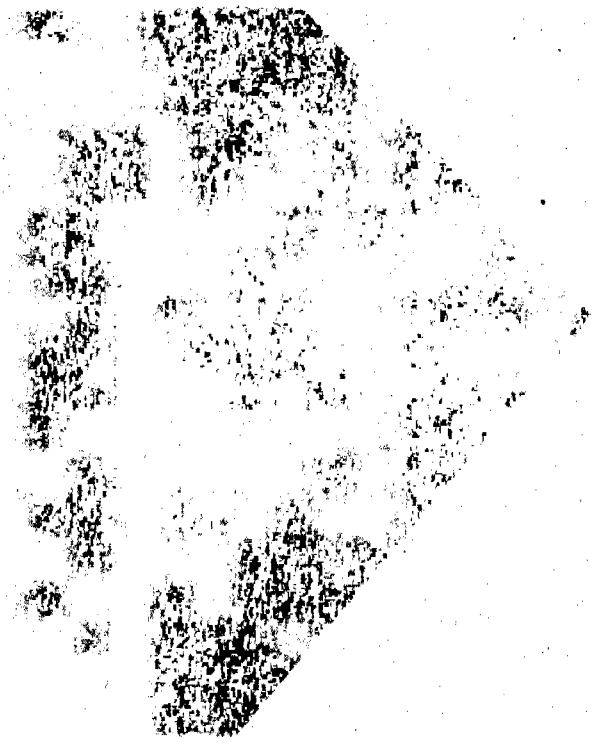
Participatory Management in Wastewater Treatment and Reuse in West Bengal



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CHAPTER 1 INTRODUCTION

Participatory management in wastewater treatment and reuse has not been tried anywhere in India in the formal sector. The reason for this can be related to the history of wastewater treatment engineering where the role of the people or their knowledge has hardly been taken into consideration. Wastewater management, the way it is understood today, emerged in response to public health considerations. The thinking was that wastewater is a pollutant and therefore should be treated accordingly. Subsequently as the concept of sustainable development became important, the component of resource recovery was introduced as a desirable achievement. Unfortunately, the task of resource recovery did not quite get along with the mainstream initiative in wastewater treatment. The reason, to be candid, is the lack of perception and attitudinal limitation of the engineers.

The significance of participatory management did not strike mainstream thinking. But in an informal way, participatory management flourished as a necessary feature in the east Calcutta wetlands. There is no other record of participatory management in wastewater treatment and reuse in this scale and as old as this anywhere in the world. This is not to say that these wetlands are an impeccable example. They are, however, an excellent tutorial for learning.

In the formal sector an opportunity for participatory management in the pond system of wastewater treatment came up under the Ganga Action Plan. This plan was designed to reduce the pollution of the river Ganga, the longest and most important river of India. The basic premise of this plan was to reduce the pollution added by municipal wastewater from the river front cities by setting up sewage treatment plants. These cities contributed about 70 per cent of the pollution load by draining their wastewater into the river. For three municipalities in West Bengal, conventional treatment plants were replaced by pond system options developed on the basis of the waste recycling practices in the east Calcutta wetlands. While designing, constructing and running these pond system projects, participatory management as a tool could only be used in fragments. This was because the prevailing framework of planning, design, construction and operation did not allow much of an opportunity to take up participatory management within its fold. Nevertheless, these three pond-system projects provide substantive lessons for adopting participatory management in wastewater treatment and reuse. The present attempt is to put these experiences in order for the future.

This paper is amongst the earliest to discuss participatory management in wastewater treatment and recycling. It has most of the weaknesses of inadequate data and analysis that were unavoidable. Yet it has a seed that can grow to completely change the fundamentals of municipal wastewater treatment. From being grant-in-aid projects, such public health facilities can be transformed into investment projects. A financial liability will become a revenue earner. Poorer parts of the world would need this transformation to materialise so that their cash strapped municipalities need not wait for multinational bank finance to give loans to construct conventional sewage treatment plants. This is why this paper is written.

CHAPTER 2 UNDERSTANDING PARTICIPATORY MANAGEMENT FOR WASTEWATER TREATMENT AND RESOURCE RECOVERY

The prevailing management of wastewater treatment and recycling is essentially an engineering programme centrally planned and laid out. It has the limited advantage of being an entirely formal and entirely safe approach for the designer. Safe because the designer is not responsible for negotiating most of the ground realities like insufficient flow, wasted resources, conflicts in sharing wastewater and problems involving interests of various stakeholders. Conventional management relies essentially upon a patron-client relationship between the planner and the beneficiaries.

