Approaches to Assess Health Impacts of Small Reservoirs

When small reservoirs are planned and constructed in Africa, it is not unusual for formal environmental or health impact assessments to be neglected (McCartney *et al.* 2007). But small reservoirs can have very significant local impacts on public health—impacts that conventional planning and design processes are unlikely to predict. When clusters of reservoirs are built, their cumulative impacts can be even more difficult to anticipate. Each small reservoir has its own unique set of impacts that needs to be addressed.

To understand the health effects of a reservoir in the context of local agroecosystems and agricultural and water management practices, there is no substitute for local participatory health impact assessment. Only in this way, through

on-the-ground integrated assessment, can locally manageable solutions be identified and implemented. Findings from participatory health impact assessments can be quickly used to make suitable adjustments in reservoir management. By combining subjective perceptions with scientific data, participatory processes can identify locally relevant suggestions for improved reservoir operation and maintenance, as well as improved management of the wider environment. Assuming there are no major conflicts, participatory processes can enhance ownership and accelerate implementation of health risk mitigation measures.

This article discusses guidelines to reduce health risks and increase health benefits from small reservoirs, for planners, designers, builders, managers and users of these small, multipurpose reservoirs. These guidelines specifically focus on

- Major water-related diseases associated with small reservoirs in Africa
- The added value of community participation in health impact assessment
- Opportunities to mitigate risks and improve human health through better planning and operation of small reservoirs at local and cluster levels
- Improved planning of a larger number of small reservoirs and design and management options for individual small dams

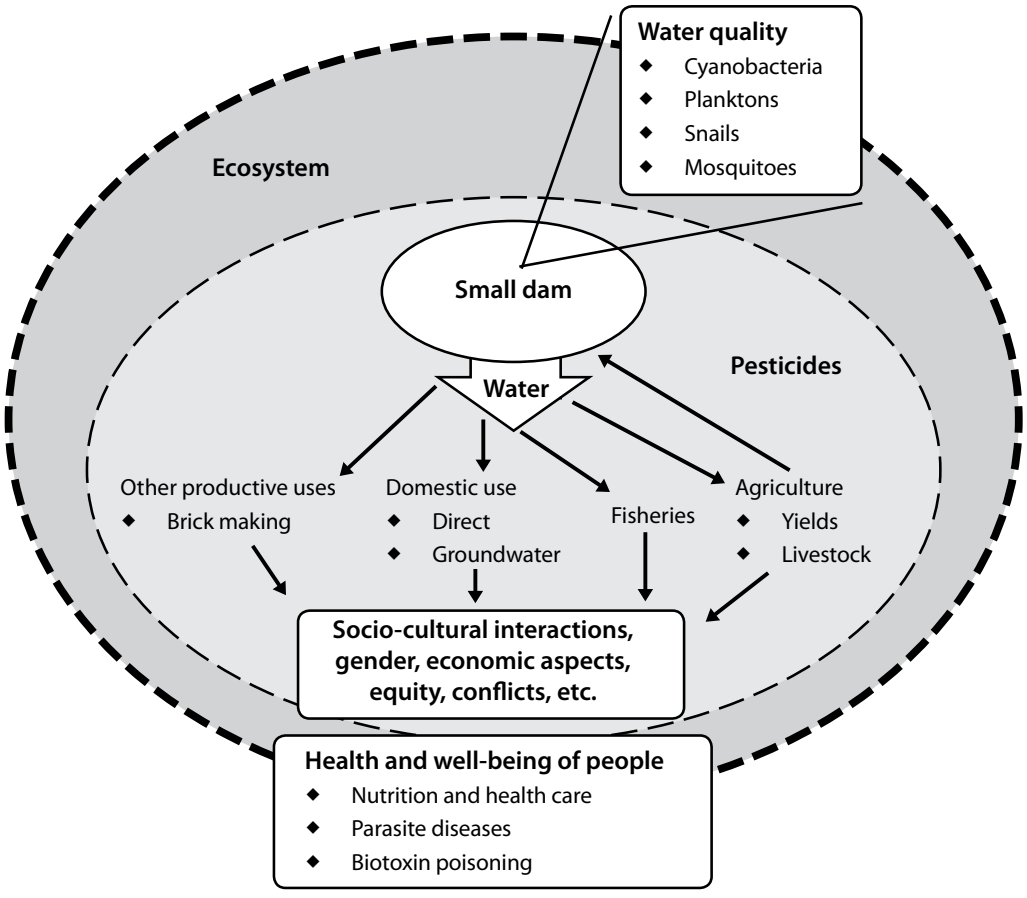


Figure 1. Conceptual model of inter-relations between small reservoirs and human health, to be used in participatory health impact assessments. Several of the aspects mentioned are addressed in other tools.

