Capacity Building for the Urban Environment:
A Comparative Research, Training and Experience Exchange

Project Paper No. 10

Community Based Sanitation and Environmental Improvement Programme : Experiences of Indore, Baroda and Ahmedabad

by

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Capacity Building for the Urban Environment: A Comparative Research, Training and Experience Exchange

A project implemented by the

Institute for Housing and Urban Development Studies (IHS), Rotterdam

In co-operation with the

Instituto de Desarrollo Urbano (CIUDAD), Lima
Institut Africain de Gestion Urbaine (IAGU), Dakar
Instituto para la Democracia Local (IPADEL), Lima
Human Settlements Management Institute (HSMI), New Delhi
Centro de Servicios para el Desarrollo Urbano (PROA), La Paz

Sponsored by

Directorate General for International Co-operation (DGIS), Netherlands Ministry of Foreign Affairs, The Hague

and

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Introduction to the Project

Focus and Outline of the Project

Capacity Building for the Urban Environment is a comparative research, training and experience exchange project that was launched in October 1994 with the support of the Dutch government. It provides an inventory and review of the experiences of relevant bilateral and multilateral organisations and of Best Practices in urban environmental management. For the countries of India, Peru and Bolivia, it identifies, communicates and extends the application of Best Practices in environmental management for cities. In May 1995, the project was expanded to include Senegal/West Africa with the support of the Swiss government.

The focus of the project is on learning from experiences in urban environmental management at the city level and on developing strategies for capacity building in order to replicate and scale up the best of these experiences elsewhere. The overall co-ordination of the project is the responsibility of the Institute for Housing and Urban Development Studies in Rotterdam, while co-ordination in the participating countries is the responsibility of the following partner organisations:

- Human Settlements Management Institute (HSMI), New Delhi, India;
- Instituto para la Democracia Local (IPADEL), Lima, Peru;
- Instituto de Desarrollo Urbano (CIUDAD), Lima, Peru (since January 1997);
- Centro de Servicios para el Desarrollo Urbano, (PROA), La Paz, Bolivia, and
- Institut Africain de Gestion Urbaine, (IAGU), Dakar, Senegal.

Project Activities

Support to cities in the form of applied research and development activities in the area of urban environmental management has been, and continues to be, provided by the co-ordinating partner organisations through the following set of activities:

Research

Within the applied research programme undertaken in the project, Best Practices in urban environmental management in Bolivia, India, Peru and, to some extent, Senegal were identified, and their lessons and experiences reviewed. An analysis and review of the identified Best Practices then took place involving a large number of individual research groups and professionals. In a process of on-going monitoring and review, guidance and support were provided by IHS and its partner organisations. The results of both the individual studies of Best Practices and their review are being published in several books and papers in both English and Spanish. These and their publication dates are listed in the *Introduction to the Project Papers*, which follows this note.

Networking

In identifying the research priorities of the project, during the conduct of the research studies, and throughout the review of research findings, a structure was developed and utilised to ensure the participation of all interested and concerned individuals and institutions through a consultative process. Expert group meetings and consultative seminars were organised for this purpose.

Capacity Building Strategies

After the Best Practices research, analysis and review were completed for all countries, outline capacity building strategies were developed for each based on what was learned from these local experiences and practices. These strategies were developed through a broad-based consultation process involving a large number of research institutions, individual professionals and academics, city representatives, NGOs and local representatives. They are currently being modified based on the outcome and findings

of Habitat II, which was held in Istanbul in June 1996, and the emphasis has now shifted to applying a number of Best Practices to selected cities.

Best Practices Documentation

Concurrent to and co-ordinated with this project, IHS served as the secretariat of and contributed to the review of the Best Practices that were submitted to the United Nations Centre for Human Settlements (UNCHS) for the *Global Best Practice Initiative for Improving the Living Environment* in preparation for Habitat II. HSMI, PROA, IAGU and IPADEL were also involved and contributed to the national preparatory processes that took place in their own countries. An overview of the Best Practice submissions to UNCHS, as well as summaries of the additional case studies received by IHS, are being made available on the Internet through the IHS Home Page.

Databases

Two databases are also under preparation: an institutional database and a literature database. The institutional database is being developed in co-operation with the International Institute for Environment and Development (IIED) in London. It contains entries on relevant organisations, some of which are documented in extensive profiles, while others are included as shorter reference information entries. IHS is developing the second database, which provides references in the literature on experiences with urban environmental management.

Rotterdam Seminar

The Rotterdam Seminar, which took place in May 1996 during the two weeks preceding Habitat II, brought together all principal researchers, as well as city representatives and other professionals involved in the project for a period of intensive discussions. The seminar resulted in a document that provided a comparative analysis of practices and experiences in the field of urban environmental management. This analysis included the project process and network building, governance, job creation and poverty alleviation and gender. This was published as a book in February 1997 and is listed later in the *Introduction to the Project Papers*.

The Rotterdam seminar also discussed *city-level capacity building strategies* for the cities of Calcutta, India; Ilo, Peru; Santa Cruz, Bolivia and Dakar, Senegal. Experiences in *urban environmental management* were reviewed for the cities of Tilburg, The Netherlands and Nairobi, Kenya.

Habitat II

At Habitat II the project was presented in the Special Meeting on Implementing the Urban Environment, organised by UNEP and UNCHS, as well as in other fora.

Capacity Building Strategies for Peru, Bolivia, India and Senegal

The outline capacity building strategies which were developed in preparation for Habitat II (i.e., by CIUDAD, PROA, HSMI and IAGU with the support of IHS). They are being modified for implementation, which is expected to begin late in 1997.

Outline Training Program for Local Officials, CBO Workers, and other Partners for Peru, Bolivia and India

These training materials are to be developed over the next few months and will comprise curricula for short courses related to the most directly applicable Best Practices identified for each country in view of its national strategy for capacity building in urban environmental management.

The Development of a Medium-Term Capacity Building Strategy for Senegal and West Africa

This activity is in progress and addresses the building of individual and institutional capacities at the local level for urban environmental management in both Senegal and throughout West Africa.

Ed Frank, Project Manager
Rotterdam, February 1997

Introduction to the Project Papers

A number of publications have appeared under the Capacity Building for the Urban Environment project. These are listed below and can be ordered from IHS or its partner organisations respectively:

- *Capacity Building for the Urban Environment,* edited by David J. Edelman and Harry Mengers, summarises the research findings of the project and the conclusions of tile Rotterdam Seminar. It was published by the Institute for Housing and Urban Development Studies (IHS) in Rotterdam in February 1997;
- *Urban Environmental Management: The Indian Experience,* edited by B.N. Singh, Shipa Maitra and Rajiv Sharma, reviews the Indian experience in urban environmental management and presents all the Indian Best Practice of the project in detail. It was published by the Human Settlements Management Institute (HSMI) and (IHS) in New Delhi in May 1996;
- *Problems and Issues in Urban Environmental Management: Experiences of Ten Best Practices,* also edited by B.N. Singh, Shipa Maitra and Rajiv Sharma reports on the Indian Best Practices of the project in an abridged form. It was published by HSMI and IHS in New Delhi in May 1996, and
- *Ciudades para la Vida: Experiences exitosas y propuestas para la accion,* edited by Liliana Miranda Sara, presents the Best Practices and outline capacity building strategies for Peru and Bolivia for a Spanish speaking audience. It was published as Volume 6 in the Urban Management Series of the joint UNCHS/UNDP/World Bank Urban Management Programme in Quito in May 1996.

The objective of this series of *Project Papers,* then, is to bring to an English speaking, audience the results of the project research in Peru and Bolivia appearing in the Miranda book. In addition, the Indian research, while documented in English in the second and fourth references listed above, has not appeared as complete, individual studies. Consequently, a selection of these will also be chosen for this series. Finally, the first reference in the above list covers aspects of the research undertaken in all four countries of the project.

As a result, the selection of work appearing in the *Project Papers* includes the following:

Bolivia

- 'Urban and Environmental Reality Workshops' by Zoila Acebey;
- 'Urban Agriculture in Community Gardens' by Julio Prudencio Böhrt, and
- 'Institutional and Development Framework for Urban Environmental Management in Bolivia' edited by Gastón Mejía.

Peru

- 'Defence and Conservation of the Natural Swamp Area Pantanos de Villa, Lima' by Arnold Millet Luna, Eduardo Calvo, Elsie Guerrero Bedoya and Manuel Glave;
- 'Consultation in Urban Environmental Management: The Case of Ilo' by José Luis López Follegatti, Walter Melgar Paz and Doris Balvín Díaz;
- 'Promotion of Employment, Health and the Environment, Lima' by César Zela Fierro and Cecilia Castro Nureña
- 'Environmental Sanitation and Infrastructure: The Case of the Marginal Urban Areas of the Southern Cone of Lima' by Silvia Meléndez Kohatsu, Víctor Carrasco Cortez and Ana Granados Soldevilla, and
- 'Inter-institutional Consultation and Urban Environmental Management in San Marcos Cajamarca' by Marina Irigoyen and Russeles Machuca.

India

- 'Power to the People: The Local Government Context' by the Times Research Foundation;
- 'Carrying Capacity Based Regional Planning' by the National Institute of Urban Affairs;
- 'NGOs/Civic Societies and Urban Environmental Advocacy' by Development Associates;
- 'Integrated Low-Cost Sanitation: Indian Experience' by Sulabh International Institute of Technical Research and Training;
- 'City-Wide "Best Practices" in Solid Waste Management in Collection, Transportation and Disposal' by HSMI/WMC of UIFW;
- 'Environmental and Health Improvement in Jajmau Area, Kanpur: Lessons and Experiences for Wider Replication' by Ministry of Environment and Forests;
- 'An Approach to Pollution Prevention in Electroplating Sector' by Development Alternatives;
- 'Integrated Study on Wetlands Conservation and Urban Growth: A Case of Calcutta's Wetlands' by Institute of Wetlands Management and Ecological Design;
- 'Sustainable Urban Development: A Case of Navi Mumbai (New Bombay)' by City & Industrial Development Corporation;
- 'Community Based Sanitation and Environmental Improvement Programme: Experiences of Indore, Baroda and Ahmedabad' by Shri Himanshu Parikh, and
- 'Institutional and Development Framework for Urban Environmental Management in India' by HSMI.

It should be emphasised here that the nineteen *Project Papers* in this series reflect the views of their authors only and have been edited to varying degrees. Initial English language editing was done by, among others, B.N. Singh, S. Maitra and R. Sharma for India and by D.J. Edelman for Peru and Bolivia. In fairness to both the authors and the publishers, they should, therefore, be characterised as working papers rather than full academic papers.

David J. Edelman, Series Editor
Rotterdam, February 1997

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CONCEPT OF SLUM NETWORKING

Slum Networking is not just a physical solution to the problem of urban slums but more an attitude to development which embraces scales, activities and agencies. It builds upon previous experiences and good practices in India and abroad. Indeed, it does not exclude other options of development for the urban poor such as 'sites and services', land banking and slum reconstruction but, instead, has a potential to be an umbrella to a multitude of alternatives.

