



Solid Waste Management in Manali

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MANALI IS A POPULAR hill resort of India located in state of Himachal Pradesh in north-western Himalayan region of the country. It attracts about a million tourists annually. As a result the town has a large number of hotels and floating population of the town touches a peak of about 35,000 against a fixed population of about 5000 residents during peak season.

Proper solid waste management has been a burning issue at Manali for sometime as the desecration of landscape was beginning to be noticed by large number of tourist visiting the place. Collection of waste has been a major constraint due to difficult hilly terrain. Disposal options are also limited as the land for disposal is hard to come by. Manali is a favourite summer resort for a large number of important decision makers and prominent citizens of India, including the Prime Minister, clean Manali has therefore been an issue for consideration at national level.

Government of Himachal Pradesh under a funded scheme invited the author to study the situation and formulate a solid waste management project strategy for Manali. The work therefore was undertaken in 1999 to study existing situation and develop a properly formulated action plan.

Project objectives

The project objectives were formulated by using a system engineering technique SNAC (Stakeholder Needs, Alterables and Constraints). Stakeholder analysis identified different stakeholders and their degree of influence and importance were mapped. Stakeholder needs for each category was clearly identified and project objectives were developed as below:

- To have a eco-friendly solid waste collection and disposal system
- To have socially, institutionally and financially sustainable systems
- To improve working conditions of various functional stakeholders

Waste characterisation

The physical waste characteristics of Manali waste were taken from principal author's earlier sampling work carried out in Manali during 1996-97. The physical waste characteristics are presented below in Table 1. The quick verification check was carried out by taking few samples and confirming the range of numbers developed earlier.

The characterisation outlines three separate components in the solid waste namely Ready Bio-degradables (RBD), Bio-degradables (BD) and Non-bio-degradables (NBD). The RBD fraction of waste is likely to degrade easily and is most suited to composting. The BD fraction of waste is theoretically degradable but the actual degradation under aerobic or anaerobic conditions depends on particle size and other favorable conditions etc. The NBD fraction does not degrade under any condition.

The Manali waste is clearly dominated by RBD fraction and about half of all waste is highly compostable. The NBD ranges from one-fourth to one third of total waste load and BD fraction accounts for one-fifth to one-fourth of all the wastes.

Table 1. Physical Characteristics of Solid Waste at Manali

Constituents	Percentage	Weight
Ready Bio-degradables		46-52%
Vegetables, Food and leaves etc.	46-52	
Bio-degradable		17.6-25%
Paper	10.4-17.9	
Rag/Cloth	2.8-5.1	
Wooden Matter	0.3-1.1	
Hay and Straw	1.6-2.3	
Coconut	0-1.1	
Non-Biodegradable		24.2-35.7
Plastic	5.8-12.1	
Glass	2.2-4.7	
Metal	0.2-0.7	
Crockery	< 0.6	
Coal	0-0.6	
Stone/Brick	1-3.5	
Bones	< 0.4	
Rubber/Leather	0.3-0.5	
Ash & Fine Earth	6.7-18.1	
Misc. (Hairs, Battery)	< 0.5	
Moisture		45-56%
Bulk Density		167-452 kgm

Waste collection

a. Waste collection: systemic

The total current collection of waste was estimated at Manali. This was carried out by assessing the average number of garbage collection trips made during various months of the year. Further, various truck loads of garbage were weighed to estimate the amount of garbage being carried by the truck. The annual collection of solid waste by the Notified Area Committee (NAC-the local government body) was thus estimated to be 2000 tons during 1998. It represents an average daily collection of about 5.5 tons for the town of Manali. The daily waste collections ranged from 4 tons in winter months to about 9 tons during summer months.

The formal/systemic waste collection by NAC is currently being done from about 30 collection points located in 7 wards of the notified area of Manali. A survey and assessment of these points indicated that there is a history of conflicts in locating the waste collection points, since most residents and hotels object to collection point being located close to them. While, NAC has put waste bins at the collection points, it was noted that most of the waste was lying outside bins. It was also found that most collection points do not have bins and the collection point is only a designated spot where residents and hotels etc. throw their waste.

