDA, Danida, DFID, GTZ and USAID) and international development agencies (e.g., FAO), have environmental policies that mainstream environmental issues at operational levels (Bos, 1999). Commercial organizations (e.g. banks) are also increasingly environmentally aware and many have signed up to the Equator Principles, which provide a common framework to manage environmental and social issues (<http://www.equator-principles.com/principles.shtml>).

To support these policies a large number of Environmental Assessment (EA) tools have been developed. These include project-level Environmental Impact Assessment (EIA), Strategic and Sectoral Environmental Assessments (SEA), Social Impact Assessments (SIA), Health Impact Assessments (HIA) and Environmental Audits and Appraisals (EAA) (Table 1). However, currently there remains considerable diversity among donors and other institutions in their mandates and approaches to dealing with social issues (including health). Most institutions routinely consider social impacts that are mediated by

the environment, such as the health impacts of water pollution and many also consider a range of physical/biological impacts on directly affected groups (e.g., displacement or adverse impacts on local communities). Nevertheless, current coverage of human health aspects within environmental and social assessments is widely regarded as inadequate (Birley *et al.* 1997). Public health agencies are often excluded or only marginally involved and Environmental Health Impact Assessments (EHIA) are generally underutilized as tools for health protection (Fehr, 1999).

Practical approaches to EHIA have been advocated by the World Health Organization and the Asian Development Bank. The WHO/FAO/UNEP/UNCHS Panel of Experts on Environmental Management for Vector Control (PEEM), jointly with the Danish Bilharziasis Laboratory, developed a training course on rapid health impact assessments, later further refined and disseminated by the Liverpool School of Tropical Medicine (Birley 1995; Furu *et al.* 1999; Bos *et al.* 2003). In addition, some good text books are now available (e.g., Kemm *et al.* 2004). However, for the most part EHIA development has occurred in parallel, but is not integrated, with EIA methodologies. There is need for much better integration. A policy shift is required so that institutions promote EHIA rather than EIA (Amerasinghe and Boelee 2004).

Table 1: *Environmental, Health and Social Assessment Tools*

Environmental Impact Assessment (EIA)
A process for examining the environmental and human consequences, both beneficial and adverse, of a proposed development activity, and for incorporating appropriate measures to address them into project design and implementation. In many instances EIA is defined broadly to include social dimensions such as health.
Health Impact Assessment (HIA)
Similar to EIAs, these are intended to focus specifically on the health implications of a project, in situations where greater emphasis is required.
Social Assessment (SA)
Similar to EIAs, these are intended to analyze, manage and monitor both the intended and unintended social consequences of a development. They may be used to promote social goals such as social inclusion or poverty reduction.
Strategic Environmental Assessment (SEA)
A process to assess the environmental and social implications of strategic decision-making. SEA differs from EIA in that it is applied to policies, plans and programs rather than to projects. It addresses a number of shortcomings of EIA in that it is capable of addressing the cumulative impacts of projects (i.e., where one project stimulates other development), it can address synergistic impacts (i.e., where the impact of several projects exceeds the sum of the individual project impacts) and it can address global impacts such as biodiversity loss.
Environmental Management Plans (EMP)
Strategies developed for ongoing activities to avoid, mitigate or compensate for adverse impacts. They should include specific quantifiable aims and objectives and assign responsibilities and budgets for the environmental and social (including health) impact management measures.
Environmental Audits and Appraisals (EAAs)
Determine the effectiveness of mitigation measures conducted and, where appropriate, propose remedial measures.

3. Constraints to successful planning and management

In common with other regions in the World, in sub-Saharan Africa, approaches to reduce the negative impacts of irrigation schemes are successful in some circumstances but are not effective in others. Constraints to environmental and health management, and the successful implementation of measures to ameliorate negative impacts, arise for a range of technical reasons as well as limitations in human, financial and institutional capacity.

Many countries lack the resources to properly enforce policies and to ensure that recommended practices are followed. Consequently, despite current national policies, EIAs are most often restricted to large construction projects and are largely donor-driven. For example, the effectiveness of the Environmental Council of Zambia (ECZ), the lead institution for overseeing EIAs in Zambia, is severely curtailed by the inadequate budget and limited human resources (McCartney et al., 2004).