Slum Networking has some unique facets which blend together to make it an enduring and replicable development mechanism. The main features are the holistic approach in the context of the city, significant cost reduction, mobilisation and convergence of substantial human and material resources, increase in community control and improvement of overall quality of life with an integrated mix of physical, educational, health and income generation inputs.

The slum fabric is seen in the context of the whole city and interventions proposed are mutually beneficial to the slums as well as the rest of the city. The objective is not to find solutions unique to slums but, instead, explore the commonality between the slums and better parts of the city to integrate the two. As slums are not the causes of urban degradation but the consequences of distorted development, the solutions likewise must treat the slums as mere symptoms and use them to work back into the city fabric to the origins of the problems.

Physically, Slum Networking involves upgradation of the entire city using slums not as individual islands but as an urban net, exploiting the inter-linkages between the slums and also the transitions between the slum and the city fabrics. The spatial spread of slums over a city together with contiguity between slum settlements gives an opportunity to strengthen the city level infrastructure networks. Studies of cities, both in India and abroad, show that the two fabrics are generally bound together by the skeletons of natural drainage courses. As there is a close correlation between the location of slums and the natural water paths, the slums become the entry points to urban renewal. Next, the functional and the aesthetic potentials of the natural drainage skeleton can be realized with the installation of low cost service trunks, particularly for gravity based systems of sewerage and storm drainage, along its lengths. This makes possible extensive environmental improvements such as cleaning up of polluted rivers, creation of fresh water bodies, development of green pedestrian spines and the restoration of waterfront structures. Finally, one can permeate back into the urban fabric other than the slums to complete the cycle of development.

The slums naturally benefit from the improved city level support. For the city too, the slums offer opportunities of change through this symbiotic process instead of drawing upon its resources. This coordinated process replaces the overlapping, and often conflicting, developments normally undertaken in a piecemeal way by a legion of agencies. As a vehicle for urban development Slum Networking is both catalytic and cost effective.

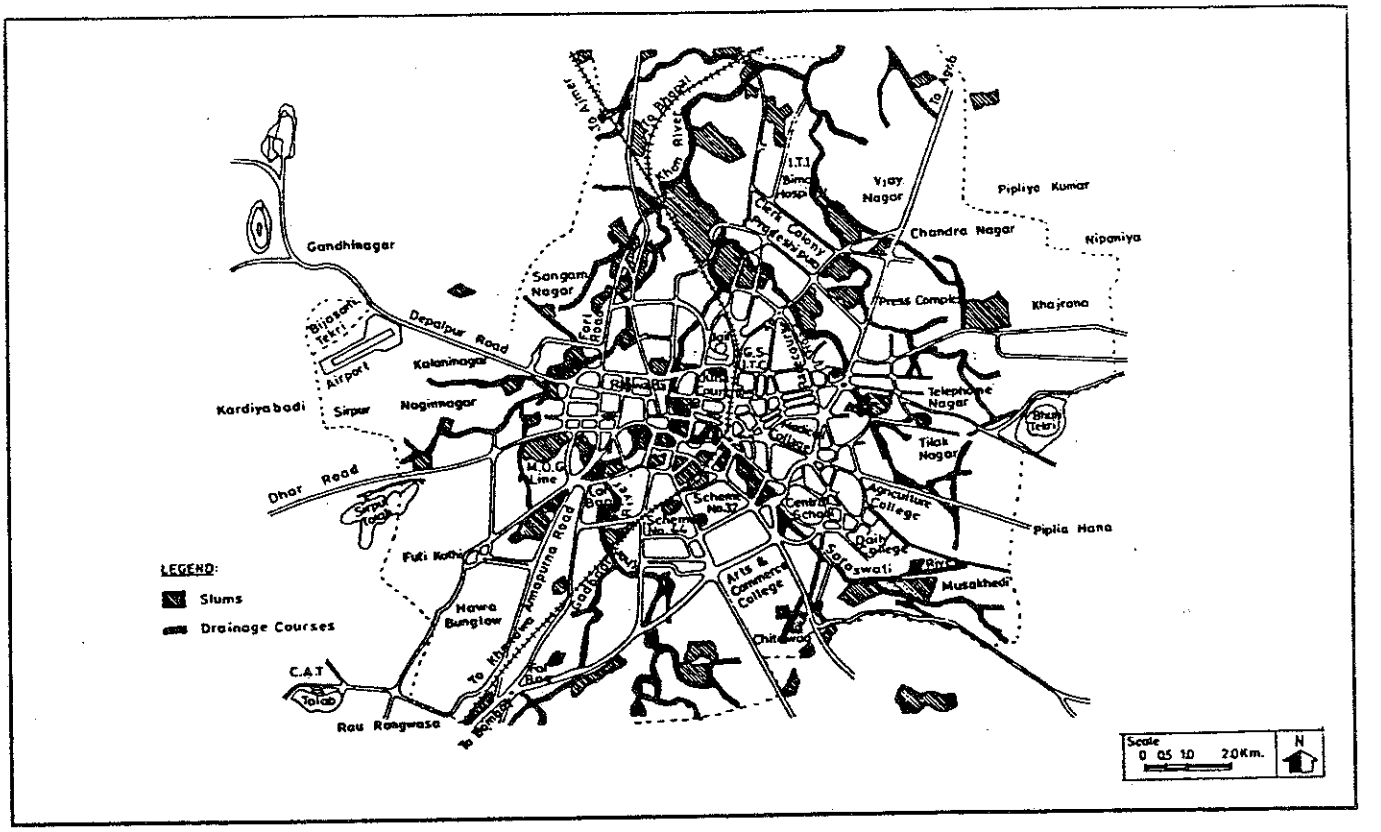
Unconventional concepts such as topography management, earth regradation and constructive landscaping are introduced. Service infrastructure is simplified and modified so that individual services (instead of shared facilities) can be offered to slum families at low costs. At the same time the maintenance burden is reduced and shifted from the local government to individual families.

The strategy prescribed requires sensitive and intense participation of the public through self-help in the development process. NGOs play an active role in motivating the communities, mobilising resources from the slum dwellers and converging the efforts of the people with the inputs from the local government and the business community of the city. The mechanisms evolved for community interaction are used equally gainfully for health, educational and income generation programmes. The net effect is holistic development which changes the functional, physical, socio-economic and environmental qualities of a city at a fraction of the cost of the conventional approach.

A HOLISTIC AND INTEGRATED FRAME

The integration of both scales and activities intrinsic to Slum Networking opens up exciting possibilities missing in other development strategies.

The method ties up micro-level improvements with the whole



Indore city slum fabric and Natural Drainage courses

city through the Networking principle and in the process makes possible many solutions which would otherwise be mutually exclusive. For example, it would not be conceivable to environmentally improve the city's water bodies unless the open gutters discharging into them from the slums and other areas are sewered in close pipes. Similarly, working across scales, many solutions at first thought unviable at micro level become quite economic. A comparative study in Indore showed that the cost of underground sewerage and centralized treatment by Networking was Rs. 1500 per slum family for the on-site provisions and Rs. 1000 for the off-site collection and treatment. Against this, the cost of a shared UNDP twin pit latrine, normally considered to be the 'appropriate' solution for developing countries, worked out at about Rs. 2500 per family. Although the costs appear to be comparable, the UNDP toilet does not take care of the grey waters from kitchens and bathrooms, whereas the sewerage system does. The additional advantages of piped sewerage are, firstly, that all the families have individual facilities and, secondly, the families other than in slums can also be connected to the same system without recurring the off-site costs - i.e. per family cost decreases as the contributing families increase.

In slums, most components of physical and community infrastructure are missing or deficient. By making slums the foci of development strategy, this apparent disadvantage turns into a virtue. There is an opportunity to work simultaneously on all aspects of development in an integrated manner, a luxury rarely available in the non-slum areas. For the physical works, abortive duplication is avoided and fine tuning of the related components is possible. For example, roads do not have to be repeatedly dug and be made good to install various services. Or, grades of roads and sewers can be jointly tuned to economize on both. When extended to the entire city, the compounded savings are substantial.

Physical upgradation by itself cannot improve the overall quality of life unless the economic, social, educational and health conditions change. Although the concept of community development running parallel to the physical improvements is often promoted, in practice, the two rarely keep in step for the want of coordinating mechanisms. In Slum Networking, integration is facilitated by the nature of physical works such as earth management, landscaping and individual services. These demand an active participation of the community and provide the necessary platform for weaving in the socio-economic components of development.

SPATIAL COVERAGE AND LINKAGES

In an Indian city, slums are usually spread over the city's entire area forming a loosely connected matrix. The spatial coverage as well as the near contiguity of slums enables infrastructure networks to be developed at the total city level to augment or

even replace existing and decaying services. It would normally be inconceivable to overhaul the city networks in view of the disruptions, costs and non-availability of land/access. The slum fabric makes this massive urban renewal possible at costs marginally more than those for conventional upgradation of slums.

Networking, though a more sensitive and painstaking process, essentially involves a constructive intervention rather than replacement. Because of its incremental nature it consumes far fewer resources. For example, as a city grows, new branches are drawn from the existing water supply pipes. The process of sub-branching continues with each successive growth cycle until the end pressures become almost negligible. At any one stage, it is unthinkable to replace the existing system because the costs are too high and the disruptions unacceptable to meet the incremental demand. With Slum Networking, this imbalance of pressure across the city can be redressed without a major overhaul by using the internal lines provided in the slums to short circuit the existing city branches and automat-. ically turn them into more efficient loops. This way, by using slums, the deficient city systems can be salvaged to improve their performances.

Since slums abut the natural drainage paths of the city, it is possible to build up sewerage networks for the entire city by simply providing the missing links between the slums. Likewise, roads on slum peripheries can be interlinked to create a secondary network in order to relieve traffic congestion on trunk roads of the city.

TOPOGRAPHY AND LAND MANAGEMENT

Site topography has a powerful influence on the layout and functioning of the gravity based infrastructures. Coordinating the roads, storm drainage and sewerage to natural gradients results in better function and economy.

At the city level only 40% of the land is marketable, out of which half is generally built upon. The powerful impact of the remaining 80% of the open land on the urban character and environment is often not appreciated. Slums spring up on many of these sites because of the lack of clear territoriality. Often slums are located on topographically disadvantaged sites or on marginal lands such as road verges, railway margins, high. tension line corridors, residual open spaces, river beds and drainage courses. Otherwise neglected areas of the city can be brought under environmental control by focusing on them.

Topography and land management coupled with the locational attributes of the slums with respect to the water courses and marginal lands has certain ramifications. The natural water courses and low lying areas tend to form nuclei around which slums cluster. By sensitive treatment of these lands several advantages are possible.

Firstly, areas prone to flooding and waterlogging may be lastingly improved by earth regrading at marginal costs. For example, a storm drainage system for Baroda was planned in 1985 to alleviate the frequent flooding in the central areas of the city. The then project cost of Rs. 222.5 million has now escalated to almost Rs. 500 million and the proposals are lying on the shelf for the want of funds. And yet, there is already a natural drainage system permeating deep into the city which can be activated with nominal efforts to relieve the flooding. The cost implications of the latter are only Rs. 40 million.

