

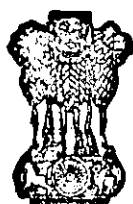
STUDY ON UTILIZATION OF URBAN WASTES



Committee on Natural Resources
GOVERNMENT OF INDIA
PLANNING COMMISSION

1963

UTILIZATION OF URBAN WASTES



सत्यमेव जयते

Committee on Natural Resources
GOVERNMENT OF INDIA
PLANNING COMMISSION

1963

FOREWORD

The Committee on Natural Resources, in its task of planning co-ordinated studies on natural resources on a continuing basis, suggested a study on the *Survey and Utilisation of Wastes and By-products of Agriculture, Forestry, Animal Husbandry and Fisheries*. This study on the *Utilisation of Urban Wastes*, presented here, is a part of the main study.

This study has revealed that while the potential capacity for composting of urban wastes is about 78 lakh tons, actual utilisation at present is only 29 lakh tons. This focuses attention on the large quantity of urban wastes which still remain to be utilised. In addition to this, about 700 million gallons of sewage and sullage per day is available in the cities and towns with sewerage systems out of which only about 200 million gallons are used. The remaining quantity of sewage and sullage is discharged into rivers and streams causing pollution of water detrimental to human health. There is a possibility of utilising more of this sewage and sullage in a number of urban areas. The study has further shown that it is very necessary that adequate areas are earmarked for sewage farming in our growing towns which should not be built upon. The lack of forethought in town planning is one of the major causes of wastage of sewage and sullage.

Effective utilisation of the city wastes including sewage and sullage will be a valuable contribution to the manurial resources of the country. It would mean not only increased agricultural production but also cleaner cities. The study reveals that there is scope for fuller utilisation of urban wastes.

This study report was approved by the Planning Commission at their meeting held on 27th June, 1963. It is hoped that the recommendations embodied in this study will receive careful attention and implementation by the concerned Ministries at the Centre as well as by the States.

M. S. THACKER.

NEW DELHI
August 7, 1963.

P R E F A C E

The study on the *Utilisation of Urban Wastes* was undertaken as a part of the study on *Utilisation of Agricultural and Industrial Wastes* on a directive of the Committee on Natural Resources. A Working Group consisting of the following members prepared the Report.

1. Dr. K. N. Synghal, Ministry of Food and
Assistant Fertilizer Adviser Agriculture.
2. Shri L. S. Yadava, Ministry of Food and
Technical Officer (Compost Agriculture.
and Sewage).
3. Shri S. Rajagopalan, Ministry of Health.
Assistant Director of Health
Services (Public Health Engg.).
4. Shri T. Durairaj, Ministry of Health.
Deputy Assistant Director
General of Health Services
(Public Health Engineering).
5. Dr. S. P. Raychaudhuri, Planning Commission
Senior Specialist (Land (Convener)
Resources).

The study was approved by the Planning Commission at their meeting held on 27th June, 1963. It has revealed that there is considerable scope for augmenting manurial resources of the country from this source which can make a sizeable contribution to agricultural production. This is a problem which is closely related to the health and sanitation problem of urban areas. Fuller and more effective utilisation of these wastes means greater availability of organic manure for the crops and also cleaner towns and cities.

M. S. RANDHAWA.

NEW DELHI:

August 7, 1963.

UTILIZATION OF URBAN WASTES

Urban wastes contain organic substances which are residues or derivatives of human and vegetable materials, the original nature of which was provided directly or indirectly by the soil. Therefore, it is imperative that these are not allowed to remain mere wastes; but are recovered, suitably treated in order to obtain the full benefit of their fertilizing qualities and returned to the soil to contribute to the maintenance of its fertility.

In India where the available cattle manure is so very inadequate for the needs of the soil, utilization of urban wastes for manurial purposes is of the utmost importance. These wastes are especially useful for growing of vegetables and short duration crops for which there is a large and rapidly growing demand in the urban areas and which are grown mostly in the vicinity of these. Larger applications of manure are required for growing these crops than for most others, and compost from urban wastes is particularly useful for them. Speedy and adequate removal, proper processing and treatment of urban wastes is essential also for maintenance of sanitary conditions, in the towns and cities.

Urban wastes are of two types:

- (a) Solid wastes which include city sweepings, garbage, kitchen wastes, slaughter-house wastes, night soil and industrial organic wastes; and
- (b) Liquid wastes which include sewage and sullage comprising all waste water and night soil.

Suitability of urban wastes as a source of organic manure was recognised as early as 1914 when research on composting these was taken up. As a result of this work, the Bangalore system of compost making was evolved, which has since been adopted in most towns and cities of the country. A scheme for preparation of town compost was sponsored by the Indian Council of Agricultural Research in 1943-44. Later, in August 1945, the Ministry of Food & Agriculture took over direct supervision of the scheme for introduction in different States. Under the scheme it was contemplated that all Municipal Committees and other local bodies would ensure that the entire refuse available in their areas was carefully collected, converted into compost and supplied to agriculturists of the surrounding areas. Legislation, making it obligatory for the Municipal Committee to subject refuse to composting, has also been enacted

in the States of Andhra Pradesh, Bihar, Gujarat, Madhya Pradesh, Orissa, Maharashtra, Punjab and Rajasthan. But, in other States such legislation does not exist as yet. Investigations by agricultural experts have shown that the composting process results in products possessing valuable fertilizing and soil improving properties. The trace elements present in town compost have acquired a new importance in the light of recent knowledge, about their role in maintaining soil fertility. Hygienic requirements are also completely satisfied by composting. Moreover Municipalities preparing compost get good income from its sale to cultivators. The year to year progress of compost production and distribution since the inception of the town compost scheme is given in Table I in the Appendix. It will be seen from this table that compost production and distribution have shown progressive increase. By 1960-61, 2121 urban centres had been covered by the Scheme and 28.55 lakh tons of compost was being produced.