Failure of measures to mitigate negative impacts often stem from a lack of sufficient information at the design stage in planning (Morardet et al. 2005). More often than not, baseline information is unavailable for irrigation projects. Furthermore, adverse environmental and health consequences often occur because schemes are planned and managed in isolation from other things occurring within the catchment. In many instances too little thought is given to the dynamics of catchment change and there is inadequate evaluation of the specific biophysical and socio-economic context in which the scheme is located. Available descriptions of effective mitigation measures generally do not include the underlying assumptions or specifications that were used to design them. Without appropriate criteria and specifications for the design of measures, it is unusual for the measures to achieve the desired goals. To develop the necessary criteria and specifications, sufficient information must be obtained. Very often the environmental, ecological and socio-economic monitoring required, both for design prior to the implementation of a scheme and afterwards to assess the effectiveness of protection measures, is

inadequate. For example, in Ghana a data checklist sent to 22 irrigation schemes, provided limited information for just three schemes. This lack of data was attributed to poor data keeping and the fact that, for the majority of schemes, assessment of environmental and/or health impacts had never been undertaken (Kranjac-Berisavljevic and Cofie, 2004). In relation to health, baseline information on the health and socio-economic status of communities, and hence their susceptibility to change, is often lacking (Fehr, 1999).

To a large extent the effectiveness of environmental and health management depends on the abilities of those people who plan and manage mitigation measures. In many parts of sub-Saharan Africa, the requisite professionals are unavailable or not proficient in the interdisciplinary working habits necessary for successful environmental and health planning and management. Furthermore, there is often a lack of coordination between relevant government departments. In a review of World Bank projects in Africa, the most frequently cited recommendation for corrective action for environmentally sensitive projects was improvement of capacity in responsible institutions (Green and Raphael 2000). This lack of capacity is being exacerbated by the HIV/AIDS epidemic (Cohen, 2002).

Another major limitation to formal environmental and health procedures is that often there are no mechanisms to ensure adaptation in the design of the project. Usually the people who demand the assessment are not the same as those who decide on changes in the project design or even whether or not the project will be carried out. Most sub-Saharan African countries have neither the necessary framework to ensure legal compliance nor organized civil society to ensure that recommended environmental and health safeguards are implemented. In such situations the contractual arrangement with the donor may be the major means for ensuring compliance. However, in the absence of a transparent accountable system this arrangement is rarely successful. Very little is known about the proportion of assessments that lead to actual adaptations or implementation of mitigating measures.

However, a study of the follow-up to the EIA conducted for the Koga irrigation scheme in Ethiopia found that only two of the twenty major recommendations made in the EIA were being implemented satisfactorily. The lack of follow-up was largely attributed to institutional failure, with no single authority being responsible for ensuring that the EIA recommendations were implemented (Abebe *et al.* 2007).

In a global review of the effectiveness of its EA procedures the World Bank found that key constraints to successful implementation in projects for which EA was not deemed to have been performed effectively were: i) the lack of a definitive Environmental Management Plan (EMP) with time-bound actions and responsibilities; ii) the absence of environmental monitoring indicators; iii) a lack of reporting requirements for project performance (including environmental and health indicators) and iv) the absence of legal commitments by borrowers to undertake environmental actions (World Bank 1997).

4. Recommendations

Clearly, if irrigation is to make a significant contribution to realizing the potential of agriculture in sub-Saharan Africa, there is need for much improved and integrated planning. Measures that promote sustainability by, among other things, capitalizing on the opportunities for enhancing human health, should be at the core of agricultural water development. The EA process, recommended by most donors and governments, is widely recognized as a useful for identifying issues and developing plans to address them. However, within sub-Saharan Africa there are, as outlined above, many constraints to the process and subsequent follow-up is often weak. Furthermore, the process is inappropriate for many small-scale developments. Subjecting smallholder and community-led projects to full environmental and health assessment, and monitoring, although justifiable, is often neither economically feasible nor practical. Against this background, the following recommendations are a pragmatic attempt to address current limitations in environmental and health planning and management pertaining to irrigation development. Focused on what governments and donors can do to improve planning and

management, the recommendations are divided into three categories:

- strategic planning at national and regional level
- agricultural water projects for which full environmental and health assessment should be mandatory (i.e., all government and donor funded projects, whatever their size, plus all other projects involved in commercial agricultural production and greater than 20 ha in extent²⁵)
- agricultural water projects that by-pass current procedures and for which it is unrealistic to expect full environmental and health assessment to be conducted (i.e., private, community and NGO organized projects smaller than 20 ha in extent²).

