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Experiences in planning and implementing low cost sanitation

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Introduction

The Government of India as part of its commitment to the International Drinking Water Supply & sanitation Decade has placed a target of providing hygienic means of sanitation to 80% of its estimated urban population of 289.4 millions by 1991 at an estimated cost of Rs.3685 million. At present (1984) only about 200 towns and cities out of 3245 in the country have some partial underground sewerage. In view of the stupendous task to be undertaken to meet the decade's target it is quite apparent that some type of simple and low cost sanitation system and which can be easily converted later on to a regular sewerage system would have to be developed and adopted. The National Environmental Engineering Research Institute (NEERI), Nagpur, India while working on its sanitation projects in rural areas, had developed water seal pour flush offset pit latrines and which are found to be best suited for the purpose. The Technology Advisory Group of UNDP on confirming the feasibility (through actual trials) of adopting such latrines initiated their project No.IND/81/014 in India and requested all the State Governments to participate. NEERI has been very much associated with this project not only for giving its expertise but also in the monitoring and the evaluation of the system. Some of the experiences gained in the implementation of this programme in the country are narrated in this paper.

The new system of low cost sanitation

The sanitation system (fig.1) is of "On-site treatment and disposal type" and does not need any costly underground sewerage. The excreta of the users is collected by pour flush (2 liters of water at a time) type of pan having a shallow (20 mm) water seal and passed on into two covered pits (one at a time) constructed behind or nearby the latrine cubicle. The pits work both as septic tanks and soakage pits and are made of a capacity to last for about 2 to 3 years for the number of users at about 45 to 50 liters per capita per year in dry soils and with 50% more capacity in wet soils i.e. where ground water level rises to within one meter from ground.

A filled up pit is left out for over two years when its contents decompose and get converted into humus containing rich organic manure while most of the pathogens (if any) in the mass die on account of the long (over 2 years) storage (in the pit) under unfavourable environmental conditions. The pit is then emptied and kept ready for connecting to the latrine through the bifurcation chamber and the system works thus uninterrupted. When used carefully the system is perfectly hygienic and does not cause any nuisance from odours or insects and can be placed close to (or forming part of) residences. The gases produced in the pits during digestion of excremental matter get absorbed and arrested in the soil around and no vent pipe is required. The system can be converted into conventional sewerage system if and when required.

Factors contributing to the success of the system

Availability of water:- Experience shows that the success of implementing and working of this system depends upon a number of factors like the availability of required quantity of water, space and sites suitable for construction in different house holds, right type of materials, community participation, dedicated officials and simplified administrative and financial procedures etc. These will now be discussed.

Water is a necessity for working this system. Considering that for each use about 2 lit. of water would be required for flushing with hand the pan and also that it will have to be thoroughly cleaned once every day, a family of five may require about 30 lit. (maximum) of water per day for flushing and ablution purposes in the latrines. This quantity of water will have to be made available to the people in the town in all and especially in hot and dry seasons. The quality of water to be used for flushing need not be potable but it should be clean and clear. Since there are possibilities of ground water pollution where the system is

adopted treated piped water supply from a distant source be provided to the town at least for meeting the needs of drinking, cooking and washing of utensils (i.e. about 100 liters per day for a family of five).

Space and suitable site conditions

There should be sufficient space for accommodating the two pits and latrines cubicles in all houses. The sites chosen should not be subjected to flooding by rain/storm water. The strata under ground should again not be hard and rocky type for a depth of 5 meters. Similarly the ground water table in the area should normally be 5 meters below ground and should not rise to above $1\frac{1}{2}$ meters below ground. It would then be possible to accommodate the latrines, construct the digestion cum soakage pits without any difficulty and there would be lesser possibility of pollution of ground water through the leaching of digesting excremental matter from the pits.

In some houses apparently there may not appear sufficient space or suitable site in courtyards for accommodating a latrine cubicle with the two pits and the bifurcation chamber. A corner of the verandah in the houses can be then used to accommodate the cubicle only and the pits (fig. 2a) be kept out in the courtyard. When there is no courtyard at all, (fig. 2b) the pits may be accommodated in the adjacent verandah/room and properly covered so that its normal usage can be continued as before.

In some localities service lanes are provided for removal and transport of excreta by scavengers from existing bucket type of latrines. Such service lanes can be conveniently (fig. 2c) utilised for locating the pits. Where there is no space available at all and there are no such service lanes, pits may be located under the foot paths and some times even under (the low density traffic) roads.

