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Sanjib Sarma - India

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DIRECTORATE FOR PROGRAMME DEVELOPMENT
DIRECTORATE GENERAL OF HUMAN SETTLEMENTS
MINISTRY OF PUBLIC WORKS

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BY
SANJIB SARMA
FELLOW
HUMAN SETTLEMENT INSTITUTE
(HUDCO)
NEW DELHI

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* Sanjib Sarma

1. Introduction

Of the various elements of physical infrastructure the one which is faced with the severest problems in the developing world is sanitation. Poor levels of health attributable to diseases like cholera, dysentery, gastroenteritis and various worm infections are also directly related to defective or non-available sanitation in these countries.

In India, due to the fast expansion of the larger and metropolitan cities and because of previous neglect to the sector, it is estimated that over 115 million urban dweller s out of the total of 160 million are without effective sanitation facilities. However, with recent Government emphasis on the subject, their is a spurt in sanitation provision. Various ministries of the central government, international institutions, public sector organizations and prominent NGOs are involved in sanitation provision schemes around the country.

In this fast expanding scene new provision receives overriding attention with relatively little attention paid to already provided and aging facilities. Amongst the existing stock a number of facilities have already reached a stage of major overhaul of even renewal.

Therefore, next to the concern for new construction, maintenance of the existing stock is already commanding increasing attention and at some stage in the future will unavoidably become the major issue.

Although the ratio of existing v/s newly developed is increasing, the interest still tends to be less on operation, maintenance and other post installation issues since they are considered to be unglamours tasks.

It is the major aim here to identify these ills, to deliberate on them, to discuss hinterlying causes and to identify and design ways and means to overcome them.

2. Low Cost Sanitation

Many of the schemes referred to above deal with the field of Low Cost Sanitation. It has increasingly been realized that due to financial an other constraints, the coverage of all human settlements with conventional sanitation technologies will prove to be an impossible task at least in the forseable future. India has proved itself to be a pioneer in the global search for innovative, low cost solutions to infrastructural problems and in the field of sanitation, its development of the two-pit, pour flush latrine has become legendary. Many of these solutions are being implemented in the field.

The main factors which have led to the embracement of low cost sanitation are the following:

Cost per capita of conventional systems is far beyond reach. Operation and maintenance of conventional system is also expensive and cannot be afforded. Poor performance is apparent in most of these systems;clogging is rampant and huge maintenance backlogs are building up. Often, even if the collection of the sewage works, then the treatment is either absent or leaves much to be desired resulting in only partially treated or raw sewage being discharged into canals and water courses.

Technically speaking, problems occur when water supply is irregular and sufficient. Often it is also considered a great waste to use scarce water for the mere purpose of flushing excreta.

To understand the various issues involved in the post installation phase of these facilities it is necessary to present some basic characteristics of low cost sanitation technologies which set them apart from conventional systems.

The facilities are generally on-site. They are dispersed in nature and do not involve extensive networks. They are built of simple materials and utilize locally available materials to the greatest extent possible. There is a grater degree of involvement of the individual households and are there designed to be largely maintained by the owner. Construction details are normally quite simple but pre-supposes basic hygiene awareness on the part of the user as also basic knowledge of the technology being applied. Management of the system after installation is therefore relegated more towards monitoring and guidance rather than on daily operation and maintenance related functions on the part of the municipal body. However, authorities may be needed to make interventions every few years when complaints need to be dealt with or pit emptying operations are necessary.

Management of this process however is a truly integrated exercise taking into account user behaviour, cultural aspects and many technical and non-technical issues including the fact that the work is at the household level. Success of such schemes are much dependent on attention to these issues during the planning and provision stages. Low Cost Sanitation is further often developed in households where literacy levels may be low and sanitary practices have been imported from the countryside.

3. Post Installation Issues

The question of Post Installation Management is becoming an increasingly important issue with the rapidly growing numbers of facilities installed. Especially when one looks at the longer term perspective does one realize that the ultimate concern may be shifting from new provision to the management of the existing stock.