The quality of town compost is very important in its evaluation by consumers, most of whom are market-gardeners, vegetable growers and nursery men. They want compost in which the content of extraneous material like broken glass, brick ball, iron and steel particles and other undecomposed material is the minimum and which has a uniform composition like that of cattle manure. The characteristics of compost actually produced vary from one urban area to another and within the same area from season to season and according to the care taken in its preparation. But in case of most towns the compost produced is not of good quality, as it contains a lot of inert material of the type described above, and has a low percentage of nitrogen. It is, therefore, necessary that systematic efforts be made to improve the quality of the compost produced. It would, also be desirable to analyse samples of the compost produced to determine its quality and maintain uniform standards.

The urban population of the country is 7.88 crores. The town compost that could be prepared from the wastes of this population is estimated at 78.8 lakh tons per year. As against this the present production is only 28.55 lakh tons or a little more than 1/3rd of the potential. This gap indicates the enormous scope for increasing production and utilization of town compost. Town compost contains on an average 1.3 per cent nitrogen, 1.1 per cent phosphoric acid (P_2O_5) and 1.5 per cent of potash (K_2O) on dry basis. The potential production of 78.8 lakh tons of town compost would contain 0.614 lakh tons of nitrogen, 0.520 lakh tons of phosphoric acid (P_2O_5) and 0.709 lakh tons of potash (K.O). The monetary value of these plant nutrients would be about Rs. 25.0 crores. The potential availability of nitrogen alone is almost equal to the nitrogen

supplied by the ammonium sulphate production of the Sindri Fertilizer Factory. The additional agricultural production in terms of foodgrains, expected from application of the above quantity of town compost would be about 2·8 lakh tons valued at Rs. 11·76 crores. However, the actual value would be larger, since town compost is utilised for high value crops like vegetables. Further, since the urban population is increasing rapidly the quantities of waste available for composting will also go on increasing from year to year.

Mechanical Composting.—The method of composting used in this country takes four to six months for maturation of the compost. In Japan considerable efforts are being made currently to mechanize and speed up the composting process. These have resulted in various mechanical innovations, most of which consist in enclosing the waste material in some type of digester which speeds up the composting process and yields good quality compost in the very short period of about seven days. The digester has the additional advantage of saving space and labour, both of which are scarce in large cities. A full-scale compost plant processing 100 tons of material per day is estimated to cost between Rs. 5—10 lakhs. However, if such plants are to be used in India they will have to be re-designed to suit Indian conditions. Further, in view of the enormous variations in conditions in different parts of the country it may also be necessary to design plants to meet the particular conditions of different areas. Plants of different sizes will have to be made to meet the needs of towns and cities of different sizes. The Central Public Health Engineering Institute, Nagpur, have under consideration a proposal to construct a pilot plant, in order to obtain data for the design of such plants in India and to pursue trials of such matters as ratios of sullage, night soil, refuse and dust necessary for the successful operation of these plants.

A. PROGRESS OF THE URBAN COMPOST REVELOPMENT SCHEME IN THE SECOND FIVE YEAR PLAN AND PROGRAMME OF WORK FOR THE THIRD PLAN

The target of compost production under this scheme in the period of the Second Five Year Plan was 3·0 million tons. As against this the achievement was 2·855 million tons. The total expenditure on the scheme during the plan period was Rs. 1·40 crores. Under the Third Five Year Plan, it is proposed to extend the scheme to a total of 3100 urban centres* and to achieve a total production of 5·0 million tons per year. The financial allocations under the scheme made

*Urban centres signify urban units served by Municipal Committees; Notified Area Committees, and those Notified Panchayats in which there are arrangements for removal and collection of urban wastes.

in the plans of the States total Rs. 1.95 crores. With the achievement of these targets, 91% of the urban centres in the country will be covered by the compost production scheme; but the production of compost will be only about 63% of the potential of 7.88 million tons.

Difficulties in compost preparation:—The principal difficulties experienced in preparation of compost, and intensification of this work in the urban areas are the following:—

- (i) Inadequate arrangements for removal of city wastes;
- (ii) Apathy and lack of interest on the part of the municipalities and other local bodies resulting partly from their inability to meet the recurring and non-recurring expenses on composting on account of their poor financial position;
- (iii) Lack of cheap transport facilities to cultivated areas near cities. This results in low off-take of town compost and accumulation of prepared compost which ultimately restricts production;
- (iv) Lack of sufficient local demand for town compost particularly within big cities having comparatively little cultivated area near them;
- (v) Limited demand for compost in towns located in areas of low rainfall and with little irrigation facilities;
- (vi) Lack of night soil as a starter in towns having sewerage systems;
- (vii) Prejudice against the use of night soil compost especially in hilly areas;
- (viii) Throwing of town wastes in depressions for purpose of reclamation of land. This is resorted to especially in the bigger cities for reclaiming land for construction, for laying out parks etc.

B. UTILISATION OF LIQUID HUMAN WASTES, SEWAGE AND SULLAGE

Nearly 80 cities and towns in India have complete or partial sewage system. Besides these, there are nearly 600 towns which have the surface drainage system (open drains). The sewage/sullage of these towns and cities is disposed of in two ways at present: (i) by road irrigation on the land with or without treatment, and

(ii) discharge into the nearest river or stream either throughout the year where no sewage irrigation farms exist or at least for some part of the year even where there are sewage farms. The practice of discharging sewage/sullage into the rivers not only causes pollution of water with consequent danger to the health of the people and animals downstream who use these waters for drinking but also deprives the soil of valuable manure. The total quantity of the sewage/sullage available in the above cities and towns is estimated at about 700 million gallons per day. As against this, information received from State Governments indicates that only 200 million gallons are being utilised at present for irrigation in about 70 cities and towns. The area receiving sewage irrigation is only 25,000 acres (Tables 2, 3 and 4 in Appendix).

