

The safe use of greywater and excreta in agriculture requires adopting an appropriate planning approach at both the national level and the individual project level, with health as a first priority. Planning strategies, including communication with different groups of stakeholders, have been dealt with in chapter 10. The present chapter describes other planning and implementation issues, partly adapted to the local level.

### 11.1 Adopting an appropriate planning approach

Planning and development of sanitation programmes have been comprehensively addressed elsewhere (see, for example, WSSCC, 2005). This information can be used as a basis for the creation of new programmes. The planning of sanitary systems aimed to use excreta and greywater should take account of certain specific considerations responding to the needs of a safe use-oriented approach:

- *Integrate aspects of safe use in the assessment of the current sanitary situation and in all the planning activities and conceptual work:* When planning systems to safely use excreta and greywater, a broader spectrum of issues has to be considered. These include the assessment of the current agricultural situation, the type of crops cultivated and prevalent agricultural practices. These relate to the water and fertilizer needs, agricultural equipment and irrigation practices. The quality of the irrigation water used relates to the relative risks of contamination as well as livestock production, practices concerning the treatment and use of manure and current and traditional practices of fertilization and soil conservation. Productivity, costs and benefits, farmers' and consumers' perceptions of the use of artificial fertilizer, manure, treated wastewater, greywater and human excreta as well as other aspects should also be considered. In addition to traditional agriculture, excreta and greywater can be and have been applied as fertilizers in areas such as forestry, aquaculture (see Volume 3 of the Guidelines) and market gardening or for energy production.
- *Integrate aspects related to water supply:* As the source separation of excreta and greywater may reduce the amount of treated fresh water used in homes (e.g. to transport excreta in waterborne systems), water supply systems can often be reviewed and modified.
- *Integrate aspects of urban planning:* As excreta and greywater should be used as close to the source as possible to minimize transport requirements, coordination with urban planners may be required (e.g. in order to provide space for the integration of a constructed wetland in an urban park, to support urban agriculture or to provide small-scale service providers with an area for the treatment and storage of excreta in the neighbourhood).
- *Integrate aspects of solid waste management:* The collection, transport, treatment and use of, for example, composted or dehydrated faeces may be carried out as part of a solid waste management programme. In many countries, those responsible for solid waste management have a long experience with organizing the collection and use systems, as well as marketing know-how.
- *Consider a much wider variety of sanitation systems:* A wide array of technical and operational solutions supporting the use of excreta and greywater are available (see chapter 5). Planners may consider a range of different options for the local circumstances. From the users' perspective, the

ability to choose between different effective technology options to fit their household and budgetary needs is vital. Planners should consider the corresponding institutional and management arrangements needed for different excreta and greywater use options.

- *Apply new and wider-ranging decision-making and evaluation criteria for water supply and sanitation services:* Excreta and greywater use systems highlight the widened boundaries of sanitation systems (integrating aspects of agriculture, energy production, nutrition and public health). Traditionally used evaluation criteria (e.g. the limiting parameters for discharge into receiving water bodies) are insufficient to evaluate different sanitation options. Decision-making criteria should support the choice of sustainable systems and include consideration of resource conservation, health impact, economic, environmental and social aspects and the technical functionality of the system.
- *Provide stakeholders with the relevant information, enabling them to make an “informed choice”:* The range of possibilities to recover and safely use excreta and greywater is often unknown to most stakeholders (including decision-makers), which limits their ability to make an informed choice of a sanitary system and its components. Suitable information and awareness raising are therefore needed.

In addition, it is valuable to:

- integrate educational, institutional and capacity-building aspects into planning instruments;
- focus on the assessment of the needs of the user of the sanitation, the end users of the treated excreta and greywater and the service providers;
- consider smaller planning units and a greater number of decentralized options.

To successfully integrate the additional considerations of safe use-oriented sanitation systems, an appropriate approach to the planning processes must be adopted. A sound basis for such an approach can be found in the Bellagio Principles (Box 11.1), drawn up by the Environmental Sanitation Working Group of the Water Supply and Sanitation Collaborative Council (WSSCC) and endorsed by the Council during its 5th Global Forum in November 2000 in Iguazu, Brazil. The principles call for a change of conventional sanitation policies and practices worldwide (WSSCC/EAWAG/SANDEC, 2000).

The WSSCC (WSSCC/EAWAG/SANDEC, 2004) has published an implementation guide for the Bellagio Principles, promoting a household-centred environmental sanitation approach with two main components:

- 1) The focal point of environmental sanitation planning should be the household, reversing the customary order of centralized top-down planning. The users of the services should have a deciding voice in their design, and sanitation issues should be dealt with as close as possible to the site where they occur. With the household as the key stakeholder, women are provided with a strong voice in the planning process, and the government’s role changes from that of provider to that of enabler.
- 2) A circular system of resource management should be used, emphasizing the conservation, recycling and reuse of resources, in contrast to the current linear sanitation service system.