This scenario was noted to result in two specific problems. Firstly, it led to desecration of the landscape and secondly it represented poor work conditions for NAC staff, who then have to shovel all the waste physically on to their trucks and face difficulty in controlling waste dispersal through transfer stages.

b. Waste collection: informal systems

Due recognition was given to fact that apart from waste collections by the Notified Area Committee (NAC), local government body, there is an active informal sector comprising of waste handlers and ragpickers active in the study area. Accordingly, the team made a survey and carried out detailed interviews to ascertain current role being played by them and also to develop an approach to their future participation in waste collections.

i. Rag pickers

After survey and interviews with ragpickers, it was estimated that their numbers in Manali range from 25-150 depending upon the tourist season. It was also found that 95 percent of rag pickers hail from neighbouring states. They were found to be working under unhygienic conditions and had poor access to basic amenities and primary healthcare facilities. They also reported frequent problems with police due to lack of proper identification.

The ragpickers were found to understand the waste and its constituents very well due to their long and close association with it. The team also discovered that there is no system of informal area rights amongst the ragpickers

and there are no apparent conflicts relating to rights to pick wastes in a particular area. The ragpickers however showed presence of informal groups based on state of their origin or family ties. Some of the ragpickers were also found to have good business skills as far as trading in waste was concerned.

ii. Waste traders/handlers

The waste traders represent the next higher level in the value chain of the informal waste collection and handling system. In Manali, three waste traders were noted. All hailed from neighbouring states and were found to have settled in Manali for a long time. They however indicated need for better treatment and acceptability. Their other needs were found to be basic amenities and space to carry out waste handling and trading.

Traders were found to be dealing in bottles, newspaper, plastics, scrap iron and metals etc. They had also developed good informal networks of ragpickers who formed a part of their supply chain. The waste traders were found to be trading 50 tons of waste per month during the tourist season and about 10 tons per month during off-season period. Their average profits were estimated at Rs. 1000/ton of waste traded.

Waste generation

Since, in Manali collections are poor, all the waste generated does not get collected. Therefore, an attempt was also made to estimate actual waste generation and waste collection efficiency under peak load conditions. It was estimated that under peak tourist conditions, total Manali population reaches about 40,000. At 0.5.kg/person/day, it was estimated that the peak waste generation is about 20 tons per day. Since, peak systemic collection was found to be 9 tons per day, the collection efficiency of the SWM system in Manali was estimated to be 45%.

Waste disposal

Currently, the conservancy department of NAC has two vehicles and a staff of 35 personnel for collection and disposal activities. The waste collected is being transported to outskirts of the town and tipped by side of river Beas running thru the scenic Kullu valley, where Manali is located. A barrier wall has been erected by river side to avoid waste running into river. After tipping, wastes are also burnt to apparently reduce the volume. The waste site has vector problem. The site was found to be inadequate to handle wastes and practices were found to be unsuited to proper waste disposal.

Proposed interventions

a. Waste collection

A new system of waste collection thru bags by way of door to door collections was proposed. It was felt that bags will offer total containment of waste at the point of generation.

It will lead to hygienic handling as it will eliminate shoveling and loading of open waste. The bag is also considered to eliminate dispersal of waste thru handling at various stages.

The new scheme also proposed additional features. It was decided to introduce different colour bags for biodegradable and non biodegradable waste. It was also proposed that each house will be given bags of various capacities such as 20, 25, 50 litres. The user charge was proposed at Rs. 1/litre/month/household.

It was further proposed that the existing ragpickers may be allowed area collection rights in each ward to carry out the proposed door to door collections. It was estimated that based on proposed user charge a total income of Rs. 400,000 per month will accrue. It was estimated that this income level can generate employment for about 100 persons.

b. Recycling

The second proposed intervention sought to establish a recycling centre. The centre was recommended, keeping in view segregated clean non biodegradable waste to be collected thru the new collection system. It was also found that NAC had a suitable building already available to house a recycling centre. Management of Recycling centre was proposed to be contracted out to one of the waste traders in Manali thru a selection process. It was felt that NAC can limit its role to overseeing the work for norms etc. only. It was estimated that recycling centre will be able to generate a profit of Rs. 75,000 per annum. It was further suggested that collections from such work could be used for sanitation worker welfare programme.

c. Composting

Based on the waste characteristics, composting as a waste disposal option was recommended. The team in this context was also asked to evaluate centralised composting options of Windrow based composting and Close tunnel technology. In windrow composting, the waste are piled in long piles. The waste is then turned and watered once a week. Microbial processes lead to waste stabilisation and hygenisation. After 4-6 weeks compost is ready for sieving and bagging.