Secondly, the natural drainage courses are highly efficient routes for the gravity based city services such as sewerage and storm drainage. Further these paths eliminate the usual problems of land acquisition and demolitions. Thirdly, these drainage nets bind the slums with the city fabric, thus integrating the two. Lastly, topography management measures like cut and fill, site grading and landscaping dramatically improve the environmental qualities of a city at costs far lower than those for the conventional alternatives.

EQUITY FOR THE NEEDIEST

The 27% of the urban population living in slums makes a vital contribution to urban productivity but does not enjoy commensurate access to urban services. This is compounded by a disproportionate growth in the slum population of around 8-10% per annum compared to the average urban growth in India of about 4%. In many cities (i.e. Vijayawada in Andhra Pradesh) almost the entire population growth in the last decade is accounted for in the slums. Slum Networking automatically gives a high priority to this very large group which is also suffering the greatest deprivations.

The ultimate aim is to assimilate these settlements into the city so that there is equity between the income groups in terms of the quality of life enjoyed and the distribution of benefits.

CONCENTRATION OF RESOURCES

Where resources are scarce, it is prudent to give priority to the worst distresses. Slums naturally qualify for this bias. Further, the 27% of the urban population living in slums occupies only about 5% of the residential area of the cities. Thus, by exploiting the slum fabric, massive impact can be made on the city by just working on one-twentieth of the landmass. Focusing resources in this way is highly cost effective.

HEALTH

Faecal-oral contact, flies and mosquitoes account for most of the illnesses in our cities. Slums become the centres of epidemics because of contaminated ater supplies, open sewers and waterlogging. As the central themes of Networking are slums, underground networks, intercepting drains and earth management, it is clear that its positive impact on urban health must be enormous.

In many cities throughout the world, the sharpest declines in the urban death rates have occurred with the advent of under-

ground sewerage coupled with safer water supplies. London is one such example. Similarly, in the tropical countries, the elimination of mosquito breeding sites has had the same effect.

POTENTIAL FOR RESOURCE MOBILISATION

Development for the urban poor is normally financed with public funds, normally in the form of grants. The limited public revenues are rarely enough to match the overwhelming needs. In any case grants foster dependency. Loans, on the other hand have a recycling element which helps to stretch resources. Both these mechanisms, however, depend on the revenue base of the government. As 80% of the population falling under the EWS and low income categories is not eligible for direct taxation, resources are raised from the remaining 20% who fall in the tax net. Similarly, the greatest contribution to the indirect taxes also comes from the middle and upper income groups whereas the basic needs of the urban poor are met through subsidised public distributions. The investments, therefore, tend to be lop-sided in favour of high income areas where the resources are raised in the first place and where subsequent recovery of investments is also easier.

Once the upper income groups become beneficiaries of slum upgradation rather than the other way round, the resource base expands and the willingness to cross-subsidise increases. Thus, with Slum Networking, the tables are turned. When the greater concentration of inputs is in slums, recovery can be directly and justifiably be made from a very large section of the population which remains untapped. A quid pro quo approach of services for payments does work, particularly if individual services are provided. The individual contributions may be small but the aggregate across a large population base is significant. As the higher income groups also gain from the improved city level services, they too are less reluctant to contribute through connection charges and betterment taxes.

The greatest advantage of Networking, however, is that because of its catalytic nature as well as its strong emphasis on public participation, huge resources from the private sector as well as direct contribution of the benefitting individuals comes into play. The concepts of 'affordability' and 'cost recovery' are not new. However, the resources which the poor can marshall are greatly underestimated.

A large number of slum dwellers prefer to become ratepayers, provided they get adequate services. It legitimises their right to the land, specially when there is no land tenure. Municipalities and Corporations cannot ignore such a large source of recurring income which can be used to meet the maintenance costs.

THE GENDER ASPECT

The urban poor are trapped in a vicious cycle of poverty, ill health, miserable living conditions and illiteracy in which the 'causes' cannot be clearly distinguished from the 'effects'. Improvements in the environmental and sanitation conditions alone cannot break the cycle and a holistic outlook is required. Care has, however, to be taken to stop this from turning into a blunderbuss approach in which a plethora of actions are launched at random in the hope that some may work. Instead, it is much better to target the endeavours to specific objectives or groups. In Slum Networking many of the community development interventions are focused on women and girls, who will in turn be tomorrow's mothers. The reason for doing so is to stem the carry over of disadvantages from one generation to another. For example, there is a clear correlation between the female literacy rate and an array of other indicators such as infant mortality rate, birth rate, educational levels of children and family incomes. Thus, activities such as mother and child care, female literacy, income generation, vocational training and legal literacy assume special importance in Slum Networking.

Many of the above activities are specially designed to empower the women to ontrol their destinies. Legal literacy for women, for example, covers the legislations related to marriage, divorce, property rights, inheritance and dowry and also teaches the women to effectively use the complaints and redressal systems. The income generation programmes encourage the women to formalise their cottage industries into registered Cooperative Societies, make value addition to their products, develop marketing outlets and establish linkages with the formal sector financial institutions. Further, the right to majority representation of women, both in terms of the numbers and also the key positions held, is enshrined in all the projects. In Indore, not only are the majority of members in all the 79 Basti Vikas Mandals women but they also predominantly hold positions of the chairpersons, secretaries and treasurers.

On the physical front, women in slums face the worst hardships of environmental and sanitation degradations. Sometimes hours have to be spent just to fetch enough water for the day. Often girls miss school to help with the daily chores of cleaning the house and its insanitary environs. Women are, therefore, highly motivated to initiate development and play a more mature role in reaching consensus and resolving differences which arise in the community. They also show a greater degree of responsibility in managing money and making repayments. The Baroda project came to fruition in spite of a long incubation period of three years simply because of the persistence of the women there to have individual water taps and toilets. In Indore, as a result of Indore Habitat Project, slum women now prefer to marry in areas which have underground sewerage and individual sanitation. This in turn has triggered a social change which will have long term repercussions.

INDORE

In view of a large slum population in the city of Indore and its anticipated growth over the next decade, the Indore Habitat Project for slum upgradation was launched by Indore Development Authority (IDA) in March 1989 with financial assistance from Overseas Development Administration (ODA), U.K. through the Government of India. However, effective implementation on the ground could not start before early 1991.

The project builds upon the precedent of integrated development evolved in other cities of the country and overlays on it the structure of Slum Networking. Slum Networking exploits the extensive spatial coverage, contiguity and locational attributes of the slum fabric and other environmentally distressed areas within the context of the city as effective mechanisms of intervention at the total city scale. It seeks convergence of scales, activities, agencies and resources to improve the quality of life in a holistic manner.

Slum Networking as implemented in Indore has for the first time shown that the slum fabric can be exploited to transcend from a settlement scale to that of the city and in the process change the urban environment and infrastructure to the extent which was not possible through the conventional route. This section gives the basic outline of Indore Habitat Project. The subsequent sections give greater details of the components to illustrate the principles of Networking as applied in practice.

CITY PROFILE

Indore, the largest city of Madhya Pradesh State in India, is situated at latitude 22°-43' North and longitude 75°-57' East. The average level above Mean Sea Level is 550 meters, though, the general elevation of the town varies from 536 to 563 meters. The city is located almost centrally on the fertile Malwa Plateau.

Indore is an important textile manufacturing centre of India. The city has numerous engineering industries engaged in the production of finished and semi-finished goods. The industrial development in nearby towns has also increased its commercial importance. Because of its central location and excellent linkages, the city is an important marketing and distribution centre for cotton, ground nut, wheat and a number of other cash and commercial crops.

The city is very well connected with the rest of the country. It is situated on the Bombay-Agra trunk road and is a railway junction on the Meter and Broad gauge lines of Western Railways. There are regular flights between Indore and Bombay, Delhi, Bhopal, Gwalior, Ahmedabad, Calcutta and Pune.

In the last two decades the population of the city has grown very rapidly from 0.56 million in 1971 to 1.25 million in 1992. The present population of the city is about 1.4 million.

INDORE SLUMS

As the leading industrial city, Indore exercises a great 'pull' on the adjoining hinterlands. This coupled with the natural increase in population has meant that the city has seen a mushrooming growth of slums with unhygienic living conditions. As seen in Table 10.1 below, from 1971 to 1991, whereas the city population doubled, the slum population almost quadrupled over the same period.

TABLE 10.1 GROWTH OF INDORE SLUMS

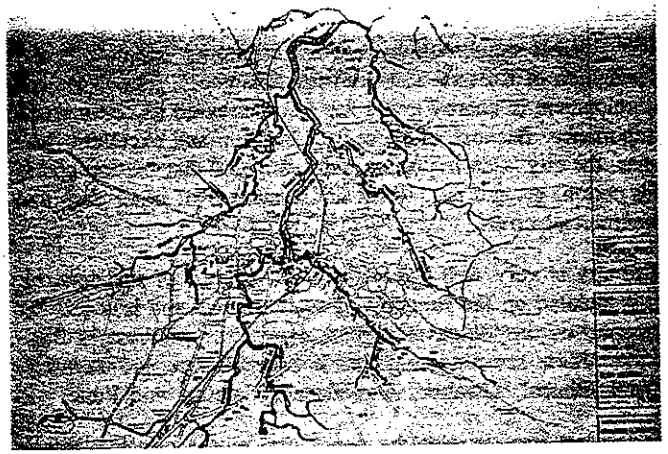
	1971		1981		1991		2001
Total Population (000)	560.95		827.07		1250.00		1800.00
Annual Growth Rate %		4.74		5.11		4.4	
Slum Population (000)	100.00		208.00		350.00		540.00
Annual Growth Rate %		10.80		6.82		5.42	
Slum Population as % of Total	17.82		25.15		28.00		30.00

Source: IDA 1992, Indore Habitat Project Report

Slums in Indore are characterised by overcrowding, kutcha or dilapidated structures, unhygienic conditions, grossly inadequate basic amenities, unplanned layouts and poor accessibility. These areas generally house economically weaker sections of the community who are often engaged in casual service occupations. More than half of the total slums of the city are situated in the textile mill areas. The remaining are either in the inner core or scattered on the periphery around the trunk roads.

Indore is an old city and a large number of its houses are in dilapidated condition. Nearly 30% of the houses are unfit for human habitation. In 1971 the housing shortage was 20,000 dwelling units which by 1981 increased to 51,000. This shortage has forced a large number of households into slums. Over half the houses in slums are kutcha (temporary) the rest being semi-kutcha (35%) or permanent (15%). In terms of tenure, 31% of the families are tenants.

As per a 1990 survey, over two-thirds of the slum families are below the poverty line earning less than Rs. 1000 per month. Temporary and daily wage workers in the surveyed slums form a large proportion of the workers, being almost 54%, followed by 31% who are self employed or engaged in petty trading. Only 66% workers find work for at least 14 days a month indicating a high level of underemployment (estimated at 35%).



Slums joined up to install sewerage in Indore

The rate of underemployment among females is as high as 79%.