**Box 11.1 The Bellagio Principles**

1) Human dignity, quality of life and environmental security at the household level should be at the centre of the new approach, which should be responsive and accountable to needs and demands in the local and national setting;

- Solutions should be tailored to the full spectrum of social, economic, health and environmental concerns;
- The household and community environment should be protected;
- The economic opportunities of waste recovery and use should be harnessed.

2) In line with good governance principles, decision-making should involve participation of all stakeholders, especially the consumers and providers of services;

- Decision-making at all levels should be based on informed choices;
- Incentives for provision and consumption of services and facilities should be consistent with the overall goal and objective;
- Rights of consumer and providers should be balanced by responsibilities to the wider human community and environment.

3) Waste should be considered a resource, and its management should be holistic and form part of integrated water resources, nutrient flow and waste management;

- Inputs should be reduced so as to promote efficiency and water and environmental security;
- Exports of waste should be minimized to promote efficiency and reduce the spread of pollution;
- Wastewater should be recycled and added to the water budget.

4) The domain in which environmental sanitation problems are resolved should be kept to the minimum practical size (household, community, town, district, catchment, city) and wastes diluted as little as possible;

- Waste should be managed as close as possible to the source;
- Water should be minimally used to transport waste;
- Additional technologies for waste sanitization and reuse should be developed.

## **11.2 Local project planning: specific considerations**

Individual project planning requires consideration of different issues, including the involvement of stakeholders through the use of participatory approaches, treatment, crop restriction, waste application, human exposure control, costs, technical aspects, support services and training.

### **11.2.1 Participatory approaches**

Effective sanitation and hygiene programmes need to combine interventions to change behaviour with the selection of the right technology. Changing behaviour requires culturally sensitive and appropriate health education. People need to understand, in terms meaningful to their lifestyles and existing belief systems, why better health depends on the adoption of hygienic practices such as hand washing, the use of sanitation systems for the safe management of excreta and greywater, and safe storage and handling of drinking-water and food. Raising awareness about the importance of sanitation and hygiene may increase motivation to change harmful behaviours. Selecting the right sanitation technology is about having effective alternatives and making the right choice for the specific circumstances.

Making the right choice of technology requires an assessment of the costs (both for building the facility and for operation and maintenance) and its effectiveness in a specific setting. Participatory approaches such as Self-esteem, Associative strengths, Resourcefulness, Action-planning, and Responsibility (SARAR) and its focused application Participatory Hygiene and Sanitation Transformation (PHAST) have been effective in increasing sanitation coverage and good hygiene behaviours. SARAR has

**Box 11.2 SARAR programme achievements in Mexico**

Since its inception in 2003, the TepozEco Municipal Ecological Sanitation Project has used SARAR participatory tools to involve community groups in deepening their understanding of their environment and to develop strategies for improving water and sanitation services. TepozEco has worked closely with a local youth group in the periurban community of San Juan Tlacotenco. Members of this group have been trained as sanitation promoters and facilitators of the community decision-making process. In San Juan, the SARAR tools have been particularly valuable as a way to explore community perceptions of their problems and needs and to maintain the focus of decision-making within the community itself. For example:

- An adaptation of the extremely versatile *three-pile sorting* activity was used to involve the community in analysing and prioritizing various public services: not surprisingly, water and sanitation were at the top of the list.
- In a subsequent session, the *sanitation ladder* permitted the community to identify and compare the range of basic sanitation technologies available to them and to decide which options would be most appropriate given the particular local context (severe seasonal water shortages; absence of a central sewage system now and for the longer term; moderate to low income; need for inexpensive fertilizer for local crops; and a concern to avoid contamination of local streams at the top of the watershed).
- A *community mapping* exercise, the *story-with-a-gap* and a set of hygiene behaviour *sorting cards* helped the community to identify critical interventions, including greywater and solid waste management.

Sarar Transformación SC, responsible for coordinating the TepozEco, together with El Taller, a partner nongovernmental organization, have produced an Ecological Sanitation Educational Tool Kit, to facilitate the replication of the process in other programmes. The package includes a set of participatory materials as well as illustrated *technical guides* to provide information to the community in a timely and easily assimilated format with the aim to achieve better hygiene and sanitation behaviour as well as make use of accessible fertilizers in a safe way.

Source: Sarar Transformación SC, Mexico, 2005 (R. Sawyer, personal communication)

been used successfully as a core tool to start sanitation programmes in places as diverse as Mongolia, Kyrgyzstan, Mozambique, South Africa and El Salvador. Box 11.2 gives some examples of how SARAR tools have been used within the context of the TepozEco Municipal Ecological Sanitation Project in Tepoztlán, Mexico.