The benefits deprived by crops from sewage irrigation are due to the additional supplies of water as well as to the plant nutrients and organic matter. Ordinary domestic sewage contains from 15 to 35 p.p.m. of nitrogen (N), 4 to 6 p.p.m. of phosphoric acid (P_2O_5), 10 to 20 p.p.m. of potash (K_2O) and an average of 400 p.p.m. of organic matter. Taking an average of 25 p.p.m. of nitrogen, 5 p.p.m. of phosphoric acid, and 15 p.p.m. of potash, the manurial constituents of 700 million gallons of sewage per day would be as follows:—

Nitrogen (N)—80 tons per day or 29200 tons per year.

Phosphoric acid (P_2O_5)—16 tons per day or 5840 tons per year.

Potash (K_2O)—48 tons per day or 17520 tons per year.

Organic matter—1280 tons per day or 467,200 tons per year.

The total manurial value of these works out to Rs. 5.58 crores annually.

Irrigational Value:—The discharge of 700 million gallons of sewage per day is equivalent to flow from 1400 tube-wells and can irrigate an area of 210,000 acres, or double this area if biennial rotation is adopted. The extra produce in terms of foodgrains from this acreage would be about 3 lakh tons valued at about Rs. 12 crores. Therefore, sewage irrigation which supplies both the plant nutrients and water has a great potential for increasing agricultural production.

Crops suited for sewage irrigation.—In India irrigation is normally carried out with sewage which has not received a high degree of treatment and from which gross solids only have been removed by

simple settlement. Accordingly, not all crops should receive sewage irrigation, and such irrigation should be subject to regulation of the Departments of Health of the State Governments. There is however no health hazard involved, if well oxidized effluent is used for irrigation. The crops best suited to sewage irrigation are fodder crops like Rhodes grass, Guinea grass, Elephant grass, Buffalo grass, Guatemala grass, lucern and fodder jowar, and industrial crops like sugarcane, tobacco and cotton which undergo drastic treatment before they are used. Crops such as papaya and plantain which grow well above the ground level may also be grown on sewage. On the other hand, root vegetables like potatoes and leafy vegetables like spinach and cabbage which grow near the ground level should not be grown under sewage irrigation. It is a good practice to dilute sewage with well or stream water. The beneficial effect of dilution is due largely to the dissolved oxygen in the diluent which influences development of aerobic organisms and the attendant oxidation changes. It has also the practical advantage of making available more land for farming and better utilisation of the fertilizing ingredients of sewage.

Sludge.—Treatment of sewage results in production of sludge which is a valuable manure. It is estimated that about 2 lakh tons of sludge could be available per year by treatment of all the available sewage. Taking the composition of sludge as 3.0 per cent nitrogen, 2.0 per cent phosphoric acid and 0.5 per cent potash, the above quantity would contain 6000 tons of nitrogen, 4000 tons of phosphoric acid. As against this potential, the present availability of sludge is only 50000 tons. In sewered cities, where little night soil is available for composting with refuse, sludge should be used for this purpose. This will ensure proper utilization of both sludge and of refuse. A common site for sewage treatment plant and for disposal of refuse would be advantageous.

Sewage Utilization Schemes.—The Ministry of Food and Agriculture took up the question of utilisation of sewage for agricultural production from 1949 onwards. Nearly 50 sewage and sullage schemes were prepared for various cities and towns having either complete or partial drainage systems. Financial assistance in the form of long-term loans was given for execution of these schemes and for setting up sewage farms. These farms have been established in about a dozen towns. The more important of these are at Kanpur, Indore, Ujjain, Jaipur, Madras, Lucknow, Mysore, Madurai, Hyderabad and Baroda. The loan provision made for this scheme during the Second Plan period was Rs. 48.0 lakhs. The States of U.P. and Madras took advantage of this financial assistance. In the Third Plan several States have made provisions totalling over Rs. 1.20 crores for sewage

utilisation schemes. The details of these provisions are as follows:—

<i>States</i>	<i>Rs. (lakhs)</i>
Madhya Pradesh	60·0
U.P.	50·0
Kerala	5·0
Punjab	5·0
Delhi	1·75
Andhra Pradesh	1·0
Orissa	1·0

Under the Second Plan, assistance was given only in the form of loans but in the Third Plan subsidy to the extent of 25 per cent of the recurring cost of the scheme, to be shared equally by the Centre and the State, has also been provided. However, progress under these schemes has been inadequate. The main reasons for this are as follows:—

- (i) Lack of funds with municipalities to bear their share of the cost;
- (ii) Difficulties in obtaining equipment and materials especially those which have to be imported.
- (iii) Utilization of most of the funds provided under the National Water Supply and Drainage Scheme on water supply schemes leaving very little for drainage schemes.
- (iv) Delay in acquisition of land for sewage farms.
- (v) Uneconomic sewage farming in certain areas resulting in loss of interest in the scheme on the part of the municipal committee concerned.
- (vi) Failure to provide for utilisation of sewage on land in several sewage disposal schemes framed by Public Health Engineering Departments.

Another major difficulty faced in sewage farming is that the crops require water and manure at stated intervals only, while the stream of sewage flows continuously. Therefore, if the area of land under sewage farms is not adequate the sewage is allowed to go waste with consequent economic loss and nuisance and danger to health of the people.