Participatory management, on the other hand, becomes effective because of meaningful involvement of the people – the stakeholder groups/major beneficiaries. This is an alternative tool for making the task of wastewater treatment economically, ecologically and socially gainful. It liberates the concept of wastewater management from the confines of knowledge owned by a selected few. In participatory management the local people are no longer passive objects. On the contrary, it is they, who hold the key to effective functioning of the system.

Participatory management in wastewater treatment and recycling will be a methodology to establish a 'waste-as-resource' approach in place of the conventional 'waste-as-pollutant' projections. Here, the people will be involved throughout in the process of planning, design, construction and system management. These steps will require collection of information, concept articulation, understanding local requirements, skill and priorities and garnering political support.

CHAPTER 3 WHERE THE PEOPLE KNOW BETTER

The waste recycling practices developed and managed by the local people for many decades in the east Calcutta wetlands form the bedrock of developing the participatory management paradigm for wastewater treatment and recycling. This is essentially because it is an altogether different worldview that drives the system where wastewater is considered as a resource rather than a pollutant. Being a special kind of production process, here the most important actors are the entrepreneurs, the local self-government in the form of village panchayats, trade unions of fish farm labourers and the irrigation and drainage agency. For any degree of success achieved by this wastewater based livelihood and production process, participation of all the major actors for managing matters has been an obligatory criterion. Not that the level and degree of participation have always been satisfactory. In fact, sometimes they have been hardly desirable. But then, lessons in participatory management have been effective. What would happen if a certain decision is reached with or without the participation of one or more actors, how adversely would a failure in participation affect, and such other vital lessons emerge more easily on the basis of real life experiences of both failures and successes.

In the wetlands to the east of Calcutta wastewater is used in fisheries and agriculture covering an area of about 12000 hectares. This was mapped by the present author in 1995 while working with the State Planning Board of the government of West Bengal. The area has been described as the waste recycling region. It has three sub-regions. There are farms growing vegetables on a garbage substrate and are uniquely planned with alternate bands of garbage filled lands and channel ponds. The ponds are filled with sewage twice a year. After allowing for suitable detention time the treated sewage is used for irrigating the garbage fields for growing vegetables. In a report published on this system in 1986, the average daily production of vegetables was found to be 150 tonnes. The same ponds also grow fish fingerlings on a commercial basis. They are among the earliest sewage-fed fisheries in the world and started around the turn of the century.

The second sub-region consists of the fishponds. Wastewater from the city flows through the fishponds after being detained for a few days for the process of bio-degradation of organic components of the wastewater to take place. Organic loading rate in these fishponds appears to vary between 20 kg and 70 kg per hectare per day (in the form of biochemical oxygen demand). There is a network of channels, which supplies untreated sewage and drains out the used water. The last sub-region comprises paddy fields that use the effluent from fishponds to grow more than one crop a year. Here there are some fish ponds that do not have any access to untreated sewage and therefore use the spent water from upstream fishponds.

To a planner an alternative concept that is less capital intensive than the traditional resource recovery practice of east Calcutta and yet gives the best desired benefits is seldom available. This is particularly true when the search is for an ecologically acceptable choice. The fish pond ecosystem of east Calcutta is one of such none-too-frequent examples in environmental protection and development management that is in harmony with Nature and benefits are achieved at a much lower cost. From this we can learn, examine and adopt elsewhere. What however is more striking that how easily the complex ecological process has been adopted by

poor farmers of the wetlands of Calcutta. These natural ecologists have developed such a mastery of the resource recovery activities that they are easily growing fish at a yield rate and a production cost which are unmatched in any other freshwater fishponds of the country. It is always true that the culture of conserving a resource and using it as many times and in as many ways as possible has been seen to thrive among the poor. There is prima facie an inverse relationship between affluence and affinity with recycling. Most of the discoveries in waste reuse over which scientists in advanced countries congratulate each other are likely to have been perceived and used much before in the villages of the less developed parts of the world.