**11.2.2 Treatment**

The different characteristics of specific treatments available (see chapter 5) allow choices regarding the use of nutrients and soil conditioners from excreta or of water from greywater.

When excreta from many small sources are used, verification monitoring and assessment of the treatment efficiency of all the sources are impossible. Secondary off-site treatment is then an informed choice, especially in cities. The collection, treatment and reuse of the excreta can provide economic incentives to small entrepreneurs. In rural areas, however, farmers who have used raw excreta for years may not be easily persuaded to treat it. This should be dealt with by health educators and extension officers.

Whatever method is used for health protection when using excreta or greywater, its implementation is likely to demand a change in behaviour by a large number of individual users, which needs to be part of a sensitization process. One motivating factor might be the greater convenience and privacy of an in-house toilet, the waste from which can be treated, compared with open defecation.

### **11.2.3 Crop restriction**

Crop restriction is relatively simple to implement where the treated excreta and greywater are used by a small number of large organizations, whether they are private firms, cooperatives, state farms or the municipal authority itself. However, the enforcement of crop restrictions on a large number of smaller farmers can be much more difficult. The products most likely to be excluded, such as vegetables for direct human consumption, are among those that would give higher cash yields than waste use to produce animal feed. Crop restriction is not impossible in such circumstances; it is most likely to succeed where local dietary habits limit the demand for uncooked vegetables and where there are profitable alternative crops for which a market exists.

In some countries, the existing planning structures and procedures allow a firm control of all produce grown, with regular inspection of farms and sanctions against those who deviate from agreed arrangements. Such mechanisms can be used at little extra cost to ensure that produce restrictions are followed.

If there is no local experience of the application of crop restrictions, their feasibility should be tested in a trial area before they are implemented on a wide scale. Such a trial will also give an initial estimate of the resources required for enforcement, as well as clarifying the most suitable institutional arrangements for the implementation of restrictions.

Enforcement may not always be as easy as might at first appear. Although a crop may take months to grow and can be inspected throughout this time, the excreta and greywater may need to be applied for only a few days each month, and this can be concealed, even from vigilant inspectors.

### **11.2.4 Application**

The Agriculture Extension Service or the organization of Farmer Field Schools may be in the best position to promote hygienic practices relating to the application of excreta and greywater in agriculture/horticulture. Where a municipal body controls the source of treated excreta or faecal sludge, it may be able to encourage application before harvest periods by making it available only at certain times of the year. As stated in chapter 4, a withholding time should always apply, in addition to on-site/off-site treatment. Alternatively, the agency controlling distribution of the excreta or greywater may itself assume responsibility for the application of the treated products and charge for this service. The workers handling the excreta would then be the employees of a single entity, which would facilitate exposure control measures among them.

Source separation of urine and faeces may facilitate the application of excreta to a large degree, although if large amounts of nutrients are needed, the urine volume to be transported may prove impractical.

### **11.2.5 Human exposure control**

Measures to reduce exposure to pathogens associated with water and sanitation and to promote good case management are well known components of primary health care. They include health education, particularly regarding domestic hygiene.

An obvious measure is to provide access to safe drinking-water and adequate sanitation. Controlling the exposure of users of excreta may have little effect if they continue to be exposed to infectious agents in their drinking-water and in their domestic environment through lack of these basic facilities. Particular care is required to ensure that the use of excreta or greywater does not cause contamination of nearby wells or other sources of drinking-water.

Where salaried workers are involved, their employers have a responsibility to protect them from exposure to pathogens, which in many countries is set down in existing legislation on occupational health. This may need to be brought to the employers' attention, together with guidance on the measures they should take, such as the issuing of protective clothing, particularly footwear and gloves, although these may not be comfortable in a tropical climate. Any effort to promote the issuing of protective clothing by employers must be accompanied by still greater efforts to convince their employees that they must wear it.

Measures to control the exposure of those who handle the produce can be implemented in much the same way as for farm workers. When produce handlers all work for a small number of employers, exposure control fits into a general programme of occupational health. On the other hand, when a large number of small traders are involved in selling or processing the produce, it will be difficult to implement exposure control measures unless they are all gathered together in a market. Most markets are subject to public health inspection, and basic exposure control measures may be a good thing, whether or not crops produced using wastes are being handled. In addition to protecting produce handlers from contamination, they may help to protect safe produce from becoming contaminated by the handlers. Markets are also good places to advise consumers about the hygienic precautions they should take with the food they purchase.

Residents who are not involved in the use of excreta or greywater are best placed to ensure that their health is not put at risk by those who are, once it has been explained to them what precautions are required and what risks they and their families may run if the precautions are not taken. Of course, a government inspector can ensure that fences are built and warning signs put up, but vigilant neighbours will be the first to notice when they need repair or replacement. The establishment of a residents' health committee can be a focus for a health education campaign, as well as providing a locally controlled institution to monitor the practice of waste use. The treatment and operational guidelines will in most instances safeguard the use.