RECOMMENDATIONS

S. No.	Recommendation	Action to be taken by
<i>I. Urban Compost :</i>		
1	Necessary legislation should be passed by all State Governments, making it obligatory for local bodies to subject their refuse to composting. In States where such legislation already exists, steps should be taken to enforce it strictly.	State Governments.
2	Programmes for composting of refuse in big cities like Delhi are especially important both to avoid wastage of the enormous quantities of refuse available, and to improve sanitary conditions. Special attention should be given to such cities by the State Governments and the Local Administration concerned.	State Governments and local Administration concerned.
3	As far as possible, local bodies should provide transport facilities for carrying compost to cultivators' fields on 'no-profit-no-loss' basis. In other cases, the State Governments should either maintain trucks for the purpose or grant a suitable subsidy to farmers to meet a part of the transport cost.	Ministry of Food & Agriculture and State Governments.
4	Taccavi loans should be given to cultivators to enable them to purchase compost manure and meet the transport cost.	State Governments.
5	Specific mention should be made for loan provision under Urban Compost Development Scheme in the pattern of Central assistance to States.	Ministry of Food and Agriculture.
6	Greater stress should be laid on production of good quality town compost by strictly adhering to the composting method.	State Governments and local bodies.
7	In schemes of town planning, specific areas should be earmarked for composting grounds.	State Governments and local bodies.
<i>II. Sewage and Sullage :</i>		
8	The problem of utilisation of sewage is closely linked with that of its collection through drainage systems. In all towns having drainage systems, the local bodies should extend the lines so as to cover the entire town. Much larger quantities of sewage can thus be collected and made available for utilisation. The same applies also to open drains carrying sullage. Generally, one-half to one-third of these drains are kutchha. There should be a phased programme to make these drains pucca at the earliest.	State Governments and local bodies.

S. No.	Recommendation	Action to be taken by
9	In small towns of rural nature, pucca drains should be laid for the collection of sullage and the sullage so collected, should be stored in sumps and lifted for irrigation.	State Governments and local bodies.
10	Most of the funds allotted under the National Water Supply and Drainage Scheme are spent on water supply schemes and very little is left for drainage schemes with the result that the latter remain unfulfilled. Specific amounts must be earmarked for underground and open drainage schemes separately, in the allotments made under the N.W.S. & D. Scheme.	Ministry of Health and State Governments.
11	The State Governments should be requested by the Ministry of Health to ensure that the initial planning and estimation of sewage schemes include provision for disposal of the sewage on land. Failure to make such provision has resulted in non-utilisation of sewage in several cases. In planning such schemes it is necessary also that the Public Health Engineering Departments work in close collaboration with the Departments of Agriculture of the States so that selection of sites and rails for sewage farming is made on proper lines.	Ministry of Health and State Governments.
12	In places where the available sewage is not being utilised or is being only partially utilised, special surveys should be undertaken jointly by the Public Health Engineering and Agriculture Departments of the States to study the scope of full utilisation, and suitable schemes should be prepared with this object.	Ministries of Food and Agriculture and Health, and State Governments.
13	The management of sewage farms should be directed by an officer of the Department of Agriculture. Only in this manner can the farm be kept in good condition. Such items as proper irrigation, rotation of crops, systematic resting and liming of the land are technical agriculture problems which require expert knowledge.	Ministries of Health, Food & Agriculture, and State Governments.
14	Sewage irrigation requires large areas of land which it is difficult for Municipalities to acquire. Acquisition also leads to dislocation of cultivators owing the land. Therefore, acquisition of land should be avoided to the extent possible, and sewage should be applied on cultivators' fields on payment of reasonable charges. To meet hygienic requirements the Central Ministry of Health should lay down standards regarding sewage farming practices.	Ministry of Health, State Governments and local bodies.
15	In schemes of town planning, specific areas should be earmarked for setting up of sewage farms by the Municipal Corporation/Committees and these should not be built upon.	Ministry of Health, State Governments and local bodies.

S. No.	Recommendation	Action to be taken by
16	Sewage utilisation schemes should be treated on par with minor irrigation schemes for purposes of financial assistance. Special mention should be made for loan provision under these schemes in the pattern of Central assistance to States. The State Governments should make adequate provision for these schemes in their State Plans. The Municipal bodies should be given long-term loans for these. The cultivators using sewage waters should receive assistance in financing construction of all irrigation structures.	Ministry of Food and Agriculture; State Governments and local bodies.
17	There is need to undertake research on photo-synthetic purification of sewage and extraction of pure Vitamin B-12 from digested sullage.	Council of Scientific and Industrial Research.
18	There is colossal wastage of sewage particularly in the case of bigger cities. The question of utilisation of sewage in these cities calls for thorough investigation from technical and economic administrative aspects. An operational study group should go into these problems in detail and suggest ways and means for utilising the available sewage.	Ministries of Food and Agriculture and Health.
19	Work on fabrication of sewage treatment plants suited to Indian conditions should be undertaken.	Ministries of Health and Food & Agriculture.

APPENDIX

TABLE I

Progress of work in the Town Compost Scheme

Year	No. of urban centres	Quantity of Town Compost produced in tons	Quantity of Town Compost distributed in tons
<i>A—Pre-plan Period :</i>			
1944-45	260	1,82,610	51,290
1945-46	411	2,82,670	1,79,910
1946-47	578	4,09,360	2,89,170
1947-48	566	4,86,080	3,80,527
1948-49	696	7,21,257	5,17,234
1949-50	1036	12,09,089	9,23,173
1950-51	1047	14,03,761	10,68,913
<i>B—First Five Year Plan period :</i>			
1951-52	1539	16,27,736	12,05,171
1952-53	1692	17,54,101	13,96,900
1953-54	1813	18,34,451	17,14,900
1954-55	1962	20,14,488	16,81,494
1955-56	2251	21,21,624	17,94,305
<i>C—Second Five Year Plan period</i>			
1956-57	2252	21,77,866	18,29,612
1957-58	1898	22,21,246	21,20,060
1958-59	1963	23,92,711	22,11,659
1959-60	2051	25,38,194	23,39,384
1960-61	2121	28,54,861	25,32,093

N.B.—The sudden fall in number of working centres in 1957-58 was because a large number of working urban centres in Andhra Pradesh were denotified.