Understanding the Calcutta system of resource recovery is far from being complete. There is no reason to pretend that the theoretical guidelines for translating the experience of traditional wetland practice into a reliable technology option are foolproof. In fact, the subjective tool of a pond system option for treatment and reuse of wastewater is far more crude than conventional hard system choices. Yet from the standpoint of ecological balance, economic viability and system reliability, the former towers much above the latter in its rustic grace and is destined to shape the future grammar of sanitation technology options for tropical countries, especially the poorer ones.

CHAPTER 4 THE POND SYSTEM PROJECTS

In India, the launching of the Ganga Action Plan provided the necessary fund and opportunity to experiment with the new generation options in municipal wastewater treatment. The Ganga Action Plan has provision for resource recovery. However the basic difference between the conventional wastewater treatment plant and the proposed pond system option is that resource recovery is suggestive in the former while it is obligatory in the latter. In the latter it is an integral component of the design forming the very basis of its community linkage.

The present project is an outcome of one of the earliest effort in developing community- based technology for river sanitation. Here the conventional option in wastewater treatment has been replaced by an ecological design in which the task of reducing pollution and reusing nutrients is linked with enhancement of food security and development of livelihood of the local community using nutrient-enriched effluent in fisheries and agriculture. The actual design is based on a pragmatic manipulation of natural function within the existing framework of policy and regulatory controls.

Pond areas are calculated on the basis of widely used guidelines for designing stabilisation ponds (anaerobic, facultative and maturation). However, introducing fish culture in the admissible water area improves the efficiency of the system. This is because:

- The fish population acts as an ecological manipulator by grazing on the algal population which would have otherwise caused algal bloom and

- Apart from the good revenue that is earned by the implementing agency by giving license to use the water area for pisciculture, fish production brings adequate entrepreneurial incentive to operate the system efficiently and productively.

4.1 Basic features

Basic features of the pond system projects are:

- Environmentally sound design
- Reliability
- Decentralised management and decision making
- Resource mobilisation and enabling
- Stronger livelihood support

4.1.1 Environmentally sound design

Wastewater ponds are basically solar reactors and complete most of their biochemical reactions with the help of solar energy. Reduction of BOD (biochemical oxygen demand) takes place because of a unique phenomenon of algae-bacteria symbiosis where energy is drawn from algal photosynthesis. Therefore consumption of conventional energy is minimised.

The pond system project is a flexible one. Any sewage treatment facility is designed on the basis of a projected population (20 years projection is usual). It is natural that the design flow cannot be reached at the beginning. The flow will steadily rise to the design value in course of the projected lifespan. It has been found that conventional treatment plants suffer from non-availability of sewage and in many cases continuous recirculation of effluent wastewater becomes unavoidable rendering the facility much more energy expensive. The integrated pond system on the other hand, can work with almost a no-flow condition to a full-flow condition with uniform proficiency and minor adjustments (see figure 1).

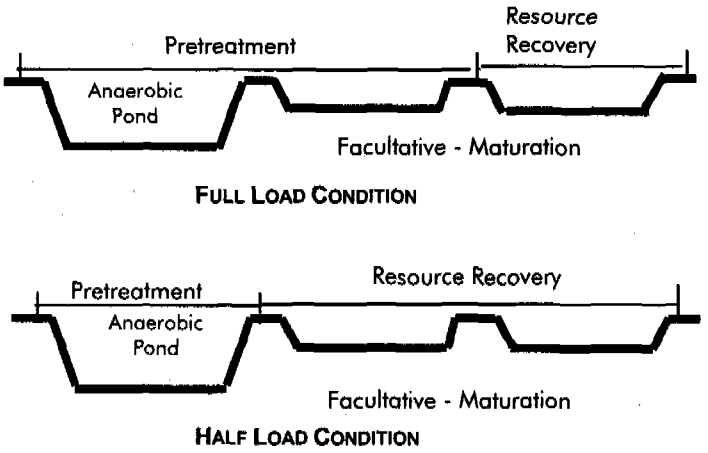

Figure 1. Pond System Projects for Wastewater Treatment and Reuse

Wastewater ponds can ensure more efficient removal of coliforms. Conventional mechanical sewage treatment plants (tricking filters or activated sludge plants) are largely inefficient in removing coliform bacteria. (Coliform is the indicator species for faecal bacteria, which are likely to be pathogenic).

