A measure of Australia's chronic shortage of water and low soil fertility is the repeated demand for more dams and irrigation and for the payment of a phosphate bounty. Yet we squander vast quantities of both water and mineral nutrients (including phosphates) by our wasteful disposal of sewage. Instead of forward planning for the long-term use of an available agricultural asset, we follow the short-term, politically expedient policy of easy disposal of sewage. This frequently results in excessive growth of unwanted plants in and around the water into which the waste is discharged.

Possibly, our coastal cities are not suitably situated for agricultural use of sewage because piping and treatment areas are very expensive in these zones. In an area of usually moderate rainfall, such as Gosford, even the recycling of nutrients from sewage would leave more residual clean water than the district can use. It is ironic that this district has suffered lately from severe water restrictions! In these places fuel (possibly methane generation) seems a more reasonable use of sewage. However, in the country west of the Dividing Range, the volume of sewage, the level of the land and the usually low output of industrial waste make agricultural usage relatively simple. The supply seems inexhaustible and almost unaffected by drought. To see the end of water shortages, such as have been in evidence in some areas in 1978-81, would be most welcome in these districts. Installation, not replacment, would be the main cost.

Preliminary treatment can make sewage suitable for fertilising pasture, as has been the practice for many years at Werribee Sewage Farm, Victoria, and for less times in other areas (Strom 1979). Extensive landscape watering using chlorinated secondary (partially treated) effluent is reported by Cooper et al (1974), while in the Broken Hill district the use of a secondary effluent has been outstandingly successful in establishing vegetation cover on mining spoil dumps (Harris & Leigh 1976). Sewage effluent can also help produce fine crops such as lucerne and timber. Its use in growing vegetable crops in South Australia is reported by Cooper et al (1974). The possible transmission of pathogenic organisms suggests that it is wise not to grow salad-use crops without special safeguards, but most of our inland area is not, in any case, used for such crops. No health problems have arisen so far in West Australia, where spray irrigation, using secondary sewage effluent, has been applied (Strom 1979). Overseas the use of sewage sludge to fill open-cut areas of mines has led to the production of good crops of corn and other plants. Sludge can also be pelletized and sold as a slow-release organic fertiliser (Calderi 1979).

As has already been pointed out, not only are we wasting sewage, we are damaging our water supplies by its disposal. We have rivers and lakes, and construct dams and irrigation channels; yet all too often we find these waterways less useful and attractive because of the heavy growth of floating (planktonic) or clogging (filamentous) algae or vascular plants (macrophytes) growing either at the edge of, on, or in, the water. The disadvantages of this can range from stock poisoning due to toxic algae, to the blocking of irrigation pipes or channels, or even of previously navigable rivers. Mostly our treatment is to kill the unwanted plants with herbicides or, in some cases, to remove chemically the mineral nutrients the plants need for growth.

These plants grow to excess because of the stimulation of the growth caused by the addition of nutrients to an environment which is in any case favourable to plant growth. The surplus nutrients are largely the result of man's activity. We disturb the soil, allowing run-off to add nutrients to the drainage system; we discharge sewage effluent, and raise large numbers of stock, as well as fertilizing the soil for our crops, and the drainage from these activities flows into our waterways.

Is it not possible to guard against further unnecessary nutrients entering the waterways? Besides using the sewage effluents we could take care to keep heavy concentrations of stock (and their waste products) and fertilisers away from waterways and also to leave untouched verges adjacent to all open water, thus allowing the soil to act as a filter for nutrients in the run-off. Also, we should be much more careful to ensure that fertiliser from aerial spraying does not enter flowing or storage waters. McCuen (1980) describes the use of a water trap basin which reduces the levels of pollutants in the inflow to receiving streams. This can trap as much as 98% of the pollutants in the inflow and certainly...
decreases pollution in the main waterway. Surely we should consider employing this technique in Australia.

As well as trying to prevent excessive nutrient reaching our waters, what can we do to remove that which is already in the water, or available in the sediment beneath it? Any removal of biota by harvesting diminishes such nutrients and should be encouraged. Algae grown in nutrient-rich water have proved satisfactory as food for cattle, sheep, pigs and poultry, since these plants have a high protein, mineral and vitamin content. Caldwell-Connell (1976) speaks of the nutrient value of such algae being comparable with that of soybean meal. Usually, collecting planktonic algae (e.g., by centrifuging) has been too expensive to balance its use as stock food or for soil improvement. Lately, however, cheaper methods have been invented, using rollers (Caldwell-Connell 1976). These studies should be followed up.

Overseas it has proved worthwhile to crop reed-like plants and use them for soil enrichment; these plants are usually applied to the field and then burnt (Weir 1976). Even the nuisance water-hyacinth has proved of some value, provided transport is not needed, since it has a high water content and therefore unwanted weight.

Any harvesting of biota removes nutrient. A possible means of having volunteer labour to remove this biota would be by stocking with suitable fish, which would in turn be gladly cropped by fishermen. Are we chasing all possible avenues to find suitable fish? Most, if not all, our native fish are high protein eaters, not herbivores. Should not we be examining the possibility of establishing a fish which could stimulate anglers to remove excessive nutrients from our waterways?

India and many eastern countries have, for a long time, made extensive use of fish grown in high nutrient ponds. Some fish (Moriarty & Moriarty 1973) are even known to ingest mainly a blue-green alga (Anacystis = Nodularia) which forms highly undesirable blooms in Australia. In America considerable research has been carried out concerning herbivorous fish (Chinese grass carp for macrophytes and silver carp for floating algae) which have been suggested as useful in controlling excessive plant growth. Research has included trials using sterile or non-reproducing fish to prevent the risk of introduced species becoming pests (although trials of the sterile male technique to control Victoria's European carp population have had little success). Any potential ill effects on aquatic ecosystems of the introduction of exotic fish would need to be examined very carefully before any action could be taken; thus avoiding a repetition of the problems of the rabbit, fox, European carp and water-hyacinth.

Surely it is time we tried to protect our, admittedly, inadequate water supplies.

REFERENCES:


Dammed area of the upper Parramatta River near Sydney choked with the floating aquatic fern *Salvinia molesta*.

The same area after spraying with herbicide to remove the weed.