TABLE 2

Availability and utilisation of sewage/sullage for irrigation purposes in selected towns in India.

State	Name of the town (with population in lakhs)	Total quantity of sewage/sullage available daily (million gallons)	Quantity daily used for irrigation (million gallons)	Quantity not utilised for irrigation (million gallons)	Area receiving sewage irrigation (acres)	Remarks
1	2	3	4	5	6	7
<i>Uttar Pradesh</i>	1. Lucknow (7.5)	22.50	7.2	15.3	1171	Pumping capacity is not sufficient. Construction work for extension of sewage farm to 6,00 acres is under progress.
	2. Varansi (3.80)	4.2	..	4.2	1400 (available)	The scheme is under execution.
	3. Agra (4.0)	3	1	2		The sewage pumping station has started functioning from November, 1961 and farming has also started.
	4. Kanpur (9.0)	23	17.44	5.56	3701	
	5. Allahabad (4.5)	10	6	4	465	The scheme amounting to Rs. 44 lakhs stipulates dilution of sewage by the wells and installation of pumping plant; 2 tube wells have been bored and pumping plant installed.

6. Dehradun (1.43)	•	•	1.4	1.4	..	26	
7. Hardwar (0.58)	•	•	5	0.46	4.54	51	The scheme aims at the expansion of the sewage farm to utilise whole of the sewage.
3. Mathura (0.99)	•	•	0.5	0.4	0.1	72	
9. Unao (0.25)	•	•	0.05	0.004	0.46	13	
10. Nainital (0.35)	•	•	0.3	0.2	0.1	20	It is a private farm.
11. Baraut (0.23)	•	•	0.06	0.02	0.04	129	
12. Bahraich (0.56)	•	•	0.008	0.008	..	170	
13. Gaziabad	•	•	0.3	..	0.3	254	
14. Basti	•	•	0.2	..	0.2	..	
15. Gorakhpur	•	•	2.59	..	2.59	..	
16. Gonda	•	•	0.5	..	0.5	..	
17. Padrauna	•	•	0.2	..	0.2	..	
18. Azamgarh	•	•	0.7	..	0.7	..	
19. Rampur	•	•	3	0.03	2.997	7	
20. Nizibabad	•	•	0.7	..	0.7	..	
21. Kothwar	•	•	0.3	..	0.3	..	
22. Pauri	•	•	0.1	..	0.1	..	
23. Vrindaban	•	•	0.6	..	0.6	117 (available)	A scheme for utilisation of sewage/ sullage is being prepared by State Govt. Provision made during 3rd Plan for the Scheme is Rs. 1 lakh.

	2	3	4	5	6	7
24. Ayodhya	0.6	..	0.6		40 (available)	
25. Orai	0.6	..	0.6		..	The scheme is under execution. At present sullage flows into nalas.
26. Deoria	0.09	0.08	0.01		63.5	
27. Moradabad	40.1	0.02	0.12 (disposed into river)		26.37	
28. Ballia	0.16	..	16		..	
<i>Delhi</i> 1. Delhi at Okhla (18)	67	36.36	30.30		3800	
<i>Maharashtra</i> 1. Phaltan (1.12) North Satara.	0.15	..	0.15		..	
6. Nagpur (6.51)	10	..	10		50 (available)	The scheme is under execution.
7. Ahmednagar (0.81)	1.2	..	1.2		..	
8. Nandurabar (1.30)	1.13	0.065 (diluted with water at the rate of 0.065)	0.065		50	
9. Bombay (3 millions)	165	..	165		..	Land is not available freely in Greater Bombay for Irrigation purposes.
10. Jalna (0.87)	1	..	1		.	

	11. Wardha (1.40)	.	.	.	..	..	..	25	
	12. Poona (x)	.	.	.	14	14	..	573	
	13. Sholapur (3.0)	.	.	.	10.5	3.9	6.6	1528 acres owned by cultivators	Disposal works are yet to be completed and put in operation.
	14. Nasik (1.0)	.	.	.	3.6	..	3.6	..	
	15. Kurduwadi (1.11)	.	.	.	.01	.005	.005	10	
	16. Kalyan	.	.	.	.008	.0003	.0077	20	
	17. Jalgaon	.	.	.	..	..	..	..	Scheme under execution.
	18. Panvel	.	.	.	..	..	..	..	Scheme under execution.
<i>Andhra Pradesh</i>	1. Hyderabad	.	.	.	16.3	16.3	..	1500	
	2. Visakhapatnam (1.79)	.	.	.	0.13	.03	.1	5	No land is available within the radius of 5 miles. Proposals are being made to extend the pipe line to a distance of 10 miles where land is available. Crop grown is Guinea Grass.
	3. Tirupathi	.	.	.	0.10	.10	..	19	
	4. Warangal	.	.	.	..	..	..	81.10	
	5. Anakapalli	.	.	.	0.04	.01	.03	2.8	
	6. Rajahmundry	.	.	.	..	..	..	10.0	
	7. Karimnagar	.	.	.	..	..	..	10.0	
	8. Vijayawada	.	.	.	0.66	0.66	..	20	Foodgrains are cultivated in 30 acres and grass grown in 50 acres.

	1	2	3	4	5	6	7
<i>Kerala</i>	1. Trivandrum (1·87)		1	1	..	13	During the Third Plan the State Govt. have decided to develop a farm at Valiathurai in Trivandrum to utilise 1 m.g.d. (estimated) of sewage available for fodder cultivation. 60 acres of land to be developed during the plan period out of 120 acres, available.
<i>Punjab</i>	1. Amritsar (3·20)		3	3	..	1800	
	2. Jullundur		1·5	1·5	..	781	
	3. Ludhiana (2·50)		2·5	2	·5	300	
	4. Jagraon (·32)		·32	·15	0·17	15	
	5. Khanna (0·17)		·3	·22	·08	50	
	6. Zira (0·08)		·05	·004	·046	7	
	7. Muktsar (0·31)		·009	·009	..	21	Crops grown are vegetables and fodder.
	8. Abohar (0·50)		·2	·2	..	36	Crops grown are vegetables and grasses.
	9. Ferozepur (0·47)		·2	·2 (Diluted] with equal volume of water).	..	90	Crops grown are vegetables and green fodder.