4.1.2 Reliability

The pond system projects are much more reliable and have longer life span of the treatment facility. The conventional sewage treatment plants are prone to damage and frequent breakdowns. A huge financial liability accrues to the parent municipal authority to properly maintain such treatment plants. Unless continuous financial assistance can be arranged from outside no municipal body in the low-income countries can afford to run conventional mechanical sewage treatment plants. Resource recovery systems, on the other hand, are a revenue earner. For the purpose of fund allotment municipal responsibility for all practical purposes ends at the pumping station from where the wastewater flows to the pond system by gravity. Ponds are wealth generating ecosystems and proper management can not only make the system self-reliant but profitable. Furthermore, being a non-structural option, the problem of damage and breakdown hardly arises and the system can continue to work for any length of time without any major system disorder.

These projects need much less construction time. The time taken to complete of any conventional mechanical sewage treatment plant will be around five years if not more. For economies with inflationary pressure, the time taken for construction escalates the price considerably. In the present case, projects can be completed within 18 months and the impact of inflation on the total project cost is noticeably lower than that for the conventional projects.

4.1.3 Decentralised management and decision making

An outstanding feature of the pond system projects which are completed is that these institutionalise participation of the stakeholders. Agenda-21 has laid particular emphasis on institutionalising participation of the stakeholders in environment improvement projects to ensure decentralised management and decision making. For conventional mechanical sewage treatment plants such an opportunity is marginal. On the contrary, for the pond system projects, institutionalisation of local people's participation at all major levels of planning, construction and particularly maintenance is a basic need for successfully running the system. After completion of the projects, it has been possible to give the local rural authorities the responsibility of the day-to-day maintenance of the system.

4.1.4 Resource mobilisation and enabling

Resource mobilisation and enabling contributes to rural development. Integrated pond system projects have a significant role in rural resource mobilisation. Completion of the projects triggers a chain of economic activities by providing enriched irrigation water in addition to the piscicultural units, which form part of the system. In West Bengal there are examples of rejuvenated rural economy that has been achieved within a short time of completion and start-up of these projects.

4.1.5 Stronger livelihood support

The pond system option compulsorily includes pisciculture, agriculture, horticulture and animal husbandry. All these systems have a common and rich nutrient base that is drawn from municipal wastewater. Unlike in the conventional sewage treatment facility productivity of these multiple food growing systems goes a long way to render strong support towards the development of livelihood of the farmer families. The conventional sewage treatment plant is invariably considered an externality in the basic social and economic activities of a city and its fringe.

The pond system option is least expensive and is estimated to cost less than Rs 30 lakh ($100,000) per million litre of wastewater per day. This includes the cost of land. The major cost of the project is that of the land which should preferably be a low-lying area at the fringe of a municipal boundary. These lands are generally the cheapest and in most cases do not raise more than one crop per year. It is possible to engage displaced farmers in the wetland project for their continuous source of income that can even be more than the amount earned by them before the implementation of the project. In fact, choosing the pond system option will be easier for the cities with a low-lying waterlogged fringe. It is also true that cities in general grow on raised

lands and occasionally around a city's fringe there are some low-lying waterlogged areas. Dhaka, Mumbai, Jakarta, Calcutta and Bangkok are a few such cities with marshy backyards.

4.2 Conditions for good performance

On the basis of about three years experience in running the pond system projects in West Bengal it has been possible to enlist major conditions for good performance as follows:

- Ensuring steady availability of wastewater in the pond system and maintenance of required hydraulic regime
- Ensuring sufficient reduction of pollutants and appropriate cultural condition for growth of fish in the admissible water area within the constructed waterbodies of the project
- Ensuring appropriate distribution of nutrient-enriched effluent from the waste system ponds.
- Prevention of any increase of waterlogging during monsoon that may be caused by construction of pond dykes
- Obstructing natural flow of monsoon runoff
- Minimising unutilised flow of wastewater
- Increasing areas of community interface and providing for involvement of stakeholders
- Ensuring continuous and comprehensive monitoring of selected indicators for appraising the operating conditions and performance level of the pond system
- Cultivation of understanding within the local community, knowledgeable people, village leaders and other groups of stakeholders and individuals

CHAPTER 5 MEASURES FOR INITIATING COMMUNITY INVOLVEMENT AND PARTICIPATORY MANAGEMENT

Measures for initiating community involvement and participatory management are listed. These measures, understandably, exclude the first step to be taken at the policy level for making participatory approach an obligation for any wastewater treatment project. It will also have to be a policy obligation to recognise wastewater as a resource (a nutrient pool to be more precise) instead of a pollutant.