Throughout the process, various rounds of community feedback are used to clarify issues, formulate hypotheses, test recommendations and ensure that the assessment maintains a focus on the right priorities. Although steps are described as being sequential, they may sometimes overlap. Some of the methods used in different steps can take quite some time to complete.

In the final phase of intervention analysis, participatory tools are again applied. The entire process, including preparation, team building and meetings, can take as long as a year or even longer if seasonal variation needs to be captured.

Step One: Scoping

Secondary data

Secondary data from government and NGO archives can help focus research, by enabling researchers to take account of current prevalence and past incidence of different diseases. Key informants can provide complementary insights. The data to be collected are typically limited by their availability and accessibility. Data collection may also be unconsciously restricted by the interest and focus of the team. It is important to be aware of this bias and be open to other health issues that the community may bring up during the participatory steps in the approach.

In northern Ethiopia, the shading of larval breeding sites with reeds and fruit trees was one of the few malaria control measures available to communities during a period when health services were restricted because of a border conflict (Yohannes *et al.* 2005).

Stakeholders and resource people

Different stakeholders within the research team, as well as within the community, must make up the interdisciplinary team that includes professionals from the agricultural and water sectors, as well as from the health sector. Health professionals will benefit from interactions with water and agriculture professionals. In many cases, solutions to community health concerns lie outside the health sector.

Local communities, civil society representatives (NGOs and CBOs), researchers, local and regional health authorities and local development authorities all have to be involved in this investigation. A more inclusive framework typically leads to a greater sense of stakeholder ownership and increased sustainability of beneficial impacts on livelihoods from small dams. An important activity in initial stakeholder workshops is the identification of indicators (see Step Four: Synthesis).

Health issues

Many health issues can be related to small reservoirs. The impacts of a small reservoir are of an entirely different magnitude than those of a large dam or of a collection of smaller dams in the same watershed or basin. Often, the presence of new bodies of water influences peoples' mobility and, consequently, the human reservoir of pathogens. People moving into an area may bring pathogens and start a new transmission cycle. People previously unexposed to waterborne or water-related diseases (e.g., pastoralists or seasonal laborers from highland areas) may be drawn to the water, increasing their own risk of disease, in addition to raising the risk factor for others.

Assessing health benefits from small reservoirs is harder than assessing their hazards. Measurement

of positive impacts usually requires longitudinal studies that compare "with" vs "without" and "before" vs "after" the implementation of a small dam. Numerous variables need to be considered, but since this kind of information is not always available, the focus may be put on overall community indicators, using experiences from clinical, socioeconomic and environmental surveys carried out in Africa.

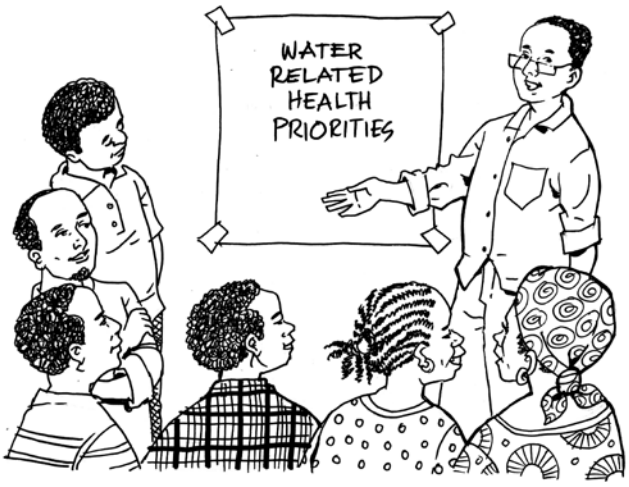
While all aspects of human health might be considered in participatory approaches, a closer focus is needed for biomedical studies: one to three key diseases should be selected. The choice of these depends on the local context, including factors such as the importance of the disease, its relation to water management and available data or expertise.

Closely related to the transmission of water-related diseases is the ecology of the small reservoir with its related environment, including upstream catchments and streams, drains and canals, and fields and seepage areas. In this integrated approach to health, the entire ecosystem is considered but water quality remains an important interface between people and pathogens. Depending on the local context, it may be necessary to do more in-depth analysis of water quality for biological indicators such as *Cryptosporidium* and fecal coliform bacteria (see Step Three: Measurements).

Step Two: Participatory Assessment

Selecting from available tools

A wealth of literature is available on participatory rapid appraisals (PRA) as well as on health impact



assessments. A good review of the literature on participatory approaches, and the merits and risks associated with different methods, is provided by Da Silva (2006). Utzinger (2004) published a similar overview for health impact assessment. Of particular interest are methods involving participatory village transects, focus group discussions, and various ways to map the health impacts of small reservoirs.