	10. Fazilla (0.32)	.	.	.	13	..	13	..	
	11. Moga (0.48)	.	.	.	15	13	..	16	
	12. Phagwara (0.36)	]	.	.	18	18	..	600	
	13. Kapurthala	]	.	.	..	..	..	80	
	14. Sadhura	.	.	.	0.001	0.0008	0.0002	15	Crops grown are foodgrains vegetable and fodder.
	15. Govind Garh	.	.	.	0.015	0.015	..	20	
	16. Sonapat	.	.	.	1	1	..	20	
	17. Hoshiarpur	.	.	.	2	2	..	41	
	18. Rampura Phul	.	.	.	0.7	0.27	..	10	
	[19. Badhlada	.	.	.	0.45	0.45	..	50	
	20. Kotkapura	.	.	.	0.015	0.015	..	25	
	21. Rohrak	.	.	.	0.9	0.7	0.2	10	
Madr	1. Vellore (1.06)	.	.	.	0.7	0.7	..	35.54	Crops grown are foodgrains, fodder and grass.
	2. Ootacamund	]	.	.	0.4	0.4	..	14	Crop grown is Rye Grass.
	3. Arni (0.25)	.	.	.	0.6	..	0.6	..	
	4. Salem (2.02)	]	.	.	0.16	..	0.16	..	Steps are being taken to establish a sewage farm.
	5. Chinglepet (0.23)	.	.	.	0.3	0.1	0.2	10	
	6. Nagapattinam (0.61)	.	.	.	0.2	..	0.2	..	
	7. Coimbatore (3.0)	.	.	.	2	1.7	0.3	71	Crops grown is fodder and grass.
	8. Karakudi (0.38)	.	.	.	0.2	0.005	0.195	0.2	

1	2	3	4	5	6	7
9. Kumbakonam (0.92)	.	1	0.003	0.997	4.5	The question of full utilisation is to be taken up after completion of underground drainage scheme.
10. Madurai (3.62)	. .	3 m.g.d. sewage + 1.5 m.g.d. effluent.	3	1.5	180	Crops grown are foodgrains, vegetables and grass.
11. Karur (0.42)5	0.24	0.5	..	
12. Tuticorin (0.99)	.	1.5	0.24	1.26	16.1	A further area of 30 acres is under acquisition.
13. Palayamkottai (0.42)	.	0.06	..	0.06	0.10 (available)	
14. Arkonam (0.23)	. .	0.1	..	0.1	..	Allowed to flow in lake.
15. Dindigul (0.79)	. .	0.3	0.3	..	1.49	Crop grown is fodder. Additional sewage farm will be taken after completion of Sithayancottai water supply scheme and lands are acquired for the purpose.
16. Srirangam (0.37)	. .	0.21	0.21	..	5	Crops grown are vegetables and fodder.
17. Chidambaram	0.003	0.003	..	0.37	Crops grown are foodgrains.
18. Erode	0.6	..	0.6	..	
19. Aruppukotai	0.2	0.003	0.197	0.72	There is a proposal for acquiring a site for sewage farm.

	20. Gobichattipalayam	.	.	0.2	..	0.2	..	
	21. Madras (17.0)	.	.	27	5	.22	200	Crops grown are paddy, grass and sugarcane. The uncultivated lands are brought under cultivation gradually with the available sewage.
		
		
	22. Virudhnagar (45)	.	.	0.15	0.15	..	5	Crops grown are fodder and grass.
	23. Pariyakulam (x)	.	.	0.004	0.0008	0.0032	5.5	
	24. Padukottai (x)	.	.	0.042	0.042	..	30	The western part of the town has no drainage system. Crops grown are foodgrains, fodder and grass.
	25. Trivaur (x)	.	.	0.02	0.02	..	1.33	Crop grown is Guinea Grass.
	26. Tirupattur (x)	.	.	0.02	0.006	0.014	10	
	27. Kancheepuram (x)	.	.	0.1	..	0.1	3	
	28. Thanjavoor (x)	.	.	0.6	0.004	0.596	1.50	A miniature Sewage Farm is under operation.
	29. Tiruvallur (x)	.	.	Not accounted for but is used for growing of grass			1.90	
<i>Himachal Pradesh</i>	1. Bilaspur (x)	.	.	0.5	..	0.5	..	} Schemes under consideration.
	2. Nahan	.	.	..	..	..	..
	3. Solan	.	.	..	..	..	..
<i>Gujarat</i>	1. Nadiad (63)	.	.	2	2	..	210	Major crop is rice. The sewage/sullage water is not utilised fully throughout the year. For this the municipality has decided to acquire more lands to have only sugar cane crop to utilise the excess water.