The measures are:

- Community based management
- Institutionalisation of stakeholders' participation
- Creating entrepreneurial opportunities
- Basin wide design for effluent disposal
- Participatory appraisal

5.1 Community based management

Non-performance of conventional sewage treatment plants, unlike water treatment plants, does not result in immediate community response. Neither is there any scope to provide incentive for excellence in performance. In such situations the task of plant management becomes more difficult and it is hardly surprising that satisfactory management of sewage treatment plants, especially when the work culture is not the best, has been a goal difficult to achieve.

In contrast, if the pond system fails to perform properly there may be irregularities in effluent distribution and in such cases the farmers, who are expecting the water, are sure to register their protest. On the other hand, the better the maintenance of the wastewater ponds, the more the yield of fish and resultant profit from sale in addition to other benefits that will accrue to the community.

Thus in the proposed pond system for wastewater treatment the management mechanism has undergone a complete change where non-performance is linked with community protest and good performance has an incentive in the form of increased profit.

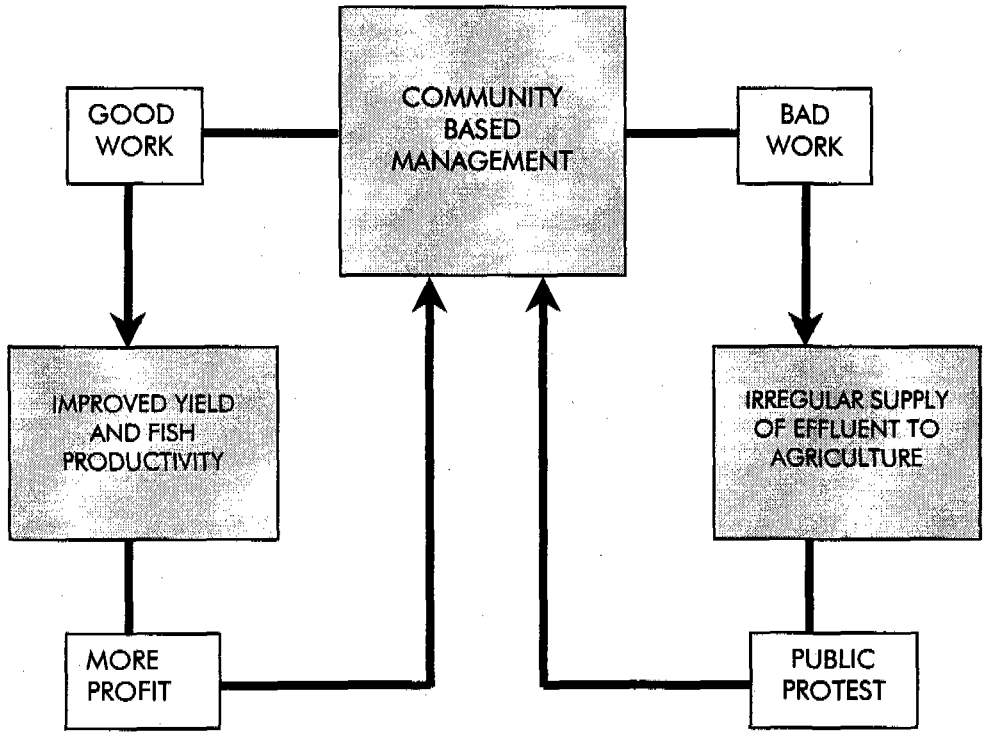

Figure 2 The influences on community based management

5.2 Institutionalisation of stakeholders' participation

One of the few areas finding repeated emphasis in Agenda-21 is the need for institutionalisation of stakeholders' participation in implementing and managing community facilities. However, not many development projects being designed these days, include this vital provision as a desired objective to be achieved.

In the community-based option discussed here, the task of institutionalisation is achievable. For example, there is a formal sharing of tasks with the local panchayat authorities in managing the pond system and distributing the nutrient-enriched effluent for irrigation.

The panchayat officials can also perform the task of identifying appropriate fish producers (individual, group or co-operative) to whom the implementing authority gives the licensing right to carry out pisciculture in the admissible water areas. The licensee in turn, pays a license fee to the implementing authority.