An advantage of using participatory tools is that the community shares the responsibility for identifying and solving water-related health problems. A disadvantage is that trained facilitators are needed, who can guide disciplinary professionals into a new process of listening to local perceptions.

Step Three: Measurements

Any study or assessment that looks at human health needs to speak the health sector language. Planners and managers who wish to be taken seriously in their attempts to address water-related public health issues need to collaborate with health care professionals. In many places in Africa and Asia, health information is not readily available and some primary data collection is needed. The

Epidemiology:

Depending on the key diseases that are selected, standard biomedical methodologies are available to determine infection rates. For schistosomiasis and other intestinal parasites, urine and stool samples are collected and analyzed. Normally, this is done for children under 14 years of age (often between 5 and 10 years of age) because they can easily be sampled at school. For malaria, blood smears are taken from finger pricks. If anemia is also studied, as a health outcome and indicator of heavy or chronic parasite burdens, a few drops of blood can be collected in micro-tubes for determination of hemoglobin levels.

When blood samples are collected from the children, ethical clearance is required. Usually this has to be requested from the Ministry of Health. In all parasitological surveys, it is important to provide treatment for infected people, usually free of charge and according to national or WHO guidelines. For example, in the case of urinary or intestinal schistosomiasis, praziquantel has to be given at 40 mg/kg of body weight. Albendazole is the proper treatment for soil-transmitted helminth infections, with doses dependent on species according to the World Health Organization (WHO Expert Committee 2002). For malaria, the most recent local protocols need to be followed because of fast-developing resistance.

Ecology–Vector Studies:

Around selected communities or schools, different types of water bodies (e.g. reservoirs, canals, drains, seepage areas, pits and rain puddles) are identified and mapped. After the first inventory, a sample of water bodies is monitored monthly for mosquito larvae and snails. Sampling for *Anopheles* larvae is done with standard dippers (350 mm), with the number of dips depending on the size of the site (Amerasinghe *et al.* 2001). Snails are sampled quantitatively using a drag scoop in deep water bodies, whereas in shallow habitats, quadrates are sampled, depending on the surface and morphological variation of the sites. Adult mosquitoes can be captured in various ways: for example, by indoor and outdoor spray catches, netting sweeps of the vegetation, human or animal bait catches or light traps. The latter methodology is standardized and the most widely accepted. In the epidemiology of schistosomiasis, in addition to snail sampling, the observation of water-use patterns is also important because this disease is contracted through water contact. Often popular water-use sites combine organic pollution with high snail densities, thus creating ideal circumstances for transmission (Boelee and Madsen 2006).

Ecology–Water Quality:

Users of small reservoirs often have concerns about water quality, sometimes because of observed water pollution and sometimes because of widespread symptoms of disease in the community. In these cases, a selection of chemical and biological water quality measurements should be done, depending on available information and perceptions. Usually national institutes have the expertise to carry out all kinds of water quality assessments.

Source: www.smallreservoirs.org

participatory assessment conducted in step two will have narrowed the health focus and pointed at opportunities for improvement, so that more expensive biomedical studies can be well targeted.

The studies described in this section use more standard approaches, yielding the hard data required by health professionals to diagnose health care issues and to suggest interventions. It may also be necessary to collect primary information on changes in water availability and water consumption. Methods for doing this are described as separate tools.

Step Four: Synthesis

Triangulation

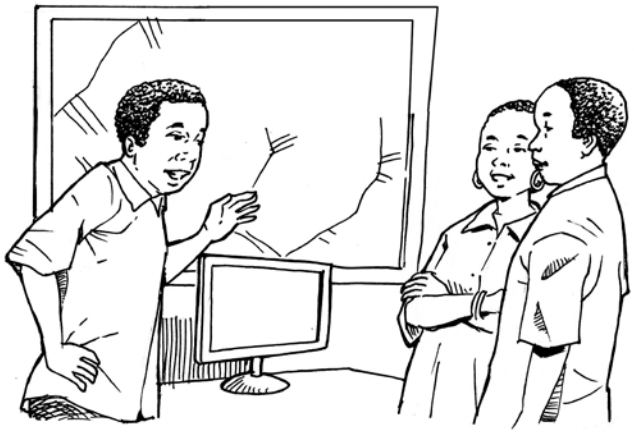
In the approach described in this tool, qualitative and quantitative measures are combined with participatory methods, reflecting the transformative potential of participatory health impact assessment in terms of knowledge and practices. Triangulation is used to cross-check the validity of tools and ensure the validity of results.