1	2	3	4	5	6
2. Surat (2.85)	. . .	3	1	2	130
3. Bhavnagar (1.75)	. . .	4	2	2	25 2 m.g.d. is allowed to flow into sea. It is very expensive for the cultivators to take the sullage water from channel and steps are being taken to fully utilise the water by giving contract to Ruva Sahkari Mandal.
4. Western Railway Workshop Colony at Dohad Panchamahals (1.0)	. . .	1	1	..	60
5. Kapadvanj (0.22)	. . .	0.4	0.4	..	82 Crops grown are foodgrains, vegetables sugarcane, fodder and grasses.
6. Navsari (0.45)	. . .	1.2	0.06	1.194	3 There is a proposal for improvement of drainage scheme.
7. Baroda (2.11)	. . .	6.5	6	0.5	700 Crops grown are foodgrains, fodder and grass.
8. Ahmedabad	. . .	48	48	..	1882 Crops grown are vegetables, fodder and grass.
9. Patan	. . .	0.33	0.33	..	7-
10. Visnagar	0.30	0.30	..	127
11. Rajkot Sewage partially utilised. Area receiving sewage irrigation not known.
12. Gandhidam
13. Gondal

<i>Madhya Pradesh</i>	1. Indore (3·51)	. . . .	5·41	5·41	..	249	
	2. Ujjain	. . . .	·7	·7	..	152	There are no underground sewers in the city; only sullage of city has been intercepted which is fully utilised except in rainy season.
	3. Bhopal	. . . .	·45	..	·45	..	Part of the town has sewerage system. The scheme for utilisation of sewage is under consideration of the State Government.
	4. Gwalior	. . . .	3	3	..	500	
	5. Mandsaūr]	. . . .	0·15	0·15	..	71	The area of the Sewage Farm is 71·0 acres, but whole area is not irrigated as sewage water available daily is inadequate.
	6. Bhilsa	. . . .	0·2	0·2	..	83	
	7. Morar	. . . .	0·25	..	0·25	..	
	8. Bhind	. . . .	0·15	..	0·15	..	
	9. Sivpuri	. . . .	0·10	..	0·10	..	
	10. Vidisha	. . . .	0·15	..	0·15	..	
<i>Mysore</i>	1. Mysore Municipality	. . . .	5·2	2·1	3·1	365	
	2. Bangalore	. . . .	..	..	..	317	A comprehensive Scheme is under execution.
<i>Rajasthan</i>	1. Jaipur	. . . .	0·7	0·7	..	80	
	2. Bikaner	. . . .	0·5	0·5	..	50	
	3. Jodhpur	. . . .	..	..	..	..	Information not available.
TOTAL			528·07	204·01	324·06	26,010	

TABLE 3

Position regarding utilisation of sewage/sullage in selected cities and towns

Sl. No.	State	Cities and towns where sewage/sullage is :—		
		Completely utilised	Partially utilised	Not utilised at all
1	2	3	4	5
1	Andhra Pradesh	(i) Hyderabad (ii) Vijayawada (iii) Tirupatti (iv) Warangal	(i) Vishakhapatnam (ii) Anakapalli (iii) Rajahmundry (iv) Karimnagar	(i) Srikakulan (ii) Vizianagram (iii) Palacole (iv) Kakinada (v) Elura (vi) Ongole (vii) Nellore (viii) Tandur
2	Assam	Nil	Nil	Nil
3	Bihar	Jamshedpur Rajgir		Patna
4	Gujarat	(i) Nadiad (ii) Visnagar (iii) Dohad (iv) Kapadvanj (v) Patan (vi) Ahmedabad	(i) Baroda (ii) Surat (iii) Bhavnagar (iv) Navsari (v) Rajkot (vi) Gandhidham (vii) Gondal	(i) Broach (ii) Bulsar (iii) Rajpipla (iv) Jamnagar (v) Viramgam city
5	Jammu and Kashmir	Jammu		
6	Kerala		Trivandrum	Ernakulam

7 Madras

(i) Vellore	(i) Aruppukottai	(i) Arkonam
(ii) Ootacamund	(ii) Periyakulam	(ii) Arni
(iii) Padukottai	(iii) Chingilepet	(iii) Salem
(iv) Trivavur	(iv) Tirupattur	(iv) Nagapattinam
(v) Kancheepuram	(v) Coimbatore	(v) Erode
(vi) Chidambaram	(vi) Karaikudi	(vi) Govichettipalayam
(vii) Madurai	(vii) Kumbakonam	(vii) Karur
(viii) Dindigul	(viii) Tuticorin	
(ix) Srirangam	(ix) Palayamkottai	
(x) Virudhnagar	(x) Thanjavur	
(xi) Tiruvallur	(xi) Madras Corporation	

8 Mysore

(i) Mysore City	1. Shimoga, 2. Belur, 3. Kolar, 4. Hubli, 5. Mangalore, 6. Hassan, 7. Dharwar, 8. Mandya, 9. Channaraypatnam, 10. Ramanagaram, 11. Tumkur, 12. Gubbi, 13. Turnvekere, 14. Koratagere, 15. Madhugiri, 16. Kunigal, 17. Tiptur, 18. Chitaldrug, 19. Jagalur, 20. Challakuere, 21. Davanagar, 22. Hiriyur, 23. Hosadurga, 24. Sira, 25. Holakere, 26. Harihar, 27. Bhadravathi, 28. Shikaripur, 29. Sagar, 30. Honnali, 31. Tarikere, 32. Koppa, 33. Chickmagalur, 34. Mudigere, 35. Kadur, 36. Birur, 37. Arasikere, 38. Sravanabelagola, 39. Holenarsipur, 40. Sakleshpur, 41. Arkalgud, 42. K. R. Nagar, 43. Hunsur, 44. T. Narsipur, 45. Najangud, 46. Chamarajanagar, 47. Srirangapatna, 48. Maddur, 49. Malavalli, 50. Magadi, 51. Hosakota, 52. Anekal, 53. Chickaballapur, 54. Chintamani, 55. Bangarpet, 56. Chikkanavakanahalli, 57. Mulbegal, 58. Malur, 59. Doddaballapur, 60. Nelamanagala, 61. Kanakapur, 62. Godag Betgeri, 63. Belgaum, 64. Chikkedi, 65. Nkal, 66. Bidar, 67. Gulbarga, 68. Bakavar.
(ii) Bangalore	