In Close Tunnel process, waste is fed into a tunnel like reactor thru hopper. Hydraulically operated doors of reactor move waste about one seventh length of the tunnel reactor each day. Temperature and air in the reactor are controlled thru sensors placed inside which turn the required blowers on/off automatically. Since, the process is better controlled, the composting process is quicker and takes about a week.

It was found that both technologies are capable of relatively good level of composting for the waste in Manali. However, it was felt that windrow composting will require large flat areas, currently not available in Manali due to hilly terrain. This is not a constraint with Close tunnel reactor process. Further, it was felt that close tunnel system

can better protect itself against frequent rain and snow conditions prevalent at Manali.

d. Local regulations

The team also proposed a set of local regulation to be promulgated. Firstly, it proposed that segregation of waste at source into biodegradable and non biodegradable fractions be made mandatory. The authorities were also requested to legislate a ban on throwing of construction debris left during or after construction in Manali. It was also recommended that Manali and area leading from Manali to Rohtang pass be declared a no littering zone with punitive measures and fines. Special police powers were proposed for ward councilors and noted citizens to enforce and administer punitive fines and measures.

e. Institutional structures

In order to evaluate institutional structures at Manali, a Viable System Model was used to evaluate various functionalities within NAC. This model looks at various generic functions within an organisation, namely: Policy, Intelligence, Control, Co-ordination and Operations. The same is depicted in the Figure 1 below.

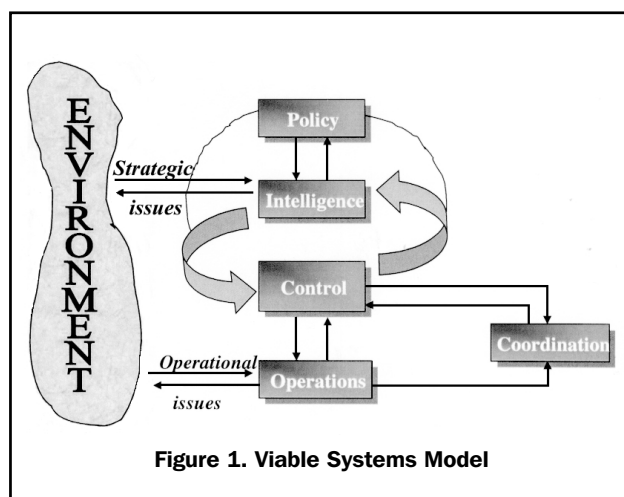


Figure 1. Viable Systems Model

The existing structure at NAC in Manali was examined. The existing role sets for persons associated with solid waste management were ascertained and analysed. It was found that Planning (Intelligence) function is weak at Manali. Supervision (Co-ordination) function with reference to SWM was also ascertained to be weak. Secretary-NAC who is an important office bearer was found overburdened with too many responsibilities. There was also no evidence of interactive mechanism in planning of solid waste related facilities.

Based on institutional analysis, NAC was provided a new responsibility structure for each of the positions. It proposed to create a separate position to head the SWM function in NAC. New positions of Sanitary inspectors

were also created to take care of the proposed enforcement role. Within the structure, role and responsibility sets were redefined for all positions to suit the new requirements.

Broadly, the aim of the new proposed institutional structure were the following:

- To strengthen participatory planning of solid waste infrastructure
- Provide role clarity at all levels
- Establish link between formal and informal sectors
- Delegation of financial authority
- Rationalisation of span of control at operational level
- Ensure effective monitoring and supervision
- Strengthen Intelligence function

Conclusion

All proposed interventions were discussed in an appropriate public forum to develop broad level acceptability at Manali. There is now a public consensus on the interventions suggested. The matter is currently being pursued with state authorities for implementation. The suitable current developments will be shared during presentation at the conference.

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