Major stakeholders' groups will include:
- Implementing agency
- Local self governments (village panchayats)
- Beneficiaries and other interest groups

The partnership which can be developed in implementing the wetland option will be of a networking nature rather than hierarchic. There can be involvement of all the three groups or between any two of them. For example the panchayat can levy water charges on the farmer families for reaching the nutrient enriched effluent in the field channel. Similarly, technical information regarding water quality can be obtained by the users directly from the implementing agency without any role for panchayats in-between.

As most of the components of the wetland option, the process of institutionalisation of stakeholders' participation is also dynamic in nature and with the passage of time things are likely to improve considerably in the light of the experience gained and the lessons learnt.

5.3 Creating entrepreneurial opportunities

Conventional sewage treatment plants are not designed to promote resource mobilisation. The wetland option, on the contrary, provides immediate opportunity to attract local investment and entrepreneurial interest in fisheries and agro-forestry. Again these new entrepreneurial efforts are likely to have multiplier effects on resource mobilisation as a whole. Enabling appropriate entrepreneurs has indeed been deemed to be an important feature of the pond system option and holds the key to the sustainability of the project.

5.4 Basin-wide design for effluent disposal

Sanitation engineers have never thought of collecting basin wide data in designing disposal of effluent from wastewater treatment plants. Their task has been to identify the nearest stream flow and link it with the plant outlet point through an outfall channel. This approach fails to attend to recycling needs and opportunities for effluent irrigation in agriculture. The best effluent irrigation planning should not aim at finding the shortest route for the effluent from the plant to the nearest receiving stream. On the contrary, it should find out the maximum possible area that can be irrigated by a regular source of nutrient enriched water.

Depending upon the availability of wastewater the provisional boundary of the command area using pond system effluent for irrigation purpose can be delineated. It will be wiser to have successively bigger command areas in phases according to the incremental nature of the availability of wastewater.

5.5 Participatory appraisal

The community-based projects are expected to have a positive impact on the existing resource base around the project area by providing nutrient enriched water to grow more food and plants and create auxiliary facilities. A reliable appraisal of the initial status of the resource base and livelihood of the target community will enable evaluation of the nature of changes that may subsequently take place.

For designating the initial status, reference situation studies should be carried out in the following aspects:

- Topography
- Species diversity
- Wastewater quality
- Existing farming practices
- Health and livelihood the target community

CHAPTER 6 LESSONS IN COMMUNITY INVOLVEMENT AND PARTICIPATORY MANAGEMENT

In the absence of any in-built provision for participatory approach it has been attempted to draw upon every available opportunity to involve the local people. The results have been mixed. Success has come in the following areas:

a) Locating the best available site
b) Gaining confidence of the village panchayats
c) Establishment of formal sharing of responsibilities with the village panchayat to run the project

The failures have been:

a) Inappropriate distribution of the pond system effluent for downstream irrigation
b) Incomplete co-ordination with the block and district level planning and administrative authorities
c) Incomplete awareness about the project among the local people leading to damaging comments by a section of them with a vested interest in the land acquired for the project

As distinguished from the new generation ecosystem conservation initiative, community-based projects still continue to be the old style sectoral development effort where engineers draw the project and local people only come to know about it. A basic change is needed in the planning concept to derive multiple social and economic benefit out of these community-based projects where the local people are active participants in decision making.

In the peri-urban ecotones, where cities meet the countryside, the development process is complex and a successful transaction has to satisfy a unique mix of both urban and rural needs and their mutuality of purpose. Pond system ecosystem for wastewater treatment and resource recovery is an initiative that satisfies most of the environmental requirements simultaneously with ecological sustainability and economic viability.

Creation and management of such symbiotic ecosystems are important to the decision makers in more than one way as they encompass almost all the vital aspects of human development needs viz. urban sanitation, livelihood development, enhancing food security, resource mobilisation and fostering self reliance. Completed projects in the Calcutta Metropolitan Area show that proper commitment and co-ordination can transform a low-lying area at the urban fringe. This is because a pond system project at the interface of a city and its countryside can improve the wastewater quality coming from the cities and recover nutrients for fisheries and agriculture.