Literacy rate in slums is relatively high, being almost 60 per cent, suppressing the age group 0-5 years. However, there is a marked difference between the sexes. A break up of the overall statistics into male and female shows literacy rates of 73% and 47% respectively. Only 35% of males and 16% of females have gone up to high school level.

A relatively large proportion of persons (12%) had reported being sick in the fortnight before the survey with the higher than average per treatment cost of Rs. 63. Surprisingly, allopathic treatment from private sources is preferred to public health services or traditional medicines. About 8% of the monthly income was reportedly spent on medical expenses. Most commonly adopted method of family planning is vasectomy. Of the 43% of couples following family planning, 93% have resorted to the operation as the safest method. Level of awareness among the residents regarding ante-natal and natal services is high. A large number of deliveries (60%) take place in hospitals. This accounts for the very high percentage of immunisation with BCG vaccine which is given at birth. As a source for immunisation, 66% of households use primary health centres or government run dispensaries.

LEVELS OF SERVICES

SETTLEMENT LEVEL

Quite a large number of slum families (86%) are served by public water distribution system either by public taps or through individual connections. The rest use alternative sources of water such as wells and handpumps. 76% of families are apparently served by public or individual toilets. The reality, however, is grimmer because most of the public toilets which serve 68% of the households are ill maintained and unusable. For example, about 47% of children sit near open drains or in the open grounds for defecation. Separate bathrooms are virtually absent. Most families (62%) bathe in the house or in the toilet. The remaining bathe in the open or near public taps.

Thirty five percent of the households had secured their electricity connections in the three years prior to the survey whilst 34% households got theirs in the previous 4-7 years.

Solid waste is mostly dumped in the vicinity of the houses. As city level solid waste management is very poor, this waste eventually either collects in local dumps or finds its way into the natural water courses, causing serious health hazards.

CITY LEVEL

The existing underground sewerage system serving the city dates back to 1936. It serves only about 5% of the city's population and covers less than 10% of the city area because of the lack of proper collection network or treatment facilities. The city has two low level pumping stations to lift the sewage at intermediate points. The treatment plant, comprising three settling tanks, is now hopelessly overloaded and most of the waste is pumped into the nearby farms or is diverted to river Khan passing through Indore. The textile mill effluent further adds to the problem as river Khan joins river Kshipra at a point little upstream of the city of Ujjain. Ujjain draws its city water supply from this river.

The large population not served by the sewerage system discharges its waste in the open gutters and open storm water channels which eventually discharge into the river. In any case, the existing underground sewer lines are inadequate to serve the increased population and in order to avoid the flooding of manholes, they have often been diverted straight to the river. Thus the river carries the major portion of the city sullage and sewage. This results in bad odours right in the heart of the city and the fly and mosquito nuisance poses a serious threat to the health of the inhabitants of the city.

The first phase of water supply to Indore city from river Narmada, which is already executed, and the second phase, which is under implementation, will eventually supply 199 MLD water to the city. However, until the second phase is commissioned, the city will continue to have intermittent supply with low pressures. In some houses the water connections pass through open drains carrying sewage. So, when the pressures in the water lines are low during non-supply hours, the sewage enters the supply pipes through leaking joints.

As the city expands, it experiences increasingly frequent flooding during monsoons as the impermeable built surfaces grow and as the natural water paths get destroyed.

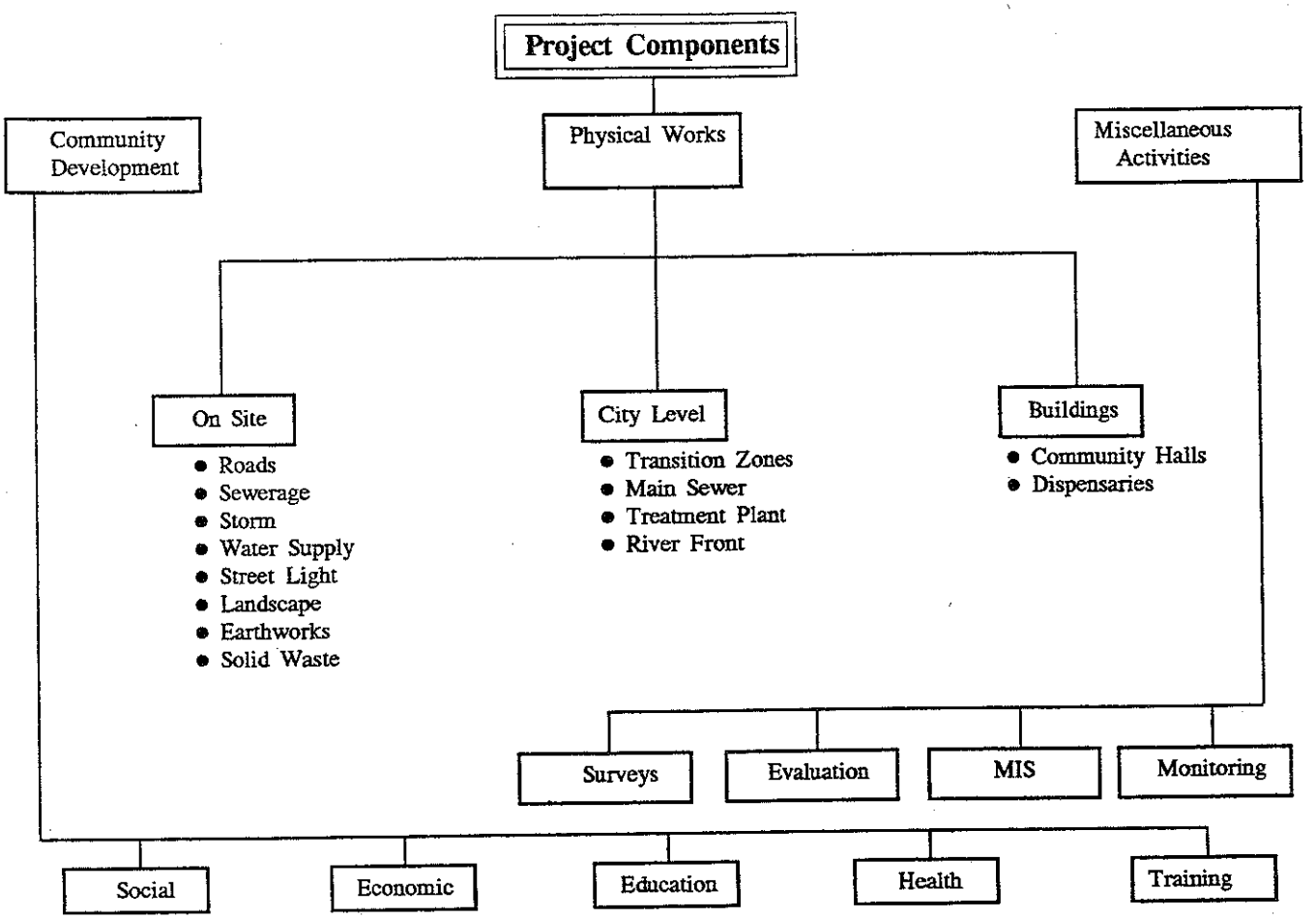
PROJECT COMPONENTS

As seen below, Indore Habitat Project has three major components.

a) Physical works in the slums and at city level.

b) Community development works.

c) Miscellaneous activities.



Components of Indore Habitat Project

PHYSICAL WORKS

COMMUNITY LEVEL WORKS

Out of the 183 slums covered under the project, 22 were previously upgraded under a World Bank scheme. Thus, improvement of physical infrastructure and environment was initially taken up in 161 slums with the rest having just the community development component. The slums developed under the World Bank scheme did not have individual sanitation nor did they have a major environmental improvement component. There was a strong representation from 11 of these slums that they should be taken up again for physical works because girls now preferred to marry in the Indore Habitat Project slums with sewerage and individual toilets in preference to the slums without. As this demand augured a major change in social attitudes, Indore Development Authority acceded to it. Hence, 11 World Bank slums were also taken up for upgradation bringing the total to 172. In total 450,000 persons were covered.

CITY LEVEL WORKS

The service infrastructure and landscaping of transition zones between the slum boundaries and the surrounding higher income areas was taken up to integrate the slum fabric more smoothly into the city. In any case, off-site infrastructure around slums has to be upgraded to accept the additional loading. Symbiotically, the slums can also strengthen the city level services they depend upon. For example, out of the 360 km. of roads provided in slums, about 80 km. on the slum peripheries were linked up at the city level to reduce the traffic congestion on the existing trunk roads.

About 90 kms. of new city mains were laid along the natural water courses to intercept the underground sewer lines from the slums. The main sewers were designed to receive the additional loads from the non-slum areas of the city presently discharging directly into the river. A new sewage treatment plant was necessary to deal with the effluent generated. However, the budgets reserved for the plant were eventually merged with

those available under National River Action Plan (NRAP) to facilitate a much higher capacity plant which could treat the effluent of other towns and the industries upstream of Indore city.

As the stretches of the rivers passing through the centre of the city became pollution free, they were turned into fresh water lakes and the banks were extensively landscaped. So far 4 kms. of banks have been taken up for environmental improvement. As the cost of this work can be met from the development of commercial cum recreational facilities along the banks, no additional financial burden is placed on the project.

BUILDING WORKS

To facilitate community development activities, 120 community halls were planned out of which 80 have already been constructed and under use. A total of four vocational training and production workshops have been built. For primary health care, two health centres are planned out of which one has already been built. In addition, three existing dispensaries which serve the city slums have been upgraded. In relation to the total project, the building works have been kept to a minimum with the view to integrate the existing city facilities into the project in preference to building new ones.

COMMUNITY DEVELOPMENT

Community development activities have been built into Indore Habitat Project to improve the socio-economic standards of the slum dwellers. These are described in detail in later section.

MISCELLANEOUS ACTIVITIES

BASELINE SOCIO-ECONOMIC SURVEY

The objective of this survey was to establish the baseline data of the physical and socio-economic conditions in the slums against which the efficacy of the project could be measured. The baseline survey also gave details of the 'perceived' needs of the slum population and also their willingness to pay for the upgradation. This gave useful inputs for the final project formulation.

It was necessary to survey at two levels. One a detailed survey of sample families and the other a survey of statistically selected slums for the overall slum profiles. The survey report contained the raw data, analysis, conclusions and also checklist parameters and indicators for the follow-up evaluation surveys.

The work was undertaken by a professional operational research agency based on a brief jointly prepared by the agency, Indore Development Authority and the specialist advisors.

PROJECT EVALUATION

Following the baseline surveys, further surveys were planned for evaluating and monitoring the project. This work was entrusted to the same agency engaged for baseline surveys.

Two evaluation surveys were proposed. The first one was conducted during the course of execution to determine the major lacunae in the project and to take the necessary corrective action. The second survey would be done some time after the project is over in order to determine the longer term effects of intervention.

