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Clean Sewage;
An Opportunity to Grow.

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Information.

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Introduction.

During discussions at the Ministry of Agriculture and Irrigation I was told of the concerns that the ministry had with regard to sewage treatment works and that they either did not function, were over loaded or both; that the effluents could not or should not be used for agricultural purposes and that it was being used despite the best efforts of the Ministry.

The Forestry and Agriculture Organisation (FAO) web site has several topical comments on the same subject and gives some useful figures, as does the paper 'Wastewater Management and Reuse in the Republic of Yemen' written by Baquhaizel and Milkat (2006).

The World Bank has published several reports of interest and I have found several un-attributed documents from which I have learnt much.

There is at this point much concern regarding the growing sewage dilemma, both in the capital and across the country; but there is at least one failing treatment works in every governorate, their capitals and in some other major cities nationwide.

This concern could or should be considered an opportunity: to both develop treatment methods that continue to use the existing infrastructure, and also to develop innovative and environmentally sustainable and ecologically desirable lower cost methodologies. Clean Rivers Trust has worked with in this area for the twenty years of its existence and has been involved in many large schemes that have broken the conventional mould of sewage treatment.

Much of the necessary raw materials are to hand; sand and gravel, cement (a daily commodity with the constant urban development that is prevalent in the country, and water – at least a liquid waste that needs to be brought up to a standard of useable water quality.

This allows for a further agricultural gain; much of the agricultural land is poorly loaded and lacking of phosphate and nitrates, also organic matter. The sewage works once transformed will provide a rich supply of these three elements at no extra cost.

The issues are not as straight forward as at first sight they may appear, but the opportunity for human, natural and agricultural environments to gain all at the same time, is rare.

The Issue.

Yemen has between 10 and 16 sewage treatment works operational. The FAO state that 13 are operational sites; the Ministry of Agriculture and Irrigation says that there are at least three sewage treatment works that are not working out of a total of 16, due to old age and breakdown. The paper by Baquhaizel and Milkat names 24 sites: 5 under construction, 4 at the design stage, 5 which they were unsure of the operational status and 10 operational.

Of the ten operational sites six were stabilisation ponds, three were Imhoff tanks including one with a two stage trickle filter system. The remaining site was an activated sludge plant.

The plants’ capacities ranged from that at Aden (Al Arish) of 70,000 cubic metres per day to works at Hajjah, where there are three plants ranging in capacity between 2,428, 724 and 253 cubic metres per day. Sana’a sewage treatment works has a capacity of 50,000 cubic metres per day, though the FAO states that the 50,000 cubic metres is the volume passing through the plant and that it was designed with a capacity of only 25,000 cubic metres maximum per day.

The certainty is that much of the waste water from the sewage treatment operations in the country is not being treated to any acceptable standard to be used for agricultural purposes, which it is. The law does not regulate this area of concern at the present.

Sana’a is fortunate in having a reasonably modern activated sludge system that was installed in 2000, though it is overloaded the waste waters are reasonably straightforward to bring up to standards that would suit European regulation.

One site, as yet to be identified, has a final effluent that is contaminated with oil residues from a military armaments facility (source; Ministry of Agriculture and Irrigation) that is discharged into the sewage works’ final effluent. It appears that this arrangement was put in place so as to protect the operation of the waste water facility. This pollution should be readily controlled and waste arising could be recycled. A close examination of the site needs to be undertaken once identified.

Ibb has a plant that was designed to treat 5,000 cubic metres a day, but now is taking in over double its capacity at 12,000 cubic metres. Again, as at Sana'a the plant is of the activated sludge variety (commissioned in 1991) and would not be over troublesome; depending on the final effluent quality, to bring up to a relatively high standard.

There appears to be little detail as to final use that the sludge is put to from any of the works. The metal loadings of some of the treatment works are noted as being within World Health Organisation Guidelines. It could be that; due to the low industrial base of Yemen, these are so depressed and that the sewage sludges could, with a little work, be developed as useful soil improvers and aid high value crop development/production.

The topic of hospital waste streams is not a purely Yemeni issue; concerns are universal. It has though been shown in Europe and North America that most contaminations of sewage are similar from hospital sources to those of ordinary residential waste waters. The control of the likes of e-coli is easily achieved by the treatment methods already in place and in sunlight can be totally eradicated. The main concerns for human health are diseases such as Weil's disease (leptospirosis) which is spread by rat urine. This is a concern near water across the world. When working with all sewage-based compounds personal hygiene is a top priority.