In discussions with the community and local experts at the beginning of the study, specific health, water quality and performance indicators were identified. These may be later complemented by standard, well-tested scientific indicators. Some of the information collected by various methodologies are best collected in a time series. It is important to align the substudies as much as possible so that data can be compared over space and time. Indicator definitions should be compatible with the literature and the field experience of those involved. Some indicators should be used in ongoing community-managed monitoring and evaluation of small reservoir health impacts.

Indicators (also available as a separate tool)
http://www.smallreservoirs.org/full/toolkit/docs/111%2009%20Indicators_MLA.pdf

Mapping

Existing topographic or agricultural maps, remote sensing imagery, and community-drawn maps can be entered into a single geographic information system (GIS) file. Where possible, indicators and their values (whether from secondary or primary data sources) should be geo-referenced and entered into the GIS file. GIS can help explore the possible relationships between health and water indicators, and potential explanatory factors, such as, altitude, vegetation, topography and distance from water sources. It may be possible to combine this into a formal model. Some caution should be used, however: formal modeling can be time-consuming and can lead to spurious accuracy. Model results are only as reliable as the least reliable information that is used as an input. In addition, skilled staff and adequate computing power to run models are sometimes lacking. On their own, maps can be very powerful in providing insights to local communities and decision-makers. Chambers (2006) has written a good evaluation of the combined use of community mapping and GIS.



Feedback

After the initial participatory phase, feedback sessions with the community should be conducted at each step in the assessment (Ait Lhaj and Laamrani 2007), even, for example, to present findings from the biomedical surveys. GIS maps with perceived and measured information from various disciplines are suitable for feedback sessions with communities and other stakeholders. These sessions offer interesting opportunities for early-stage brainstorming on possible interventions (mitigating measures). The authors have good experience with this in Morocco (Boelee and Laamrani 2004) and elsewhere (Laamrani *et al.* 2001).

Step Five: From Analysis to Implementation

In recent years, the authors have used the above steps in small reservoirs in Morocco, Burkina Faso