MANAGEMENT INFORMATION SYSTEM

The objective of MIS is to give with brevity the status information on the project and projections of the targets. The system must be capable of giving the information area wise, activity wise or chronologically as per the needs of the users. Details of all the components of the project must be available, if needed, for closer scrutiny. Detailed or consolidated information on the status of the project in terms of progress, costs, incomes and staffing must be available.

The development of MIS for Indore Habitat project started in 1989. Meetings were held with the project staff and experts at various levels. MIS reports of the State government and other institutions doing similar work were also studied. Based on this, features such as completeness, brevity, frequency and addressing were built into the system.

It was decided to prepare the progress reports, both physical and financial, separately for the three principal wings of Community, Health and Engineering. In each wing the reports are addressed to three levels. Monthly reports are prepared for the field workers giving the total achievements till previous month, achievements in the given month and the targets. Consolidated quarterly reports are generated for the supervisory level by summing up the progress of the principal indicators in each slum. A summary report reflecting jointly the progress of all three wings is produced for the senior management.

Slum wise progress of all activities is obtained on designed proformas and fed into the computers. Proprietary data base and spreadsheet softwares are used to organise and analyze the data.

MONITORING

The entire project is monitored under the overall control of the project director. A Project Monitoring Committee is constituted which has representatives from the community together with experts from many disciplines. The committee meets once every month.

Officials from the Field Management Office of Overseas Development Administration visit the sites regularly and give the necessary guidelines after assessing the progress. In addition, it has appointed an independent consultant for the monitoring of the physical works in relation to progress, quality and costs.

A team from the project consultant's office also visits the sites for one week every month to clarify any problems in the

execution of the physical works. The same team also monitors the quality of the works during these frequent visits.

Once every year, a high level mission evaluates the progress and make recommendations. The group comprises a team from British High Commission, Central and State government representatives, the project consultant and the officials of Indore Development Authority and Indore Municipal Corporation.

IMPLEMENTATION FRAMEWORK

The scale and the complexity of Indore Habitat Project obviously demands inputs from a large number of sources. Indore Development Authority is the main executive agency, assisted by its consultants. Overseas Development Administration, U.K., which is the principal funding agency, also provides the technical expertise in developing and executing the programme. Many public agencies such as Indore Municipal Corporation, District Collectorate, State Ministries, Public Health Engineering, Forestry Department, State Health and Education Departments contribute to the project. The project staff and the community participants are trained by the local School of Social Studies and many other voluntary bodies. Links are also established with local hospitals for training as well as referral services.

The greatest contribution, however, is from the people themselves. The army of community volunteers, teachers, local birth attendants, members of the Neighbourhood Committees, Youth Organisations and Womens' Cooperatives actively participate in the day to day execution of the project and its sustenance.

Overseas Development Administration, U.K., is the principal funding agency for the slum upgradation components of the project. The objective of Indore Habitat Project is to multiply the quantum of development by, firstly, appending other sources of finance to this seed funding and, secondly, to encourage contribution from the beneficiaries in cash or in kind.

Madhya Pradesh State Government is providing Rs. 24 million for the main sewage outfalls for the city. The costs of river front environmental improvements are being met from marketing the associated recreational and commercial facilities. Indore Municipal Corporation is bearing the running and maintenance costs of all the infrastructure assets created. The resources for this can be generated by drawing the upgraded slum families in the tax net and imposing connection charges to the non-slum population for the better services they will enjoy. The running and maintenance expenses of the sewage treatment plant are expected to be met from the sale of treated water and manure to the farmers. The health and educational facilities created are sustained by the respective State Departments.

The direct contribution of the community takes many forms. All families contribute a proportion of the sewerage costs by paying for the house connections from the main lines. Funds for social activities are also collected in each settlement by the respective Neighbourhood Committee. The earthworks and landscaping components are directly executed by the communities through self-help and largely at their own expense. Some incentives are offered under the project in terms of free plants and token cash rewards for trees which have survived after two years of planting. The health, educational and social components of the projects are run at the grassroot level by community volunteers who either offer their services free of charge or are paid just token honorarium through the project funds and community contributions.

The project is designed to be catalytic in nature so that vast resources are also indirectly drawn into the improvement of the urban fabric. For example, the project resolutely avoids investment in housing stock in the hope that the infrastructure development will, in turn, prompt the residents to invest in house improvements. Sample surveys of slums already completed show that this activity has indeed started. Following physical and environmental upgradation, which cost about Rs. 4200 per family, each household has on average invested around Rs. 10,000 towards the improvement of its shelter.

A separate account head is maintained for the project under which all incomes, expenditures and assets are recorded. Separate project files, vouchers and receipts are maintained. The accounts are prepared on a double entry basis. The detailed accounts are audited continuously by an independent State audit branch.

Although land tenure is not the primary catalyst of shelter upgradation for the urban poor, it is, nevertheless, an important stimulus. For all the slum settlements in the city, a parallel and independent programme is in motion to transfer the legal rights of the land to the dwellers.

PHASING AND COSTS

Slum Networking is a continuing process and not a one time project.

Complex programmes requiring intense interaction with all the participants have to respond to the changing needs and the experience gained. Normally, the project designs, budgets and time frame are all set before starting the work. This invariably leads to cost over-runs, time extensions and improper or incomplete implementation. It is preferred that project formulation be dynamically built into the project rather than be a predetermined precursor.

For Indore Habitat Project, this involves a multi-stage implementation. The project components, their budgets and the time frame were initially broadly set as per the previous experiences and norms. The preparatory work of surveys, data collection, designs and execution of pilot works was included in the same stage. Based upon the feedback from this stage and also the subsequent stages, the precise scope, character, financial needs

and phasing are periodically reviewed and published in the annual Project Status Reports.

The physical works of Indore Habitat Project are phased over four years. The community development activities are coordinated with the physical works so that the two run in tandem. Allowing for vagaries of the Indian monsoon the overall project duration was set at five years.

Table 10.2 gives the year wise and activity wise financial allocations set in December 1991. Whilst the programme is broadly on target, it has been realised that a transition period will be needed for the community and the local government to take over the long term sustenance from Indore Development Authority. A further two years have been added to the programme for this gradual weaning.

TABLE 10.2 SUMMARY OF PROJECT PHASING AND COSTS (in Rs. Million)

Component	90/1	91/2	92/3	93/4	94/5	Total
Physical Works in Slums	5.76	31.10	55.99	72.56	70.47	235.88
Overheads @ 8%	0.46	2.48	4.48	5.80	5.64	18.87
Sub-total	6.22	33.57	60.47	78.36	76.11	254.75
Community Halls	4.23	11.41	7.39	0.00	0.00	23.03
Dustbins	0.34	0.00	0.24	0.14	0.19	0.57
Dispensaries	0.00	0.86	0.93	1.01	0.00	2.80
Overheads @ 8%	0.00	0.98	0.69	0.09	0.02	2.12
Worksheds	0.00	2.81	3.03	0.00	0.00	5.84
Sub-total	4.57	16.06	12.28	1.24	0.21	34.36
Riverfront Development	0.00	0.00	3.77	2.05	0.00	5.82
Sewerage Scheme	0.00	13.67	15.75	17.01	0.00	46.43
Overheads @ 8%	0.00	1.09	1.26	1.36	0.00	3.71
Treatment Plant	0.00	0.00	0.00	0.00	8.00	8.00
Sub-total	0.00	14.76	20.78	20.42	8.00	63.96
CD, HQ Staff	0.45	0.49	0.52	0.57	0.61	2.64
CD, Field Staff	0.40	0.77	1.00	0.98	0.71	3.86
CD, Transport	0.06	0.03	0.02	0.00	0.00	0.11
Staff Training	0.27	0.14	0.16	0.16	0.04	0.77
Health Programmes	1.23	2.05	2.85	2.56	1.77	10.46
Economic Programmes	2.25	3.20	1.60	3.69	3.74	14.48
Social Programmes	1.47	1.09	1.74	0.66	0.44	5.40
Education Programmes	1.42	3.73	5.09	3.60	2.15	15.99

Component	90/1	91/2	92/3	93/4	94/5	Total
Office Costs	1.12	0.13	0.14	0.15	0.16	1.70
Mechanical Equipment	0.89	0.00	0.00	0.00	0.00	0.89
Computer	0.90	0.00	0.00	0.00	0.00	0.90
Consultants	1.32	1.45	1.39	0.68	0.29	5.13
Evaluation	0.50	0.00	0.00	0.63	0.00	1.13
Project Preparation	0.50	0.00	0.00	0.00	0.00	0.50
Sub-total	12.78	13.08	14.51	13.68	9.91	63.96
Grand Total	23.57	77.49	108.04	113.70	94.22	417.03
Inflation Factor	1.00	1.08	1.17	1.26	1.36	

INDORE - PHYSICAL WORKS AT COMMUNITY LEVEL

Around a third of the urban population of India lives in slums. Although it is well known that the physical conditions in the urban slums are quite appalling, the degree of distress and its effect on the overall socio-economic development of the slum communities is not always fully understood.

Most slums have little or no physical infrastructure support in terms of roads, water supply, sanitation, storm drainage, solid waste disposal, streetlighting, pavings and landscaping. Public agencies normally responsible for this work ascribe this to the lack of resources. They point to the infrastructure conditions in non-slum areas of our cities which are also far from satisfactory. However, the conditions in slums are much worse. The severe resource constraint may account for the overall deficiencies in urban infrastructure but cannot explain the gross imbalance between slum and non-slum areas. Lack of will, inappropriate priorities, inadequate institutions and inappropriate delivery mechanisms play a greater role in creating these distortions.

The lack of service infrastructure in slums causes severe environmental and sanitation problems. Unpaved roads and open gutters make access difficult. In the rains the roads become muddy and the gutters overflow. There is widespread flooding and waterlogging in the monsoons. Water supply is generally inadequate and often contaminated. Poor sanitation facilities lead to defecation in the open. Slums thus become foci of seasonal epidemics of diarrhoea, typhoid, cholera and malaria. Even in slums where improvements have been undertaken under the Environmental Improvement of Urban Slums (EIUS) or Low Cost Sanitation (LCS), the result are far from satisfactory. The work is undertaken in piecemeal fashion, poorly planned and shoddily executed, becoming infructious in a short period. The net impact of these cosmetic measures is not much although the resources expended are not negligible.

Physical improvements are but a component of the overall socio-economic upliftment of a community but their immediacy eclipses the other priorities such as education, health and economic development. This is reflected in the interviews with the slum communities in which their perceived needs in the order of priorities are almost invariably adequate water supply, better sanitation, storm drainage and paved access to their homes. As the field workers in the slums cannot satisfy these primary demands, their credibility is limited.

GENERAL APPROACH

In India, the planning and design of service infrastructure generally leaves a great deal to be desired. As a result, the costs are enormous and the performances poor. The following checklist has been prepared for the designers to ensure that in terms of the approach as well as details, the proposals are basically sound. The list is primarily designed for Slum Networking but is also quite relevant to other applications:

FORM AND FUNCTION

The infrastructure networks are important determinants of the urban form and can also influence the future growth patterns of a settlement. The road skeletons are particularly critical because apart from giving physical access, they are the main corridors for other services.