Construction materials

All the construction materials and pans and traps of proper design should be available at fair price so that the construction of the system would be economically feasible. Pans and traps are to be made of special design with vertical sides and steep longitudinal bottom slope and of shallow (15 to 20 mm) water seal. These are available in different materials. Cement concrete pans and traps are found to be the cheapest (cost Rs. 40 per set)

and strongest but are heavy. These are again not smooth enough and cause sticking of the excreta and would require more water or frequent mechanical cleaning using a brush with handle. Stoneware white glazed pans and traps are heavy, brittle and costly (price per set is Rs. 125 - 150). Fiber glass reinforced plastic and PVC pans and traps coated from inside with 2 mm thick polyurethane are light and smooth but require full uniform and unyielding support from the bottom to prevent cracking and breakings due to uneven load from above. These are however, cheaper (price Rs. 90 to 120) smooth and inert due to the coating and can remain so after prolonged use.

Flexibility of design and layout of the system

Space necessary to adopt the standard layout (fig. 1) is normally available only in a few houses. The layout of the system has to be therefore varied to suit the site situations. Thus the digestion-cum soakage pits may be located to the sides or to the front (figs. 3a, b) and made even abutting to one another (with certain modifications) when very little space is available (fig. 4). At places where ground water table is high (<2m below ground), 0.6 to 0.8 m high earth embankment (fig. 5) be constructed and the latrines and the pits kept over it to ensure some distance (1.5 to 2 m) between the bottom of the pits and the (high) ground water table. Where such embankments are not possible an annular layer of fine (0.2 mm size) sand (fig. 6) $\frac{1}{2}$ meter thick is placed outside the lining of the pits, to effect filtration of the leachet before it can join the ground water from the sides the bottom of the pit of-course being sealed completely by some impervious material (i.e. cement concrete) to prevent downward percolation.

Risk of ground water pollution

So far, not much work has been done in the country on the pollution aspects of ground water due to construction of such latrines since the programme itself has been new. Some investigations were carried out about 30 years back by Bhaskaran and Subrahmanian of ICMR (Indian Council of Medical Research) at Singur in West Bengal using experimental bore hole latrines to study the horizontal distance travelled by polluting organisms. They indicated a safe distance of 8 days of travel in saturated soil below ground water between the pits and wells, when the leaching organisms got completely intercepted. The velocity of ground water flow is

very slow and depends upon the type of soil. Coarse sandy soil allows the ground water to flow fast at a velocity of 1½ to 2 meters (maximum) per day and hence a safe distance of 15 meters between latrine pits and wells is advocated. In other soils the safe distance can be suitably deduced. It is generally observed that the pollution does not travel even beyond 3 meters from the pits in clayey type of soils. Although the risk of ground water pollution from such latrines is low, it is safer to recommend and adopt such latrines at places where piped public water supply from a distant source has been provided and the community is educated/instructed not to use water from the wells in the town for drinking, cooking and washing of hands and utensils in the houses.

Use of aquaprivys

If the site where latrines are to be constructed is having ground water level or hard rock at a shallow (<1m) depth, it will be impossible to excavate the pits and arrange soakage of the water and leachets from the digesting sludge. Under such site conditions aquaprivys made of water tight masonry or RCC chambers of 120 l/capita served capacity be provided. Sludge accumulation is estimated at 30 to 40 liters per capita per year and this be removed once after 2 to 3 years to obtain safety in handling and while using the same as manure.

It will be better to construct anaerobic upflow contact filters to treat the effluent of aquaprivys so as to reduce further the BOD, pathogenic organisms and the suspended solids in it. Availability of space for construction of such filters has however been a problem in some urban localities. This filter is made of 2-3 cms size metal for a depth of 60-65 cms and the BOD loading can be kept at about ½ kg per M³ per day. The size of this filter unit thus roughly comes to about 2/3 the size of the aquaprivy. Such a filter can remove 70-75% of incoming suspended solids and BOD within a detention period of 8-10 hours and can also remove helminths and eggs of ascaris by 100%. Its effluent can be then easily discharged out into open surface drains or be absorbed in shallow soakage trenches where space and suitable strata is available for constructing these.

