Reuse of sewage in agriculture and aquaculture

The reuse of wastes in agriculture and aquaculture is a sensitive subject and may be taboo in many cultures. Great care must be taken when introducing these techniques into areas where wastewater and excreta have not traditionally been used, to ensure that crops grown using human wastes as irrigation or fertilizer are acceptable to the consumers.

Health aspects

There are some problems with the reuse of sewage for fertilizing and irrigating crops :

- Risk to health from germs in wastewater, which may contaminate the food and spread disease.
- Risk to health, particularly to field workers, from helminths (worms) and nematodes in sewage.
- Risk to health from chemical contaminants in wastewater, generally only in urban areas where factory wastes are discharged into the sewerage system.
- Some chemicals can be taken up by plants. The chemicals stay in the plant and are eaten by humans in the food produced.

Quality guidelines for the reuse of sewage

There are set guideline quality standards for effluent and excreta used in agriculture and aquaculture. Effluent which is used to irrigate trees, industrial and fodder crops, fruit trees and pasture should have less than one viable nematode egg per litre. Effluent used for the irrigation of food crops, sports fields and public parks should have less than one viable nematode egg per litre and less than 1000 faecal coliforms per 100 millilitres.

Excreta and excreta-derived products (such as wastewater sludges, composts and latrine contents) which are applied to the field prior to crop planting do not have to meet quality guidelines provided that :

- Wastes are placed in a trench and covered with at least 25 centimetres of soil.

- Farm and sanitation workers are adequately protected during this process.

- Root crops are not planted directly over the trenches.

Where waste products are applied as a topsoil dressing, as in the case of composts, or are applied to the soil after planting, for instance as liquid sludge, the same quality standards should be observed as for effluent used to irrigate food crops. Thus there should be less than one nematode egg per litre or kilogram (wet weight) and less than 1000 faecal coliforms per 100 millilitres or 100 grams (wet weight).

Excreta and wastewater used in aquaculture should have less than 10 000 faecal coliforms per 100 millilitres or 100 grams, and zero trematode eggs per litre or kilogram.

Recommendations for the reuse of sewage

Where households use non-sewered sanitation, the reuse of excreta is relatively straightforward. The sullage, *which should not contain any faeces or urine*, but only water used for personal hygiene, clothes washing and domestic cleaning, can be used directly for irrigation of food crops on a small scale. Where on-site systems exist for the safe storage of excreta, for example twin pit latrines (of whatever type) or composing latrines, excreta can be used as a fertilizer. Excreta should be left for at least two years before use in order for the germs and worm eggs to die. Using the excreta too early represents a major health risk to people emptying the pit, to people working in the fields and to consumers.

Where sewered sanitation systems are used, the sewage should not be used for irrigation or fertilization of food crops until it has been passed through a treatment plant, either a conventional sewage treatment plant or a lagoon system. In general, well managed lagoons give better quality final water than conventional sewage treatment. In order to remove helminths adequately, a retention time of 11 days in the lagoons is required. Depending on the temperature, twice as long is required to meet the bacterial guideline. It is important to improve quality control of the effluent water from both conventional and lagoon treatment plants to ensure the highest standard possible for wastewater which is to be used to irrigate food crops and sludge for fertilizer.

Use of disinfectants or other chemical treatments of wastewater to reduce the level of germs is not recommended, even in emergencies, as this type of treatment is expensive, rarely effective and could have a negative impact on the environment.

Where wastewater is used for irrigation or fertilization of food crops, the foods which present the greatest risk to health are fruit and vegetables which grow close to the soil, such as lettuce, strawberries and tomatoes, and which are eaten without peeling or cooking. If fresh fruit and vegetables are stored or in transit for at least 10 days under normal temperatures and humidities, the risk to health is low, but local health requirements should be complied with, for instance washing with chlorinated water before sale.

When irrigating using treated wastewater, the most appropriate method of water application should be used. Subsurface irrigation provides the greatest degree of health protection and efficiency, but is expensive and requires a high level of water treatment to prevent clogging of the emitters through which water is supplied. Bubbler irrigation avoids the need for emitters. Sprinkler irrigation should not be used when the bacteriological quality is not ensured, except on fodder crops and pasture. Under these conditions, flood (border) irrigation should not be used for vegetables. Furrow irrigation often provides the best method of water application, as it is more efficient than flood irrigation, and often sprinkler irrigation, but is less expensive than trickle or subsurface techniques.

Local residents should be fully informed of the location of all fields where human wastes are applied, so that they and their children may avoid them. There is no evidence that local residents are at significant risk from sprinkler irrigation, but sprinklers should not be used within 50-100 metres of houses or roads.

Fish which are bred in ponds using human wastes should be kept in clean water for at least two weeks before harvest to remove objectionable odours and reduce contamination with faecal bacteria. This will not, however, completely remove pathogens from the fish tissues and digestive tract unless contamination is very slight.

Freshening of products

In many areas, fruit and vegetables are often soaked in water on the way to market to make them look more attractive. It is common to see this done in a river or stream. This practice is not recommended, as many rivers and streams have wastewaters discharged into them, which may contain faeces and urine. Market areas should, wherever possible, provide clean, disinfected water and facilities for freshening produce brought for sale, in order to discourage the use of local rivers and streams.

Health education

When properly treated and applied, the use of wastewater and excreta in agriculture and aquaculture can be of great benefit to the farmer by increasing yields and the area cultivated. There is a health risk, however, to consumers, to people collecting the waste for reuse and to those working in the fields. Where the reuse of waste is practised, an education programme should be established to tell people about the risks and show them how to store and use wastes safely.

In conjunction with an education programme dealing with waste reuse, hygiene education should encourage good food hygiene and preparation in the home. This could greatly decrease the incidence of disease within communities.