In addition to the form, the infrastructure systems must efficiently take care of the day to day functional needs of urban life. The movements of pedestrians and vehicles must be smooth.

All basic services must reach the entire population in an equitable manner related to the land uses and income mixes. Further, they must be easy to maintain, repair and upgrade.

HOLISTIC FRAMEWORK

Infrastructure must be conceived in a holistic framework in which the individual components are integrated into the unified whole in relation to the other planning requirements, natural features and constraints, topography, functional needs and the resources available. The components must complement each other to avoid wasteful overlaps, uncoordinated performance and micro-level conflicts.

The time element must also be built into this frame so that both physical extension as well as additional capacity can be accommodated with growth. Replacement of infrastructure systems in the future is more costly than upgradation.

LONG TERM SOLUTIONS

Solutions which are short term or which are not amenable to change should be avoided. This is particularly important in slum upgradation where, under financial constraints, there is a temptation to adopt cosmetic measures such as community toilets, public standposts, open gutters and cheap paving. Without proper care of the public facilities coupled with poor durability, these slums rapidly deteriorate to their original state. The money spent on improvement is thus largely wasted. Studies of the slums upgraded in this manner have shown that the health of the residents does not improve either because the underlying physical factors such as water ponding, contact with excreta or contamination of water have not been really taken care of.

Often the solutions adopted are static and cannot respond to the changes in the physical, financial or social conditions of the residents. For example, as a slum matures and the income levels increase, people aspire for higher levels of services. Private toilets and house to house water supply are then favoured in preference to community facilities. At that stage, it is not easy to change from one system to another and the previous investments become redundant.

Flexibility is all the more required where a combination of solutions are used or where slum upgradation is a transient stage to redevelopment. Here, a two tier approach may help. The primary services on the boundaries and on the main skeletons of the settlement could be designed for a longer life span and in tune with the city's long term development. The internal services would be planned to meet the short term needs so that infructious expenses are minimised when internal restructuring takes place.

DATA BASE

The success of a project depends on the data base available. Physical and other relevant surveys must be undertaken before starting a project, preferably, by professional agencies having the expertise. Numerous sewerage or drainage projects are conceived without detailed topography surveys resulting in expensive and ineffective systems.

Data banks and drawing archives must be established prior to design so as to ascertain the need, determine the extent of existing services and avoid any conflicts of coordination. Previous experience has shown that such data is rarely collected and often drawings of existing services are not even available. The data relevant to the urban development of the city would include census data, volumes of the reports of the past projects, town planning and zoning maps, transportation and other infrastructure plans, land and estate records, data on Municipal finances, etc.

PROFESSIONALISM

For successful conception, execution and management of a project, highest level of professionalism is necessary. This would involve meticulous data collection, physical surveys, feasibility studies, detailed engineering designs, preparation of complete and coordinated execution drawings, detailed specifications, accurate quantification, time and resource management, regular site supervision and testing. This regime can ensure excellence in quality, timely execution and cost controls.

Slum upgradation is more complex to plan and execute than conventional engineering projects. Under severe resource constraints there is also a need for innovative solutions. It is odd that whereas these would demand greater professional inputs, the reverse is true in practice.

INTERACTIVE DESIGN APPROACH

Often designers do not have clear perceptions of the needs of the people. Their approach, though well meaning, is not the most appropriate for the lack of research and dialogue. In these situations, an iterative design process is suggested which can take into account the views of the target population. This would start with the preparation of alternative sketch proposals for discussion with the community groups. Once a broad consensus is reached, the details of the chosen option are then firmed up in stages in joint consultations. The process not only prepares the communities for the changes to come but also increases their willingness to pay for and maintain the systems.

When working in slums, the problem is all the more acute because of the wide disparities in the lifestyles of the designers and their clients. The slums residents often assume that any work undertaken is for political expediency and tend to demand the maximum that they can get for nothing. In response, the designers often develop cynicism. However, if there is extensive dialogue between the two, the slum dwellers accept the limitations of tight budgets and cooperate with the designers. When given alternatives, the slum dwellers more often than not

opt for longer term solutions and for doorstep infrastructure (rather than shared services) even if it means additional personal expenditure on their part or missing out on some of the facilities.

TECHNICAL INNOVATION

Appropriate and innovative technologies should be incorporated into the designs. For example, conventional manholes or road sections will not work in the narrow and twisting lanes in the slums. Solutions should be amenable to local work practices and materials. They should be of scale and nature which complement the human resources. For example, expensive brick manholes can be replaced by small earthenware chambers. Precast components such as manhole covers and kerbs can be introduced to stimulate cottage industries.

This does not mean that high technology has no place. For example, computers can be gainfully used to investigate a large number of options and reach optimum solutions through interactive processes. At the same time they can simplify the processing of quantities, contract documents and other administrative chores.

REALISTIC STANDARDS AND WORKABLE SPECIFICATIONS

There is a tendency in public health engineering to follow inherited norms in preference to analysis and design. For example, there is no point in designing urban water supply systems for an ideal per capita consumption of 250 litres when that standard can clearly not be achieved. This would simply result in expensive water supply systems and dry sewer runs. Similarly, the Indian road width standards emulate the widths prescribed in the developed countries whereas the indigenous need is for frugality within the constraints of traffic intensity and grades. Essentially the standards must be constantly questioned in relation to performance and not accepted slavishly.

Under budget constraints, the ambitious standards have to be often compensated with watered down specifications at the cost of durability. Economy must be achieved through appropriate design and not by substandard specifications.

AFFORDABILITY

There is a linkage between the standards adopted and the affordability. When solution do not match the paying capacity, effectively there is subsidization. This may work on an individual project but cannot be replicated on a larger scale. Alternatively, work not fully executed to save costs can result in impaired function. For example, if service roads are planned but not executed on a major bypass, there would be serious safety hazards.

MAINTENANCE V/S. CAPITAL COSTS

Infrastructure systems must be assessed on the basis of both the capital costs and the maintenance expenses. Elements such as pumping stations, which consume energy and require permanent maintenance, should be avoided even if it means slightly more initial capital costs. Community facilities such as public latrines often appear to be more economic at the time of construction. However, once the maintenance costs are taken into account or the under-utilisation of the facilities in the event of disrepairs is considered, the picture changes. A way to balance the capital and the maintenance costs is to capitalise the running costs before making comparisons.

TOPOGRAPHY MANAGEMENT

Site topography has a very powerful influence on the layout and functioning of physical infrastructure, specially on the gravity based services. Coordinating the roads, storm drainage and sewerage to natural gradients results in economy and improved function. The relatively inexpensive measures such as cut and fill, site grading and landscaping for topography management also have substantial environmental impact. Special attention must be paid to the design of road margins, public and semi-public spaces, water courses, railway and electrical corridors and other marginal lands.

The basic principles of topography management shows that the roads are proposed in cut below the surrounding ground. Normally roads are raised above the ground level and the plot holders in turn fill up their plots even higher. In the event they do not, water logging is common which, apart from physical inconvenience, is the root cause of the majority of diseases prevalent.

ROADS AND FOOTPATHS

All the main circulation roads are designed in relation to the traffic intensities, grades and the soil bearing capacities. These roads give a long-term structure to the settlement and are designed for a suitable life span accordingly. The layouts have been integrated with the branches and loops needed for other services. The main roads have the minimum widths necessary for access to emergency vehicles such as ambulances and fire tenders.

All internal roads are made as narrow as possible. The surface cleanliness of the margins is achieved with grading and planting instead of expensive paving. In any case, as slums change constantly with time, infructious expenses on roads should be minimised. At appropriate turnings, road junctions and cul-de-sacs small public squares have been incorporated for festivals and other community activities. The layout of internal roads is generally informal in tune with the organic character of the slums. The internal roads are designed for a longer lifespan than the main roads because they are not likely to be upgraded frequently by the authorities.

As far as possible, all roads in urban areas must be in excavation and must have positively downward slopes from high points to drainage courses. The road edges must be protected by curbs. This approach has the following benefits:

- Road sections act as channels and attenuate the rain peaks, resulting in smaller pipe sizes of storm drains.
- Sewers and storm drains together with manholes remain shallow and, therefore, cheap.
- Lengths of storm drains reduce as their function is partly taken over by roads.
- Road sections with curbs are more durable.
- The expense of road filling, which may be as much as 25% of the total road cost, can be avoided if the conventional raised road section is not adopted.
- Fill needed for regrading and earthworks is generated on-site from the road excavations rather than importing from outside. This again saves costs.
- Road base and sub-base thickness can often be reduced when in excavation because the virgin ground is likely to have greater bearing capacity than fill.

Most areas in Indore are on black otton soil. This is a soft silty clay which is expansive and requires the following additional precautions in road construction in order to minimise the damage caused by soil movements:

- Replace sub-grade soil by inert material such as sand.
- Use flexible surface such as stone paving in preference to asphalt. Concrete paving may also be used provided it has frequent movement joints.
- Provide high cambers to allow for some settlements.

CONCRETE V/S ASPHALT ROADS

Bitumen is an expensive, imported product which has to be used sparingly. Wherever possible, stone, brick or concrete paving for internal lanes is preferred to asphalt. The Indore experience has shown that concrete roads are cheaper, easier to clean and more durable. Expensive reinforcement can be avoided by providing movement joints. These roads become extensions of the houses and can be used for sleeping out at night. The technology of the concrete roads is such that the local tradesmen are participating in the construction.

STORM DRAINAGE

Open masonry storm drains are expensive. They are also unsanitary because of the dirt, debris and even excreta collecting in them. Contrary to popular belief, the underground piped storm drains are relatively cheaper and hydraulically more efficient. They also incur lesser maintenance costs.

In Indore, the concept of combined road section and piped drains was successfully introduced which had all the advantages of the piped system at a fraction of the cost. Roads laid in excavation with positively downward slopes form the primary water carriers which are supplemented by piped drains only when the loads increase. It should be understood that it is not the transient flow of water which damages roads but long term stagnation, particularly on the margins of elevated roads, which undermines the road base.

The comparative cost analysis of 100 m. lengths of piped and open drains based on the Schedule of Rates of Indore Development Authority shows that in addition to the saving in per metre length, the total lengths of piped drains reduce very substantially because roads perform part of the function. As a result, the per family cost for storm drainage in Indore has reduced to just Rs. 110 against sewerage cost of Rs. 1,450.

The storm system in Indore is designed to suit the rain intensities, storm durations and permeability coefficients of the ground.

SEWERAGE

Many alternatives were considered, namely, dry pit latrines, aqua-seal pit latrines, UNDP toilets, dry composting toilets such as 'Multram', bio-gas plants, septic tanks, reticulated sewerage and community toilets. Some options were rejected because of poor soil conditions, high densities, etc. For reasons of hygiene, open gutters were not considered.

On the cost criterion community toilets and reticulated sewerage were the most attractive. The option of reticulated sewerage became viable because of the scale of the project and the presence of a new sewerage main. Further, the slums in Indore are almost contiguous and do not require long lengths of additional pipes to connect to the main sewers.

