



## Sustainable Waste-Water Management Policy

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All over India, despite massive investments, conventional waste-water treatment has largely failed. The cost of leading waste-water via Under-Ground Drainage (UGD) to centralized plants is prohibitive. UGD maintenance is rarely budgeted for, very very expensive, and disruptive of roads. Centralised plants are highly capital intensive and energy-intensive and regularly bypass their equipment because they cannot pay their huge electricity bills, or cannot cope with daily and unscheduled power cuts or power fluctuations which disrupt biological processes by turning aerobic ponds into anaerobic ones.

Worse still these unsuitable centralized solutions, mostly the results of massive external "aid", impose a needless and unwanted cost burden on the urban population in the form of hugely increased water user charges required to repay these "soft" loans. These are imposed, as at Mangalore, even when civic experts have proposed technically sound low-cost alternative solutions.

So India needs to evolve its own set of criteria and policies for natural, low-cost, low-maintenance, fail-safe waste-water treatment systems. The first requirement is for policy-makers and international funding agencies to recognize that for countries like India, sustainable alternatives to UGD and centralised sewage treatment are not only possible but desirable.

There is a natural hierarchy options, beginning with waste minimization at source, followed by treatment options that follow the flow of waste-water along its natural course and minimise its polluting effects at every stage:

### 1. On-Site Waste-water Minimization:

About 80% of fresh water consumed goes out as waste-water, and 80% of this is sullage or gray water (from bathing and washing) which is easily re-used for gardening. That means ONLY 16% of incoming fresh water ends up as sewage that really needs treatment to remove odours and germs! The low cost of treating such small volumes can be easily spread among the various units in an apartment or commercial complex.

Many cities have begun to pass legislation requiring new apartment buildings to provide for on-site treatment and reuse of grey water. Enforcement is spotty and needs

to be improved. Compliance can be encouraged by a rebate in property taxes for those who comply, and penalties for new building which do not. The cost of such rebates would be a fraction of the cost needed to transport and effectively treat this water at a centralized location.

### 2. Decentralised Natural Treatment:

This has three advantages.

It saves the enormous cost of underground drainage, which is about 80% of the overall cost of waste-water treatment facilities.

It makes treated water available close to where it is needed and easily usable. It reduces the load of sewage that the city's existing UGD has to carry and that the existing facilities have to treat.

The easiest, most successful and attractive way to find scarce space for this is to use the area of the storm-drain itself for improving waste-water quality, while providing recreational use of the space with tremendous savings in annual desilting costs and effort. Pune's 5 "Nala Baghs" are superb examples of linear urban garden-ribbons within a storm-drain, treating highly seasonal volumes of polluted water at little additional cost. These beautiful recreation spaces achieve this through creative design: a series of settling ponds, meandering beds of water-tolerant plants for biological treatment, aeration of the water through large or tiny water-falls, winding channels or turbulent flow, and sprinklers that use this odourfree nutrient-rich water for gardening. Pune's Ambiloda Garden, 1.5 km long and treating 10-12 mld impure water, easily recovers its garden-maintenance costs through nominal entry fees. A Power Point CD illustrating all these examples are available from the author on request.

Funding of such projects in prestigious downtown areas such as Gwalior's central Son Rekha canal, once an important inland waterway is easy. Firms would sponsor sections of the necessary fencing and garden development in return for external advertising rights on their respective fence panels for a fixed term.

Economic incentives and encouragement should be given to companies now purchasing raw water, if they instead treat and use sewage from nearby open storm-drains, as is done by a recycled-paper mill in Bangalore.

The Water-Supply Boards' reluctance to permit this for fear of losing their high-priced water revenues is an extremely short-sighted approach and against the broader interest of urban residents, their environment and the nation.

### 3. Duckweed Aquaculture:

Duckweed aquaculture is an option for perennially flowing waste-water. Cuttack has pioneered this technology in its sewage treatment plant, and can profitably expand the concept to its 15 + 17 km long major storm-drains through the city. This is ideal for similar cities where high water tables make septic tanks unviable.

### 4. Lakeside gardens for water cleanup:

Pimpri-Chinchwad Municipal Corporation near Pune has successfully cleaned up a stinking quarry by channeling incoming effluent to canna-beds and similar plants, whose roots, covered with pollution-eating microbes, act as fixed-film bio-reactors. A popular lakeside garden further purifies and consumes incoming waste-water, making the lake suitable for boating now. A jogging track and garden around another of their dying lakes is a cost-effective and socially useful way to exclude and utilize non-point pollution entering the lake.

### 5. Desilting polluted lakes by floating gardens:

It is even possible to desilt and deepen a lake, naturally, while cleaning it up, using the simple "Lake Restorer"<sup>TM</sup> technology of Ocean Arks, Vermont. This is an attractive artificial floating island, like the natural mats of dense vegetation that typically extend outward from shoreline wetlands and break off during storms. As the water gets deeper, these roots no longer reach the bottom, so they use the oxygen in their root mass for buoyancy. This makes the area beneath these floating mats, and the Lake Restorer, exceptionally rich in aquatic biota.