General lessons in community involvement and participatory management of wastewater treatment and reuse will include the following:

- Low-lying areas at the urban fringe are potential locations for setting up pond system projects for municipal wastewater treatment and reuse. These projects are low cost, involve minimum

construction, are energy efficient depending primarily upon solar energy and aim at self-reliance.

- Community-based pond system projects simultaneously provide a number of basic services for creating a stable urban fringe. In addition to municipal sanitation and reducing river pollution, these also ensure enhancement of food security, livelihood development of the poorer people and creation of environmental awareness

- Community based pond system projects for wastewater treatment and reuse are more reliable and have longer life-span compared to the conventional mechanical treatment plants that are prone to damage and frequent breakdowns. Being basically a non-structural option, the items of repair and replacement involve very little cost or complications

- Pond system projects are appropriately structured for rationalising the management. Here, poor performance invokes protests from downstream users whereas improvement in performance raises the productivity in the fish ponds and the resultant profit

- For ensuring greater involvement of the local people at the various stages of planning, implementation and project management, it will be wiser to look upon pond system projects as an area development effort having multiple attributes like irrigation, pollution control, environmental awareness and resource mobilisation.

- Community based projects are flexible. They can work at a low level of wastewater loading (up to about 5 per cent of the design load) and convert such situations to the advantage of the project by increasing the water area available for pisciculture

- A major barrier to the pond system approach is that it is not compulsory to ensure resource recovery. As a result, there is no incentive for engineers and decision-makers to choose a pond system option. Selecting conventional options makes their life simpler

- Environmental engineers should be exposed to the participatory approach. This will enable them to use this tool during implementation and management of the projects. Lack of skilled workers and absence of an appropriate plan for participatory approach may create more problems than it aims to resolve

- Local practitioners in wastewater reuse in poorer parts of the world are the repositories of knowledge and their folk technology and can be suitably introduced in the national environmental programme as the best available option

CHAPTER 7 CONCLUSION

In Agenda 21 a growth pattern has been envisaged that will be environmentally sound and will ensure inter-generational equity. This is considered absolutely essential to relieve the great poverty that is deepening in the developing world. But this hope for the future of humanity is conditional on decisive political action that should now begin managing environmental resources to ensure both sustainable human progress and survival. In the proposed wetland option wastewater is considered as an environmental resource instead of the conventional technology approach of treating it as a pollutant. It clearly meets the engineering challenge of finding a growth model to ensure social welfare and a sustainable future. From the capital intensive and non-viable options of the past, the time is ripe to switch over to an ecological alternative where availability of funds need not be a constraint.

Municipal sanitation programmes in many cases are linked with multinational bank finance. It is therefore an obligation of the funding agencies to appreciate the United Nations mandate on searching for technology options to replace non-viable junkyard packages. They invariably help the vested interests at the global as well as local levels with little or no improvement in the quality of life of the common people in whose name such finance is sought and who ultimately bears the debt burden. Calcutta's resource recovery practice is a tutorial ecosystem for others and is a pointer towards the future grammar of river sanitation in the poorer countries.

Nevertheless, institutionalising community involvement and stakeholders' participation is a recent concept in project planning, design and implementation of development projects. Although it is a preferred approach to enhance ecological security it has not been found to be easily achievable. It will need deeper understanding of the kinds of interest, which bind various individual groups and market forces for finding reliable guidelines to implement a community-based approach. Immediate barriers to a community-based approach may therefore be traced from the following facts:

- Prevailing top-down approach neither has enough provision for consultation at the community level nor provides adequate scope for exchanging and infusion of community wisdom

- Top-down approach assigns specialists as the key personnel, but community based approach essentially needs facilitators. This is the kind of a perceptual change that does not easily come to the classical mindset of the development promoters

- Community based approach draws the specialists much close to the problem and makes them much more answerable to the people and at times the experiences can be difficult. This is not the usual milieu that the specialists are accustomed to

- Community based approach is not as yet appropriately developed to restrict the degree of involvement within a pragmatic domain. Theoretically the involvement can keep on extending with a definite risk of far too many views to drive at a consensus. This may lead to

new conflicts and even political overtones that might result in feeding the entire effort into futility

Community involvement at the level of planning and design can, at times, open up completely different approaches to reach the objective of the project. The existing frame of working may not always be so flexible as to negotiate such wide range of conceptual variations in project planning and design.

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