On the grounds of performance, reticulated drainage was found to be more acceptable in terms of hygiene, preference for use, maintenance costs and durability. Hence, piped sewerage was proposed, designed sensitively to the topography. For better flows, the system was designed to carry both the soil sewage and foul water. In view of the scarcity of water in Indore, nodular networks are used to increase the flows and at the same time reduce the number of manholes. All families have been encouraged to take individual water connections so that most of the water supplied returns to the sewer lines. Allowance was made for some rain water infiltration in the system during monsoons.

The system was designed such that at the initial stages, when there are fewer connections, the minimum cleansing velocity is maintained and in the future, at maximum peak flows, the pipes have adequate capacities. In terms of costs the main trade off is between the pipe diameters and the slopes which generate deeper excavations and dearer manholes. Computers were use to study the various options and reach optimum solutions.

With a design sensitive to topography, pumping was avoided in the system resulting in elimination of capital, running and

maintenance costs of pumping stations. Expensive appurtenances such as drop manholes and vent shafts were omitted by making suitable changes to the design. The inspection chambers for the house connections, which account for a large part of the sewerage cost (ie. almost 30%), were replaced by small, inexpensive intercepting traps developed specially for the project. Most of the blockages in piped sewerage happen at the entry points. The traps which replaced the chambers were sufficiently small in size to be placed at the doorstep or even inside the houses. The maintenance burden, therefore, shifted from the Corporation to the individual families.

Generally water consumption of 135 to 250 litres per person per day (LPCD) is assumed for urban sewerage systems. Surveys of Indore slums, however, showed water consumption of between 40 to 60 lpcd. It was, therefore, decided to use realistic design standards. However, allowances had to be made for possible improvements in the water supply in the future as well as the population growth. This required a rather tricky balance between the slopes and the diameters such that flushing velocity was achieved in the early days and that the pipe capacities were not exceeded in the future. To be able to do this with very economic pipe sections and shallow slopes, computer software was developed to quickly investigate a large numbers of options for each settlement for the best solutions.

WATER SUPPLY

As most of the slums in Indore have reasonable water supply, an attempt was made to selectively repair or upgrade the existing systems in preference to total replacement. New networks were proposed only in the remote or newly developed sites. The existing hand pumps and wells were salvaged and integrated into the system to the extent possible. The cost of upgrading in this manner was around Rs. 450 per family in contrast to the conventional cost of water supply of Rs. 1000 per family. In addition, the supply was to individual households instead of the community standposts normally provided. The advantages of the individual water connections are obvious in terms of better maintenance, greater convenience and better sewerage flows.

In the design of new networks, the principal trade offs were between the terminal pressures, reservoir heights and the pipe diameters. For a more even distribution of pressure, looped networks were generally used in preference to branches. Some of the internal water supply runs were also used to short circuit the main branches of the city, converting them into loops. The benefits of pressure equalisation were, therefore, extended to the rest of the city.

Cast iron pipes were used for the critical runs in the main roads, whereas, for the reasons of economy and better frictional properties, cement pipes were used for all internal runs. Galvanised iron pipes were used for house to house connections.

Computers were used extensively to make the trade offs between performance and costs.

POWER AND STREETLIGHTING

Most houses in Indore have electricity and most streets are well lighted. The main problem, however, is that the lines are overhead. Both from the point of view of safety as well as performance, underground lines are better. Though the initial capital costs of the underground system are greater, the running and maintenance is cheaper. The Indore Habitat Project did not have the resources to convert the existing overhead lines to underground. Thus the existing lines can only be replaced over a period as and when resources become available. A provision has, however, been made to repair the existing streetlights in slums and provide new ones wherever necessary.

EARTHWORKS AND SOFT LANDSCAPING

These works are critical to Slum Networking for several reasons other than those of mere aesthetics.

Thoughtful planting can improve the micro-environment of the settlements. Shade trees cool the streets in summer and at the same time reduce the dust in the air. Decorative trees and flowering plants add to the beauty. Vegetable, herb and fruit yielding plants, in addition, supplement the daily needs of the families.

Landscaping was also used as an engineering tool. By sinking the roads below the adjacent land, the excavated material was used to fill up the low lying areas and regrade the slopes in order to drain the water towards the roads and the storm systems instead of ponding on site. Subsequent grassing gave clean and firm surfaces at a fractional cost of hard paving. Compared with paved surfaces, grasses absorb more water and reduce its speed of flow, thus reducing the peak flows in the storm systems. Grasses at the same time check silt erosion.

Earth management and grassing very significantly reduce the costs of roads and pavings, the most expensive components of urban infrastructure. Moreover, the work can be undertaken directly by the communities because they have the knowledge and the sensitivity of their surrounding environment.

Special attention was given in the selection of the species to the following needs:

- hardy
- maintenance free
- quick growing
- perennial
- not eaten by cattle
- low watering needed
- suitable to black cotton soil

SOLID WASTE

Solid waste management is a vital, yet often neglected urban service from the point of view of hygiene and environment. As discovered in Indore, the problem cannot be solved by mere installation of dustbins. A whole system has to be evolved from the doorstep collection to the final disposal.

Shared dust bins and community level collection points were provided to the slum families covered under the project. House to house collection and primary separation of waste (i.e. paper, glass, metals, plastics, rags) was to be undertaken by the residents themselves. An active drive was launched to educate and organise the communities for the task. As the people are more concerned about their immediate environment, it was felt that they would take greater care than the public agencies especially if the economic benefits of recycling can be ploughed back into the communities. The Indore Municipal Corporation is theoretically responsible for collecting the waste from each locality and disposing it safely.

Contrary to expectations, the results of the solid waste programme at Indore have been rather poor. It is becoming increasingly apparent that the solid waste component of the project is very weak. The Corporation does not have either the appropriate equipment or the manpower to discharge its duties. Thus the attempts at the grass root level are being frustrated by the deficiencies of the civic authority. At the same time, the educational programme has not been too effective in convincing the population about the health hazards of solid waste. Hence, waste often collects in the side lanes and, worse still, gets dumped in the sewer manholes and storm drainage chambers, thereby blocking the systems.

In the light of this experience, new proposals are now being prepared for the post sustenance period of the project in order to salvage the situation. It is clear that this operation will have to go beyond the mere movement of waste and start looking more closely at the human chain associated with waste collection. Action will have to be taken to assimilate rag-pickers and the municipal sweepers into the programme. There is also a scope for introducing innovative technologies for recycling the waste or processing it for energy. Every opportunity has to be taken to use the solid waste as a potential resource instead of treating it as nuisance.

As seen in the cost breakdown of physical works in Table 10.3, the solid waste component is only Rs. 10 against the total cost per family of Rs. 4,200. In retrospect this expenditure is not enough. However, even with additional financial inputs for strengthening the programme, the solid waste component will remain a small fraction of the total. It nevertheless can jeopardise the whole project if not handled well.

COSTS PER FAMILY

Based on 1992 prices, the cost breakdown per family for on-site upgradation of physical infrastructure is given in Table 10.3.

TABLE 10.3 ON-SITE DEVELOPMENT COSTS PER FAMILY BY COMPONENTS

(Rs.)

Component	Cost per family
Roads and footpaths	1750.00
Asphalt courses	250.00
Storm drainage	110.00
Sewerage	1450.00
Water supply	450.00
Earthworks and landscaping	130.00
Street lighting	50.00
Solid waste management	10.00
Total cost per family	4200.00

INDORE - COMMUNITY DEVELOPMENT

The aim of the project is to improve the quality of life of the urban poor. This can only be achieved by integrating the physical works with economic, social, educational and health improvements. Community development is perhaps the most critical component of total development because it can give the urban poor the self confidence and the executive ability to initiate their own development. Thus community development activities spearhead physical works. The principle that the communities will actively determine and participate in the process is enshrined in the Indore Habitat Project.

The precise needs vary from community to community. To some extent they also depend on the aspirations and the abilities of the people involved. In each settlement, the Community Organisers (COs) of Indore Development Authority do considerable preparatory work to establish rapport with the people and identify their needs. Meetings are held with small groups to explain the project objectives and to identify Resident Community Volunteers (RCVs), each representing about 20 families. RCVs are the spokespersons of their respective groups and form the backbone of all the community development activities. They are organised into democratically functioning Neighbourhood Committees. This promotes two-way communication by which the grassroot problems are brought out in the Neighbourhood Committee meetings and the decisions and the project objectives disseminated back to the people.

Community development work is not capital intensive but it does require intensive human interaction. To the extent possible, non governmental organisations, voluntary agencies and motivated individuals have been drawn into the project in preference to direct implementation by the public agencies.

COMPONENTS AND OBJECTIVES

Components:

- Social Activities.
- Economic Activities/Income Generation.
- Educational.
- Health.
- Training.

Objectives:

- To develop a sense of belonging to the urban community through increased participation in community affairs using a problem solving approach with community initiative, organisation and self-help.
- To develop community leadership and skills, to identify community needs, plain programmes and implement them on a priority basis and to supervise them at the community level.
- To create a sense of social cohesion on a neighbourhood basis through cooperative civic action and to bring about improvements in social conditions and the physical environment.
- To ensure maximum utilisation of the resources of NGOs and government awareness of the needs of the slums communities.
- To ensure full community participation in planning, implementation and management of the project components.
- To involve the communities in the long-term sustenance of the programmes and physical assets, created by the project.
- To contribute to the process of integration of the slum communities into the city and the externalisation of social and economic relations.

SOCIAL ACTIVITIES

The social inputs in the project comprise:

- Setting up a neighbourhood committee in each settlement.
- Setting up youth clubs and womens' co-operatives.
- Building community halls.
- Arranging for social activities at community halls.
- Encouraging the groups to arrange competitions and functions both within their own area and also with the neighbouring settlements.
- Holding regular awareness programmes on various issues such as, environment, solid waste management, use and maintenance of infrastructure, etc.
- Starting physical education centres.

ECONOMIC ACTIVITIES

These re set up to increase the incomes of the slum families so that their standard of living improves. The following activities for income generation have been set up in Indore Habitat Project:

- Setting up workshops for developing vocational and entrepreneurial skills and providing counselling for the aspiring entrepreneurs to register, set up and run their own industries or business.
- Establishing community based cottage industries, specially for the housewives, and creating linkages with local industries and markets.
- Setting up revolving funds for giving short term loans for raw materials, machinery and establishment.
- Providing technical education scholarships to promising students in slums.

EDUCATIONAL ACTIVITIES

The educational inputs in Indore Habitat Project comprise pre-primary education for children of three to five years of age, non-formal education for school dropouts and adult education classes aimed at improving basic literacy levels, specially of women. These particular areas of intervention have been chosen for the following reasons:

- Pre-primary education is an important link in the education chain, providing an entry point into the city's primary education system and giving slum families the encouragement and confidence to send their children to primary and secondary schools.
- Non-formal education provides additional coaching to the school going children in slums who would otherwise find it difficult to keep up with children from more privileged backgrounds. It also provides opportunities for school dropouts.
- Literacy level of slum adults is quite poor and among

women it distressingly low. For example, 73% of working women are illiterate. The adult education programme provides opportunities for the adult population, particularly those in the 15-35 age group, with an emphasis on women.