An "airlift" pipe connected to an on-shore compressor sends ultra-fine air-bubbles up past hanging roots to oxygenate the biodegrading microbes that are anchored there. The "airlift" creates a gentle current that lifts lake-bottom sludge up past the roots and enclosed floating media to provide food for microbes that consume the organic sludge. A Lake Restorer has reduced nitrogen levels at the 15 acre Flax Pond in Massachusetts, USA which continuously receives runoff from an old landfill. It has also reduced 50,000 cubic meters of sludge here in 7 years, which would otherwise have needed expensive excavation and polluted a nearby area with dumping of this silt. (Lake Restorers are also planned for a lake in Hawaii, a canal in China, and for

treating 1.3 mgd chicken-processing waste-water in USA). Compare this with the Rs, 4-6 crore estimate for one-time desilting of Bangalore's Ulsoor lake, with no guarantee of preventing fresh build-up of bottom sludges.

At Dal Lake in Kashmir, the "floating garden" farmers regularly use their "piyach" weed, whose long roots go down 5-6 feet to the lake bottom and a further 2-3 feet into the mud, to create new floating gardens. Combining these floating gardens with an airlift and Ocean Arks' design inputs, could provide the means to both clean the Dal Lake of pollutants and to slowly and naturally deepen it, with minimum disruption of the local economy.

### 6. Natural cleaning of seasonal stream-beds:

Deep water-bodies stay healthy. Shallow water-bodies die. If low-flow summer waters can be deepened to a self-cleaning depth of at least 1.5 to 2 meters, they can function like the oxidation ponds constructed in sewage treatment plants, where sunlight for a sufficient length of time helps the water become cleaner.

An ideal opportunity for such treatment is at Kanpur, where the River Ganges has shifted from its course alongside the town's many temples, to a distant parallel channel. Now 100 mld of filthy city water from Kanpur's Sisamau drain is the main summer flow in this former riverbed, polluting the Ganges 5 km downstream. This entire 50-meter wide and sandy bed can be converted to a vastly-adequate series of oxidation ponds, by bunding the bed to give the required 1-1.5 meter depth all along its length in small drops. No "land" as such would need to be consumed for this purpose. As unlined ponds, they would support fish life and the rural economy and restore the natural ecology of the stream. With a potential residence times of 2-5 five days, these seasonal oxidation ponds would discharge cleaner much cleaner water into the Ganges. There would be minor annual employment-generating costs for repairing the intermediate bunds with stream-bank sand after each monsoon, to raise upstream water depths to 2 meters. But there would be no need for expensive sludge-removal as from artificial oxidation-ponds, as this high-nitrogen-high-phosphorus material will be dredged and used as fertiliser by the 2000-odd river-side melon-farmers who have been cultivating this stretch since almost 200 years. This silt-application would save them fertiliser costs and also spare the Ganga from eutrophication by urea runoff (since only 20% of applied urea is absorbed by their planted crops).

The height and location of these bunds, to form a series of linked natural-oxidation ponds or natural "polishing-ponds", can be easily designed by experts

from UPJN and KJS, the State and city water boards. Though the water may not be of perfect "river-discharge" quality, the "low-flow" pollution load of the Ganga will be enormously reduced compared to the present. This sustainable solution will cost a fraction of the contemplated approach of reversing the flow of Sisamau water by pumping it at enormous capital and operating cost over a ridge to a conventional sewage treatment plant beside a now-unpolluted tributary, the Pandu.

#### **7. Sewage Farms and Silviculture:**

Grass-farms using sewage water have served India well since the 1900s. There is already intense competition among farmers everywhere to raw sewage for agriculture. If control of pathogens and odours is achieved without nutrient loss, again through oxidation ponds, this is a highly productive use of waste-water.

At Puri in Orissa, treated effluent from a seaside sewage treatment plant is prevented from running into the tourist beaches by applying it to a belt of very-closely-planted casuarina trees. Income from rotational harvesting of scaffolding-poles from these "high-rate-transpiration" plantations is expected to cover most of

the operating costs of the sewage treatment plant in future years.

#### **8. River-Protection Legislation**

There are at least 200 locations in India where river-based industries draw large volumes from the river and discharge their effluents downstream, claiming that it meets standards. Rather than waste time and effort (and increase the opportunities for corruption) through regular monitoring, it is necessary to pass beautifully self-regulating legislation which requires all river-based industries to position their water intake DOWNSTREAM of their effluent outfalls by say 2004.

Industries which claim that their effluent is of good enough quality should be required to demonstrate this by using it themselves. Even existing industries can be made to comply with such rules by a given deadline, through a simple "crossover" of their existing intake and outflow pipes, so that their intake will be downstream of their effluent outflows. Since it is easier and more cost-effective to prevent pollution rather than to treat it, what usually happens is that when such legislation is enforced, industries become zero-effluent producers instead.