A number of problems are encountered when effective post installation management is sought for. Sanitation schemes are implemented by state level agencies or prominent non-government organizations. In the first case the facilities are immediately handed over to the local city/town authorities for management and upkeep. In the latter case, while the facilities are again transferred as above, the actual tasks of trouble shooting and upkeep are, for all intents and purposes, left to the NGO during the guarantee period stipulated by it. After this period, of course, aftercare functions are the responsibility

of the urban authorities. It is, however, invariably found that this extra burden on the local body has not been planned for in terms of requirements for extra finance, manpower and equipment.

Again, studies have shown that low beneficiary, hygiene awareness levels coupled with poor knowledge of the new technologies being implemented may require repeated interventions on the part of the municipal body to ensure that facilities function smoothly and the full health benefits from effective sanitation provision are derived.

The consequence of all this is the need for a major reorientation of our urban management, shifting away from overriding emphasis on the issue of new provision more towards the upkeep of assets already developed. This requires a major shift in the institutional set-up, in personnel patterns and in financing patterns.

Post installation issues embrace a far greater horizon of factor/activities than the traditional concept of mere operation and maintenance. The main objectives to be kept in mind are the ultimate objectives of better health, convenience and human well being as well as the function and upkeep of installed facilities.

If we take the example of a water supply organization, it is easy to clearly identify the various factors/activities involved in operations and maintenance.

3.1 Operation

Operation can be distinguished into technical and administrative activities. Operation should be defined as keeping the plant running and delivering the service, i.e. the purified water to the customers. If we would limit ourselves to the technical operations we could identify the handling of the pumps, filters, valves, the mixing of chemicals etc. as the various elements of operation. Sanitary engineers could add a host of other activities which are essential in the bare technical running of the intake, the purification plant, the distribution network, etc.

Operation in this sense are pretty standard and routine activities. Proper operations are absolutely essential both to the daily and to the longer term functioning of the installations. The major means for operations are proper procedures and guidelines, trained operators and plant managers.

Initial investment and the extent and cost of operations have a direct relationship; mechanization and automation could largely take over the human operations. Good design is another factor which determines extent and ease of operations. Automation and mechanization are especially important where cost of labour is high and added equipment would rapidly pay itself back.

3.2 Maintenance

Maintenance, simply stated, is the activity to keep the assets is such a condition so as to fulfil their designated functions.

Many handbooks have been written on the subject of maintenance because of its major implications of cost and because of the different interpretations that can be given to it. Proper maintenance stands in a direct relation to the need for replacement of components and parts. However maintenance also comes at a cost and there is a trade-off between maintenance cost and the ultimate replacement.

As such the concept of life cycle costing also comes in whereby the maintenance burdens during the entire predicted lifespan are related to the initial investments. As a general rule the higher the initial investment, the lower the annual maintenance requirement. Life cycle costing considers the various alternative cost patterns on a discounted basis and take into account the cost of operations as well.

Maintenance can be distinguished into daily maintenance like lubricating of equipment, exchange of air and oil filters, tires, belts etc. at regular intervals down to the major overhaul operations. Outright replacement goes beyond the concept of maintenance.

In some cases lapses in the petty daily maintenance can lead to very serious costs, such as lack of lubrication that can ruin an entire machine or the late replacement of a belt or chain so that equipment overheats, pistons and valves run out of synchronization etc.

4. HSMI Studies on Low Cost Sanitation

When dealing with low cost sanitation facilities, convention concepts of operation and maintenance must undergo a quantitative change. With the current trend of widespread use of low cost sanitation technologies, however, the whole post installation stage takes on new connotations. It was thought to be a prime importance to gain a deeper understanding of the various factors involved and a series of studies were undertaken to chart the problem field and investigate the issue in direct interaction with the actors concerned, viz. the central/state/municipal agencies, associated NGO's and the communities involved.

These studies have been conducted in five towns so far covering a number of states in India and representing a variety of socio-cultural, climatic, hydrogeological and physical conditions. Some of the major findings are discussed in this paper. The following paragraphs present the issues which came to the fore along with this researcher's comments.