There are questions regarding target crops that might develop bioaccumulations of metals and other contaminants: there is a need to be aware of vegetative uptake of such contaminants in the various crops grown. The longer a plant is in contact with, or the fruit is slow to develop or ripen, the higher the risk of increased contaminants loadings in that crop. [Apples are an example, as they are predisposed to accumulate arsenic from uncontaminated natural soils) in their seeds, though not in high enough quantities to pose a health risk.]

The costs of sewage treatment are high, as are the running costs, if there is a desire for perfectly treated sewage waste water. There are though some 'soft' methods which can be installed that cost substantially less than some highly engineered options. The most common being based on wetlands and include the creation of reedbeds or willow stands known as carr systems.

The Reedbed.

These are simple to put in place once the size has been determined. This is achieved by considering the volumes, contaminants and condition of waste that need to be treated.

As an indication of size, a 50,000 cubic metres per day with an inflow from primary treatment of an influent with a BOD of 300 (a normal UK loading) and with a final discharge at 30 BOD would be achieved. The footprint would need about 1,250,000 square metres or a piece of land approximately sized at 125 hectares.

The size of the wetland is large; environmentally it could be considered a major improvement in that the area. If managed it would develop as a centre for wildlife and a development in biodiversity. The basic running costs would be in the region of 10s of dollars a day and treating the sewage output of the capital, Sana'a.

The establishing of reedbeds, at altitudes, that did not act as breading grounds for malarial mosquitoes, would be seen as a move of international importance and would be certain to attract funding from the donor community.

The establishment of a wetland this size would amount to an exercise in logistics and basic landscaping, the matrix in which the plants would grow and establish themselves would be a mix of crushed rock, sand and sewage sludge moistened by the discharge water from the sewage works. A smelly, but fast procedure, which could be completed in a few weeks.

The more difficult, and time-consuming element of such a project would be the selection of vegetation that was comfortable at altitude, and was not likely to create a problem elsewhere as alien species. There are such flora: sedges, reeds, rushes and other marginal and semi-aquatic plants that grow in the region of the Arabian Peninsular, also in East Africa.

The planning of flow regimes and pathways are straight forward technical aspects that avoid stagnation or flow scour. An interesting aspect of a wetland such as envisaged is that it would not need flat ground and could be sited in a terraced landscape. Such a design would not be as simple as a level site perhaps but could be of greater ecological value.

The development of higher altitude wetlands would attract many avian species; the actual wetland could also be engineered to allow fish or other aquatic life to be farmed in parts of the site. The exit waters would be of such a nature as to be of great agricultural value.

The reedbed could then be developed as a wetland habitat that, by its size would be capable of being an eco-tourist destination in its own right. The numbers of birdwatchers visiting the Middle East to watch birds and other wildlife is growing year on year. Yemen being a major centre of avian migration between northern climates: the tropics and the southern lands of Africa.

The reedbed technologies allow for the large scheme; they are also highly adaptable. Small village and township schemes would be quite cost effective and would produce valuable irrigation feed waters for rural areas.

A small 50 cubic metre a day sewage feed would only require a footprint of about 12,050 square metres, or a 40m X 30m plot.

In Conclusion.

The issues of sewage and its treatment are normally areas of fiscal concern: design, and construction; the running costs, the perennial concerns of finding uses for the sludge and keeping discharge waste water within the bounds of consents to discharge to the natural environment. In Yemen these issues are not so much a headache but a challenge to creativity.

The agricultural lands of much of the country are in need of improvement structurally and nutritionally. The sewage works of the country have a role to play in both areas.

There need to be steps taken to identify the number and types of sewage treatment works that are extant in the country; if they function, establish the work that needs to be carried out to bring them to a good working condition. The end water quality needs to be regularly tested, so ensuring that the treatment is working. It is recognised that the majority of sites are overloaded, due to both population growth and increased water usage.

Consider the introduction of wetland treatment so that the final effluents could be a concern free source of irrigation water and nutrient for the crops. Large sites; as might be constructed to treat sewage effluent from Sana'a and Aden could be developed as outlined in the text.

Wetland construction could allow Yemen to be seen as being at the cutting edge of sustainable development with a view to developing a new biodiversity and ecological care.

There is also a possible route for putressable wastes that have no other route apart from disposal to landfill. There are no volumes as yet to be worked on.

Finally there is huge potential to make great uses for the country's sewage waste.

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