HEALTH

The health programme creates awareness, gives training and provides the basic infrastructure for mother and child care, family planning, disease detection/curative facilities and better health statistics. A close interaction is required with the local hospitals and the state health department for auxiliary support.

The health component is managed by one community health manager, four public health nursing officers, one health education officer and three field medical officers. Training of both management and field staff is undertaken by the Regional Family Welfare Training Centre, the Indore City M Y Hospital, the Indore School of Social Work and the Social and Preventive Medicine Department of the Medical College.

Community based workers namely Auxiliary Nurse Midwives (ANM), Community Health Workers (CHW) and *dais*, the traditional birth attendants, play a major role. There is one auxiliary nurse midwife per 1,000 households and one community health worker per 200 households. These workers are complemented by strengthening the existing curative health services which involve physically upgrading three dispensaries which serve slums, and appointing a medical officer to each of these.

The activities are phased in the same way as the community development component, i.e. the project supports inputs for a three year period in each slum. A full contingent of health management staff is in place for the five year period of the project. Field Medical Officers are attached to the upgraded dispensaries as and when they are completed (during the first three years of the project). ANMs have their physical base in the community halls which are provided with appropriate furniture and equipment. Mopeds are provided for the three field Medical Officers, the four Public Health Nursing Officers and the Health Education Officer.

LONG TERM SUSTENANCE

Any development strategy must make provisions for the long term sustenance of the assets created. This is an activity which requires joint participation of the community and the local bodies. The special difficulty with Indore Habitat Project is that it is executed by Indore Development Authority which has the trained staff whereas the sustenance of the assets is to be taken over by Indore Municipal Corporation which is plagued by shortage of funds and appropriate manpower. On the other hand, the persons trained during the project in the Development Authority and in the slums may become redundant at the end. Proposals are prepared to absorb these persons in the Corporation and in the community as a permanent resource pool. These proposals also address the following issues:

- Sensitising the individuals and institutions on the importance of post project maintenance of assets created.
- Fixing institutional roles and responsibility for post project assets.
- Creating a community cell in the Corporation to assist community based post project sustenance.
- Making provision for the required resources.
- Making available the infrastructure and equipment needed.
- Training and reorienting the personnel on post project maintenance and making provisions for additional personnel required for the purpose.
- Planning for the transfer of assets to different agencies who are responsible for their maintenance.
- Insuring proper co-ordination and integration between the project staff and the agencies who are responsible for post project maintenance after the transfer of assets.
- Training the community to actively participate in post project maintenance.
- Strengthening the neighbourhood committees and involving them in the post project maintenance.
- Identifying non-governmental organisations ready to involve themselves in post project maintenance.
- Assisting the interested project staff related to community development to become NGOs.

INDORE - IMPACT AT CITY LEVEL

The essence of Slum Networking is to use the spatial coverage, contiguity and the locational attributes of slums to avail benefits for the total city. In Indore Habitat Project, the process has made a substantial impact on the city as a whole in several ways.

By interconnecting the internal sewerage in slums along the natural water courses, main intercepting drains have been installed to serve the whole city which, like most other cities in India, did not have underground sewerage to speak of before the project started. As a result, the pollution of the natural water courses has been arrested in the central portions of the city. These areas are now turning into fresh water lakes and a network of pedestrian green is being built up along the banks.

Through the Networking principle, other infrastructures of the city have also been strengthened, mainly by exploiting the transition zones around the slums. New networks have been built up for storm drainage and roads and existing water supply networks have been improved. These networks naturally serve the slums well but in the process have become equally valuable to the city.

Even the physical developments within the slums have had a city level impact. Although work in each slum may be too little in terms of the city scale, the sum of these works spread across 172 pockets does make a difference to the city. When the most distressed areas of the city, covering almost 30% of its population, are improved environmentally, the whole urban landscape changes.

Normally, major changes as above would be inconceivable in a city over a such a short time span because of high costs, disruptions to the city, land acquisition difficulties and coordination problems between a multitude of executing agencies. In Indore this city level transformation has happened over a five-year period as a mere byproduct of Slum Networking.

The details of the city level impact of Indore Habitat project are given in the following paragraphs.

ENVIRONMENTAL IMPROVEMENTS

By exploiting the contiguity of slums and their relationship with the natural water courses, it has been possible to introduce underground sewerage mains in the entire city which was previously discharging its waste into the water courses. In the absence of sewage, the water courses are turning into fresh water bodies with parks and pedestrian paths on both the banks. The river front structures in the city centre have been restored and together with the environmental improvements are becoming major recreational areas. The treatment facilities planned in the wake of the new sewerage system will ensure that the cities downstream of Indore will no longer receive polluted waters. It must be noted that these benefits are direct consequences of Slum Networking and emphaise the fact that slums offer unique opportunities to our cities.

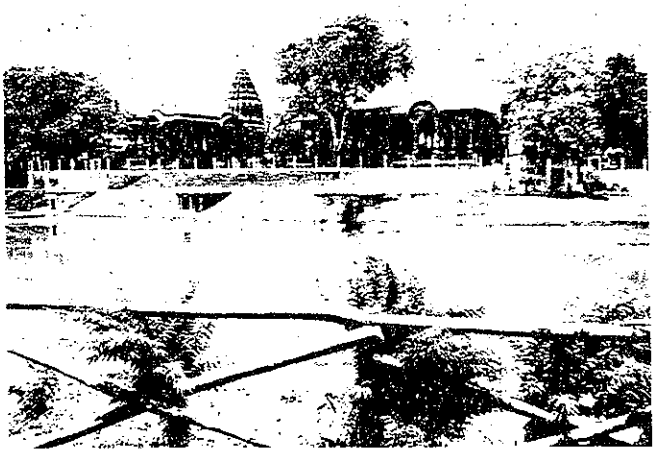
INTERCEPT SEWERS

Most cities in the world have good natural drainage courses. Without these, young towns would never mature into cities because they would drown in their own waste. There are a small number of cities in the world which have survived in low-lying troughs through constant pumping. However, these are exceptions which can not be sustained in countries other than the most affluent. The natural streams and rivers passing through our cities define the ideal gravity paths. At the same time, for reasons which are not yet fully understood but which can be speculated, slums and the other poor areas of a large number of cities studied in India and abroad are closely linked to these drainage paths. These factors have jointly given birth to the intercepting main sewers in Indore as a consequence of Slum Networking.

Five years ago, the housing colonies and the slums on the streams and the rivers were discharging untreated sewage directly into the water courses of Indore. By providing the missing links along the banks between the sewerage networks laid within the slums, city level mains were built up at costs which are a fraction of the amounts required using conventional methods. By increasing the pipe diameters of the links, the capacity of the main sewers was increased to accept the larger city load at a marginal additional cost of Rs. 24 million. About 90 km. of sewer mains now permeate deep into the city fabric. A basic framework has thus been provided to convert the whole city to underground sewerage in place of the traditional open gutters. As the banks along the natural streams are owned by the nation and because there are no major built form obstacles, the time and costs normally associated with land acquisition, demolitions, litigations and compensations have been avoided.

The secondary and tertiary networks in the slums were constructed as part of the project but those in the higher income areas were excluded because it was felt that the people there

Indore city centre – before Slum Networking



Indore city centre – after Slum Networking

could well afford to lay their own internal networks. This process has now started and more and more of the upper income areas are now connecting in the sewer mains laid. They are finding this to be a cheaper alternative to the conventional on-site treatments like septic tanks and soakpits. Even in slums the innovatively designed internal networks in combination with the economical intercept mains have proved to be the most viable of all the sanitation options considered.

In a city not experienced with underground sewerage, there are bound to be teething problems of maintenance in the early years. In Indore, blockages caused by the solid waste dumped into the manholes were quite frequent in the early years though the complaints are reducing each year as the public becomes accustomed to the system. Indore Municipal Corporation has a very large staff of sweepers and cleaners for maintaining the open gutters. This staff is not yet well equipped to maintain the underground system and will need to be retrained. However, in the long term, piped sewerage requires far less maintenance staff than open gutters and will result in substantial saving in the running expenses.

Indore is located on a plateau and, therefore does not have good slopes across the city. In spite of that, by using the natural gravity paths along the streams, the entire sewerage system remains at shallow depths, generally not exceeding two metres. Moreover, just as nature does not need pumping stations to keep the rivers flowing, they are also not required for the sewers running parallel. In fact it is for the first time in Asia that a city of this scale and terrain has no pumping stations. The savings in both capital and running costs are so enormous that the piped system not normally affordable in developing countries has become feasible in Indore. Table 10.4 below gives comparative costs of underground sewerage systems for the city of Indore, one based on networking of slums and the other for the conventional city system as was originally proposed by the Public Health Engineering Department. The city level outfalls and the distribution systems in the slum areas are executed under the project. The distribution systems in the upper income areas are to be jointly financed by the users themselves and a government grant available under National River Action Plan (NRAP).

TABLE 10.4 COMPARATIVE COSTS OF NETWORKING AND CONVENTIONAL SYSTEMS

Component	Slum Networking Method	Conventional City System
Outfall drains	Rs. 60 million	Rs. 200 million
Sewer mains	Rs. 100 million	Rs. 200 million
Distribution systems	Rs. 220 million	Rs. 400 million
Pumping stations	Nil	Rs. 30 million
Capitalized pumping costs	Nil	Rs. 20 million
TOTAL	Rs. 380 million	Rs. 850 million

The work on the outfall drains and the intercepting mains between the slums is nearing completion and some portions of the river are becoming pollution free. In the final stages of the work, as the cross drainage works are taken up and the existing city gutters discharging into the river diverted to the intercepting mains, longer stretches of the river will improve.

RIVERFRONT DEVELOPMENT

River Khan and River Saraswati, both of which are no longer perennial, flow through Indore in the north-south direction. In the heart of the city, the Saraswati merges with the Khan which continues to flow north through the city. Several minor streams through the city also flow into these two rivers. Once out of the city, River Khan joins River Kshipra which passes through the holy city of Ujjain further downstream. Over the years, River Khan had turned into an open sewer as the city's waste discharged into it. The old waterfront structures became dilapidated and the city turned its back to the river. Slums grew up along these neglected stretches. Until two years ago, the banks were no more than smelly sites of open air defecation and dumping grounds for garbage.

Once the intercepting drains were installed between the slums and along the banks, the sewage in the river started drying up in some stretches. This opened up exciting possibilities of revitalising the riverfront. Initially a 1.8 km. stretch in the centre of the city, at the confluence of Khan and Saraswati rivers, was taken up for improvement. The old temples and the stone steps along the banks were painstakingly restored. Even the people of Indore had forgotten that such fine heritage existed in their city. The river bed was dredged to a grade and the surplus earth used to widen the banks. The slopes were stabilised by the cheap and natural method of cutting the sides to the natural angle of soil repose, dressed and then extensively planted with the earth binding grasses and shrubs. Stone pitching and masonry toe walls were used to retain the banks where the space was too limited to permit the natural slopes. Pedes-