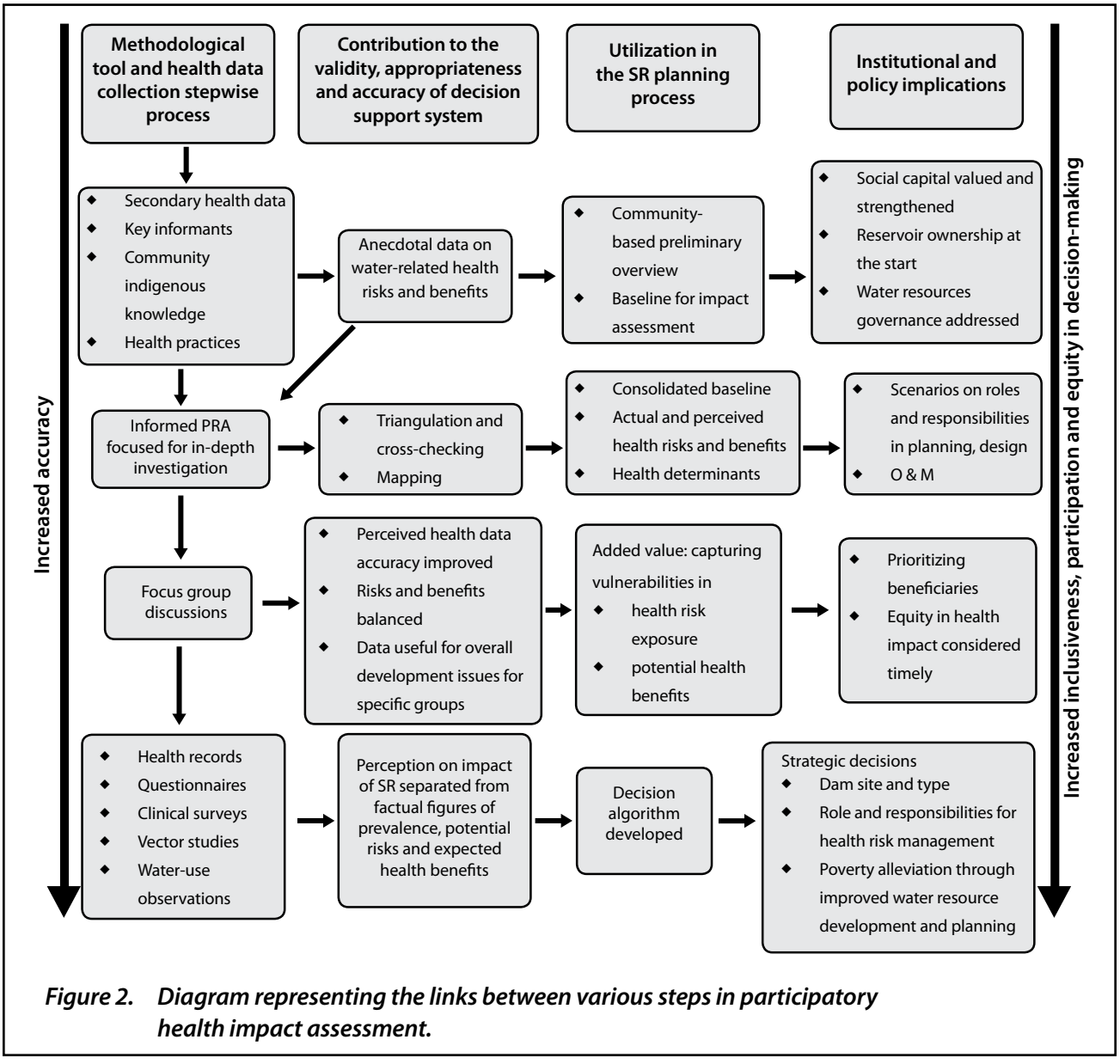


Figure 2. Diagram representing the links between various steps in participatory health impact assessment.

and Ethiopia. The most salient finding was that the methodology used in each location was dictated by local circumstances, for example, different sets of parasites, kinds of partners and political processes and relationships. The data that were collected were somewhat different in each case, and recommendations for improving the planning, design and operation of small reservoirs were different as well.

Lessons learned

- Small community reservoirs do not operate with the aid of clear policy guidance and support that is given to large dams. Hence, planning, construction, operation, and maintenance of small reservoirs do not have the same level of institutional, technical, and financial backup from government agencies. This can lead to water-related health risks, such as disease transmission. At the same time, development interventions capable of mitigating these health risks may be overlooked.

- Despite the lack of formal evaluation, according to community members across these varied agro-ecological, socioeconomic, and institutional conditions, the perceived overall health impacts of small reservoirs are positive. Generally "with and without" or "before and after" analysis based on recall of reliable informants, tends to be supportive of small reservoirs. That does not mean, of course, that their performance cannot be improved, or that water-related health risks cannot be mitigated. The approach to participatory health impact assessment combines multiple information sources (retrospective medical data, current health issues both perceived and measured, and prospective risks associated with changes in socio-ecological systems resulting from the introduction of small reservoirs) in order to better understand how benefits generated by small reservoirs can be optimized. Many interventions to improve benefits can be implemented by the communities themselves. Behavioral changes in hygiene, prophylaxis, and health seeking behavior are all dependent on awareness and require adequate health information. In as much as generic messages are not likely to lead to sustainable outcomes, the health information should be adapted to

the setting, with site-specific messages related to the use and management of the small reservoirs.

- In terms of tools, there are tradeoffs with regard to available resources (both financial and time) and the accuracy, quality, and validity of the data collected. The tools used in this participatory health impact assessment have no special intrinsic value. Their value is in the way they are combined and used: mixing complementary quantitative tools (measurements) with qualitative tools, such as participatory methods, leads to a more in-depth understanding of the health issues than using only one approach in isolation.

- A combination of mapping, questionnaires and focus group discussions can produce consistent health data that can be cross-checked against clinical data records. Moreover, the combination of these tools can even shed light on community health concerns and priorities as part of overall strategies for community development.

- Stakeholders need to think about and work on small reservoirs as a cross-cutting issue that touches all sectors of rural development, including water, agriculture, environment, livestock, animal health, education and infrastructure. They should make harmonized interventions with properly coordinated tasks. For instance, site selection for the construction of dams has a technical component that requires expertise external to the community. But water allocation, use and infrastructure maintenance are all community issues that should be based upon the existing social capital. The devolution of power to local stakeholders may result in better decisions being made.

Limitations of the tool

The participatory health impact assessment proposed here should not be perceived as a stand-alone exercise. It is part of the multi-faceted small reservoirs toolkit (www.smallreservoirs.org) for better planning, implementation and management. It provides a different perspective from those offered by hydrology, remote sensing assessment, aquifer recharge and water quality risk assessment, Water Evaluation and Planning (WEAP), socioeconomics, aquatic ecosystem health and pollution/eutrophication. We believe that this approach is inclusive and provides a good entry point for community engagement in assessing benefits, risks, mitigation measures, and community preparedness.

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Key Reference

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Tags: PN46; Small Multi-purpose Reservoir Planning

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