4.1 Strategic planning at national and regional level

4.1 Implement Strategic Environmental Assessment at regional and national level

Strategic environmental assessments (SEAs) can be used to plan irrigation development at national level and for major international river basins (e.g., Zambezi, Limpopo, Volta). SEAs are most valuable if they integrate environmental, health and social concerns and attempt to reconcile development, environmental protection, community rights and human health. Regional and national development goals, as well as issues such as climate change and loss of biodiversity, and commitments to international conventions (e.g., the Convention on Biological Diversity) should be considered.

4.2 Improve and promote EHIA

Currently health impact assessments are often conducted in isolation from environmental assessments. Since much of the information to be collected on environmental receptivity and community

²⁵ The suggested value of 20 ha is arbitrary but intended to make recommendations operationalizable. Governments could decide on a more appropriate figure, based on the specific agro-ecological conditions and development needs of their country.

vulnerability is the same it is mutually beneficial if they are integrated. Where necessary, EHIA should specifically include the issues of migrants and livestock that hitherto have tended to receive very little attention.

4.3 Improve regional capacity for Environmental and Health Assessment

All countries without compulsory environmental and health assessment processes should consider enacting laws that make these mandatory for large infrastructure projects, including large irrigation projects. In many countries strengthened institutional arrangements would assist in the implementation of environmental and health assessment processes. For example, establishing environmental units within Government ministries responsible for irrigation could be contemplated. The effectiveness of such units would be enhanced if they work closely with national environment agencies and appropriate health authorities.

4.4 Adopt harmonized environmental and health procedures

The ability of governments to implement sound environmental and health practices would be improved if donor agencies harmonized procedures and developed a consistent framework for the evaluation, planning and management of environmental and health aspects of irrigation. Procedural requirements should conform to current international best practice and be clearly laid down in regulations and operational manuals.

4.5 Conduct regionally specific research

More research is needed on the benefits of incorporating environmental and health safeguards in irrigation planning and operation versus the cost of not taking potential negative impacts into account. Another researchable issue stems from the lack of monitoring, both for water resources development projects and in the health sector. With baseline data not available, proxies need to be developed to provide alternative ways to the same information. Specific tools need to be developed to facilitate assessment of long-term health and environmental impacts. For example, long

term cohort studies are required that are not feasible within the context of individual EHIA.

Agricultural water projects for which full environmental and health assessment should be mandatory

4.6 Implement comprehensive options assessment

Comprehensive options assessments, undertaken during the scoping of irrigation projects, provide a means, early in the planning process, to eliminate unacceptable projects or project components. Comprehensive environmental and social audits can help determine the causality of environmental and human impacts and the relative magnitude of impacts at a basin or regional level, which can then be compared to alternative development scenarios. It is essential that environmental, health and social criteria, as well as technical, economic and financial factors, are considered when comparing alternatives.

4.7 Identify and quantify intended livelihood and health benefits

The environmental and health impacts of irrigation are diverse. As with any development process, trade-offs between social, environmental and economic goals are inevitable. As far as possible these trade-offs need to be identified and made explicit. Often it is assumed that, by improving food security and/or peoples' socio-economic status, water development will inevitably result in health benefits and improved livelihoods. However, the intended livelihood and health benefits are rarely made explicit, and in reality, neither costs nor benefits are evenly distributed amongst stakeholders. Environmental and health assessments, as well as management plans, need to take into account the socio-economic diversity of communities and ensure that the weakest and most vulnerable are not adversely affected. Intended health and livelihood benefits as well as means of verification need to be identified and stated at the outset of any irrigation scheme.