With respect to intestinal helminth infections, treatment of farm workers, their families and other exposed groups through chemotherapy is relatively easy to administer in a formal programme, although additional health personnel may be required to treat a large population. It can be quite popular and provides an excellent opportunity for follow-up with hygiene education activities to publicize simple measures for personal protection. The employers may pay the cost of chemotherapy where salaried workers or sharecroppers work the fields.

If untreated excreta and greywater are used on many small and scattered fields, there are greater logistic problems. An additional problem arises where the excreta or greywater are used informally or illegally.

### ***11.2.6 Costs***

The choice of a sanitation and safe use system should also consider the overall costs — both the initial expense of the technology but also the ongoing costs of operation and maintenance. If the cost of those technologies chosen for implementation is likely to exceed the economic benefit of using the wastes, it is important to consider whether less expensive measures might suffice or whether it is worthwhile to use the wastes at all. In most cases, the benefits are likely to justify the costs, but some financial arrangement is needed to ensure that the costs are met from a suitable source. These aspects have been considered in chapter 8.

### 11.2.7 Technical aspects

Detailed planning for excreta and greywater use schemes should follow the usual national procedures for project planning, supplemented as necessary by the requirements of external funding agencies and by procedures specific to the nature of the project (excreta and/or greywater use and for the required health protection measures).

All relevant information needs to be collected to allow for decisions on the technical specifications of a new scheme. A checklist of these specifications is presented in Box 11.3.

#### Box 11.3 Technical information to be included in a project plan

- Current and projected generation rates of the wastes (excreta, sludge or greywater); proportion of industrial effluents; dilution by surface water
- Existing and required waste treatment facilities; pathogen removal efficiencies; physicochemical quality
- Existing and required land areas: size, location and soil types
- Energy requirements and energy potential of excreta/greywater (and possibility to combine with other organic waste)
- Evaporation (need for make-up water)
- Conveyance of treated wastes (collection of treated excreta and sludge by farmers or delivery by treatment authority)
- Storage requirements for the wastes
- Waste application rates and methods
- Types of crops and their requirements for waste quality and supplementary nutrients
- Estimated yields of crops per hectare per year
- Strategy for health protection

For each scheme, the planner should seek to maximize the net annual benefit in a manner consistent with labour constraints and the need to protect health and minimize costs. For this, cost estimates are valuable for the various activities, including major construction works for storage, treatment or transport of wastes, land preparation and necessary infrastructure, and also for staffing, treatment, pumping and maintenance as well as other inputs.

An assessment of the benefits requires a forecast not only of the probable yields of the crops grown but also of their anticipated prices. This, in turn, demands a survey to establish that an adequate market exists for the produce. This is particularly important where produce restriction is to be employed as a health protection measure and where the produce to be grown requires industrial processing; in the latter case, sufficient processing capacity must be available.

Projects for the use of treated excreta and faecal sludge are not static; they take time to be implemented and thereafter to evolve and grow. The plan should allow reasonable time scales for all its aspects: to obtain funding, to execute any necessary construction works and to prepare the ground for the scheme to begin. From then on, it should envisage the configuration of the project in each year of its future existence. For some projects, a long-term planning horizon will be needed.

A modest start is often advisable, followed by a phased expansion of the project in subsequent years. This will allow time to train farmers and staff in new methods and for lessons learnt in the early stages to influence later developments. It will also help to ensure that the level of production does not over-reach the current availability of excreta as fertilizers or the demand for the produce grown.

### **11.2.8 Support services**

Various support services to farmers are particularly relevant to the implementation of health protection measures, and detailed consideration should be given to them at the planning stage in larger schemes. They include the following:

- machinery (sales and servicing, or hire);
- supplementary fertilizers or feed, pumps, nets, protective clothing, etc.;
- extension and training;
- marketing services, especially where new crops are introduced or new land brought into productive use;
- primary health care, possibly including regular health checks for workers and their families.

### **11.2.9 Training**

Training requirements must be carefully evaluated at the planning stage, and often it may be necessary to start training programmes before the project begins.

The likely need for extension services must be assessed and provisions made for them to be available to producers after implementation of the project. Extension officers themselves will need training in the methods appropriate to health protection, as will the staff responsible for enforcing sanitary regulations regarding, among other things, produce restriction, occupational health and food hygiene.

Such training requirements are best met by local technical colleges and universities, but many countries may lack the specific expertise needed; overseas training may then be the only alternative in the short term until sufficient in-country experience is developed. This is an area in which cooperation between neighbouring countries can be especially fruitful.