1	2	3	4	5
9	Madhya Pradesh	(i) Indore (ii) Ujjain (iii) Gwalior (iv) Mandasaur (v) Bhilsa		(i) Bhopal (ii) Morar (iii) Bhind (iv) Shivpuri (v) Vidisha
10	Maharashtra	(i) Chalisgaon (ii) Poona (iii) Wardha	(i) Kalyan (ii) Kurduwadi (iii) Nandurbar (iv) Sholapur	(i) Nagpur (Scheme under execution). (ii) Bombay (Municipal Corporation). (iii) Jalgaon (Scheme under execution). (iv) Panval (v) Nasik (vi) Jalna (vii) Bhir (viii) Katol (ix) Ahmednagar (x) Phaltan (xi) Ichal Karanji
11	Orissa		Cuttack	Bhuvanesar (Scheme under execution).
12	Punjab	(i) Amritsar (ii) Jullundur (iii) Ludhiana (iv) Gobind Garh (v) Sonapat (vi) Ferozepur City (vii) Kapurthala (viii) Phagwara (ix) Hoshiarpur (x) Abhor (xi) Moga (xii) Muktsar (xiii) Khanna (xiv) Rampura Phool (xv) Jaitu (xvi) Budhlada (xvii) Sadhura (xviii) Kokapura (xix) Jagraon (xx) Zira (xxi) Dinanagar	(i) Rohtak (ii) Jagadri (iii) Ambala (iv) Karnal (v) Panipat (vi) Thanesar (vii) Kaithal (viii) Rewari (ix) Jind	(i) Fazilka (ii) Tarantaran (iii) Jamunanagar (iv) Goniara (v) Darababa Nanak (vi) Samrala (vii) Hansi

			(xxii) Gurdaspur								
			(xxiii) Rupar								
			(xxiv) Bhiwani								
			(xxv) Hissar								
			(xxvi) Dhuri								
			(xxvii) Nilokheri								
			(xxviii) Sangrur								
			(xxix) Kalka								
			(xxx) Faridkot								
			(xxxi) Batala								
			(xxxii) Qudian								
			(xxxiii) Gurgaon								
			(xxxiv) Nangal								
			(xxxv) Bhatinda								
13	Rajasthan	.	.	.	(v) Jaipur	.	.	(i) Jodhpur	.	(i) Bhilwara	} Schemes under preparation
							(ii) Bikaner	.	(ii) Udaipur		
									(iii) Alwar		
									(iv) Kota		
									(v) Ganganagar		
14	Uttar Pradesh	.	.	.	(i) Dehradun	.	.	(i) Lucknow	.	(i) Varanasi	(Scheme under execution).
					(ii) Bahraich	.	.	(ii) Agra	.	(ii) Ayodhya	"
					(iii) Philkhuwa	.	.	(iii) Kanpur	.	(iii) Basti	"
					(iv) Gaziabad	.	.	(iv) Allahabad	.	(iv) Gorakhpur	
								(v) Hardwar	.	(v) Gonda	
								(vi) Mathura	.	(vi) Padrauna	
								(vii) Baraut	.	(vii) Azamgarh	
								(viii) Nainital	.	(viii) Maunath Bhanjan	
								(ix) Rampur	.	(ix) Vrindaban	
								(x) Deori	.	(x) Ballia	
								(xi) Unnao	.	(xi) Nazibabad	
								(xii) Moradabad	.	(xii) Orai	(Scheme under execution.)
										(xiii) Kothwar	
										(xiv) Pauri	
15	West Bengal	.	.	.	Nil	.	.	Calcutta	.	.	
16	Pondicherry	.	.	.	Nil	.	.	Nil	.	(i) Pondicherry	
										(ii) Karikal	
17	Delhi	.	.	.	Nil	.	.	Delhi	.	(i) Bilaspur	
18	Himachal Pradesh	.	.	.		.	.	(i) Nahan	.	(ii) Mandi	
								(ii) Solan	.	(iii) Chamba	(Scheme under execution.)

N.B. Information concerning Bihar and West Bengal is not available.

2. Bihar Patna.
 3. Gujarat Surat, Bhavnagar.
 4. Kerala Ernakulam.
 5. Madras Salem, Kumba Konam, Tuticorin, Arup-
pukotai, Madras, Thanjavar.
 6. Madhya Pradesh Bhopal, Jabalpur, Rewa, Sagaur, Raipur,
Bilaspur.
 7. Maharashtra Nagpur, Ahmednagar, Bombay, Sholapur,
Nasik, Jalgaon, Panval, Kalyan.
 8. Mysore Mysore, Bangalore, Dharwar, Hubli.
 9. Orissa Cuttack, Bhavaneswar.
 10. Punjab Fazilka, Karnal, Panipat, Rewari, Ambala
City, Jagadhri, Hansi.
 11. Rajasthan Udaipur, Kotah, Ganganagar, Alwar,
Bikaner, Jodhpur.
 12. Uttar Pradesh Lucknow, Varanasi, Kanpur, Allahabad,
Hardwar, Gorakhpur, Rampur, Vrinda-
ban, Orai.
 13. West Bengal Calcutta.
 14. Delhi Delhi.
 15. Himachal Pradesh Bilaspur, Mandi Chamba
 16. Pondicherry Pondicherry, Karikal.
-

**Publications of the Committee on Natural Resources,
Planning Commission.**

- (1) Committee on Natural Resources, Organisation and problems proposed for studies (1962).
- (2) Natural Resources of India (A brief statement) by M. S. Randhawa. (1963).
- (3) A Coordinated Study of Organisations concerned with the Surveys of Natural Resources, e.g. The Survey of India, Geological Survey of India, Soil and Land Use Surveys, Forest Surveys, Cadastral Surveys and Town Planning Surveys. (1963).
- (4) Study on Wastelands, including Saline, Alkali and Waterlogged Lands and their Reclamation Measures. (1963).
- (5) Study on Cotton in India. (1963).
- (6) Study on Groundnut in India. (1963).