Simplified administrative and accounts procedures

This system involves highly scattered type

of construction activity to be undertaken in hundreds of residences having different site and space conditions so that each one becomes a separate small micro-sanitation project. Conventional procedures of giving a mass scale construction contract and its execution through licensed agencies may therefore not work and would have to be suitably modified. Similarly the accounts procedures for giving advances to petty contractors executing such work and paying their bills may have to be also adjusted to effect speedy implementation. Without such flexibilities in administrative and financial procedures it would be difficult/impossible to carry on/complete the work and within the stipulated period.

Dedicated Public Health Workers

The work of construction of such sanitary latrines has got a very important bearing upon the health of the community. Hence dedication to the cause of the community and public health rather than development or application of a high degree engineering technique (which is normally being valued more amongst the Engineering profession) will have to be the motivating force for the personnel engaged in the execution of this work.

Community and Individual Participation

The construction of this system of sanitation and its regular use later cannot be ensured without the active participation of all the landlords and their tenants in the towns. All the residents of the town where the project is to be taken up will have to be therefore first convinced of the utility of the new scheme, its advantages over the existing system and particularly its non reliance for day to day operation on scavengers.

General and health education in the community would also very much help the programme. Medical practitioners in the town should explain and publicise the new sanitation system and its effect on clean environment and better health through lecture meetings. Social workers and service clubs be got involved in promoting the acceptance of the new system.

Present situation of sanitation in the country and strategy for introducing the new system

In most of the small and medium size towns in the country (India) about 25% of the households may have 'bucket or service type'

of latrines which are cleaned once in a day by scavengers. Part (10-15% of the total) of the remaining population uses public latrines of the same type and more than half of the house-holds go out to the fields or bushes for defecation. In order to change over to the new system of sanitation, general and health education will have to be first given to the people through group meeting held in different wards. The new system of sanitation would be explained to them simultaneously and its personal/practical (to the family) and health benefits (to the society) will be emphasized.

The elected representatives of the local body and/or the leaders of the communities in the town should be simultaneously told to adopt the new system of sanitation. These new latrines water seal pour flush pit type should serve as demonstration units and will help the general public in understanding its usage and benefits and would promote its acceptance.

It may then be notified by the local authority that the scavenger service of the town is to be discontinued and the people be asked to either convert their existing latrines into the new type and/or construct latrines of new design within a stipulated period eg. two years. For such simple small and scattered type of work regular contractors may not be available and skilled workers in the town may have to be trained and enrolled as small petty contractors, and the conversion/new construction work will have to be got done through them under the supervision of the Municipal Engineers.

It is again better to start the programme at such places where site conditions are suitable and the house-holders are progressive and cooperative. The latrines constructed in these houses will be naturally used properly and maintained better so that these would work as additional demonstration units and would lead to further adoption of the system by the remaining households.

Financing of the scheme

For converting existing bucket type of latrines into the new system, the present day (April 84) cost is about Rs. 800/- in the country. Since most of the house owners

in towns would belong to the lower middle income group they could be given for conversion purpose a loan plus subsidy of that amount repayable within a period of about 10-15 years. The Municipal or local body should construct these latrines at its own cost by borrowing money in bulk from a scheduled bank or other public financing agency and (continue to) charge the same amount (ie. about Rs. 50 per annum per family) equivalent to old annual taxes for the scavenger services towards refund of the loan amount. Such a system of financing and recovery of loans has been found to be working satisfactorily. The local body should also at its own cost arrange through contractors removal of digested excremental matter from the pits after it is fully matured and dried. The manure will fetch an income of Rs. 200 biannually per family of five and would meet the service charge for alternating and emptying pits and would also help the repayment of loan charges as well by the municipality.

Summary and Conclusions

To fulfill the targets of the International Drinking Water Supply & Sanitation Decade (1981-90) low cost sanitation programmes comprising of construction of house hold pour flush water seal pit latrines have been taken up in India on a massive scale. Experience in the implementation has shown that it is better to initiate such programmes at places where sufficient water is available all the year round for hand flushing of the latrines, and space and suitable sites are also available for the construction. In congested urban localities great ingenuity is necessary to accommodate the system by making suitable modifications in the layout. Aquaprivys followed by anaerobic contact filters will prove more appropriate where the ground water strata is hard and rocky or ground water level is high. The success of the implementation programmes would also depend upon the motivation and participation of the communities for whom the work is being undertaken, deployment of dedicated technical personnel having a sense of social service, simplified administrative and accounts procedures and availability of sufficient finances on easy terms and conditions.

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