4.8 *Plan and manage using a catchment-wide perspective*

Given the inter-linkages between impacts and what occurs elsewhere in the catchment it is essential that projects are planned and managed within the specific socio-economic and biophysical context in which they are located. Consideration must be given to potential environmental impacts on, as well as impacts caused by, the development. Assessments of impacts on the catchment water balance and sediment fluxes, including evaluation of possible future development (particularly relating to land-use change), are essential. The potential cumulative affect of small-scale interventions should be specifically included in assessments.

4.9 *Improve data generation and analysis related to environmental and health impacts*

A major constraint to the sustainability of agricultural water development is the lack of site-specific data and long-term monitoring; pre-requisites for informed decision-making. For this reason measures to significantly improve data generation and analysis related to environmental and health impacts should be encouraged (e.g., coordination of existing data collection efforts between sectors and/or establishment of meta-databases). Ideally monitoring strategies would be mandatory in all projects and governments and donors must provide adequate funding to enable this.

4.10 *Develop innovative ways for financing environmental and health measures*

The cost of effective environmental and health measures is often very high and must usually be borne by the organization responsible for the irrigation development. The most common mechanism for financing these measures is to incorporate the costs into the capital financial package of the project. The costs that are most readily incorporated into the capital costs are those that occur once (e.g., construction of fish ladders in dams). Financing on-going obligations, such as environmental and health monitoring, is more difficult. Whilst it is sometimes appropriate for beneficiaries to

cover these, in many cases it is not. For this reason donors and governments ought to investigate innovative ways of financing recurring costs, such as trust funds²⁶.

4.11 *Develop innovative approaches to ensure compliance with environmental and health requirements*

Incorporating environmental protection and health measures into irrigation projects is made difficult by the failure of many project operators to fulfill voluntary and mandatory obligations. Innovative approaches to encourage compliance ought to be investigated. Options could include: a) the use of performance bonds, supported by financial guarantees and expressed in wellbeing-related outcomes and not just agricultural yields and water use efficiency; b) implementation of a sector-specific environmental management system, perhaps constructed around that developed by the International Standards Organization (ISO); c) development of an ethical code for large-scale irrigation projects to ensure that environmental and health concerns are adequately addressed.

Agricultural water projects for which it is impractical to conduct full environmental and health assessment

4.12 *Increase local-level awareness of environmental and health issues*

Governments and donors should support campaigns of health awareness carried out by community health teams and training programs that, in collaboration with community groups (e.g., farmers associations, agricultural water user associations, water committees and women groups), increase

²⁶ Trust funds have been suggested as a possible mechanism for financing the mitigation of the environmental impacts caused by large dams (Bizer 2000). A project-specific trust could be established at the outset of a project (by the project financier) with the condition that funds are used specifically for environmental and health management, including monitoring. The approach could incorporate annual contributions from the scheme owners/beneficiaries as well as other organizations (e.g., governments or donors), with the environment and health program funded from the proceeds of the trust.

awareness of potential environmental hazards and approaches to mitigation. Information on practical ways to maximize health benefits should be provided, as well as outlining potential hazards and approaches to mitigate negative impacts.

4.13 Develop “user-friendly” methods of rapid appraisal for evaluating small-scale projects

Donor and government funded programs that promote small-scale development (e.g., the community driven development program of the World Bank), should conduct program-specific environmental and health assessments. These should assess the potential impacts of the micro-projects to be financed under the program and the possible cumulative impacts of scaling-up. They should set the context for lower-level assessments and, based on the priorities for attention, simple checklists, intended for use by small local organizations and communities, should be developed to evaluate the impacts for individual micro-projects.

4.14 Ensure programs that promote small-scale agricultural water development are embedded within rural development programs

Governments and donors should ensure that programs promoting small-scale irrigation are undertaken in conjunction with broader rural development programs that include water and sanitation, as well as health components. Care must be taken that these projects are designed so that the main beneficiaries are clearly identified and the objective of improving livelihoods through irrigation remains the primary focus.

Concluding remarks

Addressing environmental and health impacts are crucial for the sustainability of future irrigation development in sub-Saharan Africa. The recommendations presented above focus on ways to improve the policies and practices pertaining to impact assessment and planning for both large and small developments. To be effective the recommendations require a coordinated

effort and long-term commitment from both governments and donors. If implemented they will contribute to better awareness of the linkages between environmental and health impacts and improve the sustainability of irrigation development in sub-Saharan Africa.

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