5. Major Findings and Comments

5.1 Operation and Common Problems

Since large centralized plants are dispensed with and the facilities are dispersed and located in individual houses, the operation of these facilities is in the hands of the home owners. Flushing and cleaning are the main daily operations. However, if the people have not been properly instructed on the use of these latrines, a number of problems may occur. Rags, stones and other materials used for anal cleansing and other purposes may be flushed into the system with resulting clogging. In some schemes, funding is not provided for the superstructure which, it is assumed, will be constructed by the beneficiary. In

many such cases the superstructure is not - or is partly - constructed e.g. having no roof. Leaves and other wind blown matter then find their way into the system leading again to clogging. The result is that, in such cases, the new technology used immediately becomes suspect and cases are not uncommon where users destroy the pan and trap and try to return to former defecation practices.

5.2 Hygiene Awareness

If enhancing hygiene awareness is not given due importance, the expected improvement in health conditions does not come about. Examples are when the faeces of infants are not thrown into the latrine but is disposed of in nearby open spaces or when hands are not washed properly after defecation leading to propagation of disease. The problem seems small and mundane but it effectively leads to non-utilization of facilities despite their proper design and construction or health and environmental conditions not improving as expected.

5.3 Responsibility for Maintenance

Should the providing or caretaker agency then take the responsibility to rectify defects or should they be left to the users to employ small contractors for the purpose? If the former is the case, what institutional mechanism does the formal agency need to develop to guarantee continuous performance from the facilities? One solution seems to lie in granting a maintenance contact to a NGO for specified number of years. In both these cases is it planned to charge the beneficiaries for the service rendered or is it a subsidy component justifiable by the creation of a feeling of overall acceptance for the new technology by the people and enhanced health benefits? In such a case this subsidy component will have to be built into the overall project cost at the initial planning stage. Again should the job of improving awareness, related to hygiene and the technology used, be the responsibility of the provider or caretaker agency and how should associated costs be borne?

The responsibility of maintenance and petty repair of facilities generally falls on the local municipal agency. It is invariably found that future needs of staff, additional finances, equipment and revised organizational structure are not catered to in the planning stage leading to associated problems in the post installation stage.

5.4 Scavenger Liberation Schemes

Low cost sanitation schemes are more often sanctioned as conversion schemes for areas which have traditionally used dry latrines utilizing the scavengers or head-load, night soil remover. Training of the emancipated scavengers in various alternate trades like carpentry, bicycle/scooter/car repairs, masonry etc. and their re-employment in gainful occupations is built into such 'scavenger liberation schemes' which are implemented country-wide on a "whole town approach' so that scavenging is eliminated totally in towns identified under this programme. However, the training and employment of the liberated scavengers in alternate jobs is an oft neglected aspect.

5.5 Funding and Cost Recovery

Most Low Cost Sanitation schemes are financed on a part grant-part loan basis. Since the loan repayment is often not formalized in an agreement with the house holder, the payback structure is not known to the involved parties. Also the municipal body is most offer not the party that applied for the loan while it becomes its duty to realize the loan component from each household individually and repay the central/state government agency which provided it. This leads to a problematic situation where the municipality may have to organize door-to-door collection from (often) unwilling beneficiaries or enhance annual loan repayment amount. The actual implementation of either system is, at best, only partially successful and invariably hampers the repayment of the loan component by the city or state level agency which was responsible for implementation. Over a broader spectrum, since shortage of finance is a general constraint, the total number of schemes which can be financed is severely reduced.

5.6 User Education

Beneficiaries by and large belong to the economically weaker sections with corresponding low literacy levels. Since, the pre-occupation is to put facilities in place, the aspect of user education and awareness creation associated with hygiene and health related benefits is often overlooked. In such cases these "software" areas need careful attention to ensure correct use and maintenance which in turn will lead to the long-term smooth running of facilities.

5.7 Training of Municipal Staff

Municipal engineers and health officials are quite often found to have had no connection with the scheme and are therefore found to have low knowledge of the system itself and insufficient motivation to the successful upkeep of the facilities. This clearly indicates the requirement of advance training of municipal staff who will be required to spearhead any local, user-oriented programmes.

5.8 Sectoral Coordination and Beneficiary Involvement

After completion of the construction phase, the handover stage between developer and maintainer is very crucial. Caretaker agencies are often not involved in the planning, design and beneficiary identification stages. This leads to a number of post installation problems which have already been identified. Enhanced coordination between sectoral agencies, state level and local level authorities and involvement of beneficiaries along with sustained awareness creation programmes right from the planning stage will go a long way in alleviating post installation problems.

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