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# Republic of India

# IN Support Strategic Assessment for Innovative and Transformative change in delivering Urban Env Services in Amritsar a Ludhiana

July 2015

GWADR

SOUTH ASIA

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# INDIA: Strategic Assessment f Innovative and Tranformative change in delivering Urba Environmental Services in Amrits and Ludhiana (P14943(

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## List of Key Abbreviations

| | |
|---|---|
| BRTS: | Bus Rapid Transit System |
| CETP: | Common Effluent Treatment Plants |
| CEPI: | Comprehensive Environmental Pollution Index |
| CPCB: | Central Pollution Control Board |
| CPHEEO: | Central Public Health and Environmental Engineering Organization |
| Cr | Crore (10 million) |
| CSR: | Corporate Social Responsibility |
| DEA: | Department of Economic Affairs |
| EMAP: | Environmental Management Action Plan |
| GOI: | Government of India |
| GOP: | Government of Punjab |
| IMD: | Indian Meteorological Department |
| INR: | Indian Rupees |
| Lpcd: | Litre per Capita per day |
| MBL: | Main Branch Lower |
| MCA: | Amritsar Municipal Corporation |
| MCL: | Ludhiana Municipal Corporation |
| MLD: | Million Litres per Day |
| NAAQS: | National Ambient Air Quality Standards |
| NGO: | Non-Governmental Organization |
| NLTA: | Non-Lending Technical Assistance |
| NRW: | Non- Revenue Water |
| PMIDC: | Punjab Municipal Infrastructure Development Corporation |
| RWH: | Rain Water Harvesting |
| STP: | Sewage Treatment Plants |
| ULG: | Urban Local Government |
| ULB | Urban Local Body |
| VAT: | Value Added Tax |
| WTP: | Water Treatment Plant |

# INDIA - SUPPORT STRATEGIC ASSESSMENT FOR INNOVATIVE AND TRANSFORMATIVE CHANGE IN DELIVERING URBAN ENVIRONMENTAL SERVICES IN AMRITSAR AND LUDHIANA (P149430)

## 1. INTRODUCTION:

### 1.1 Background

1.1.1 The Government of Punjab, through Government of India's (GoI) Department of Economic Affairs (DEA) had requested the World Bank to provide Non-Lending Technical Assistance (NLTA) "to provide high quality basic urban civic amenities to the residents of cities of Ludhiana and Amritsar in the areas of: Water Supply, Sewerage, Storm Water Drainage, Solid Waste Management and modern urban transport system". The request at section 4 says: "A major switch from the current system of highly polluted ground water based water supply to surface water supply (canal water based) is envisaged under this proposal. The study is expected to recommend measures and technologies to overcome the existing problems and transform the cities in to modern cities with substantially developed urban civic amenities. Capacity building, Institution and legal reforms will also be the component of the project report". Therefore, the request is quite broad but in nutshell, it stresses on "Innovative Transformation in Urban Services delivery".

1.1.2 Punjab is the most urbanized state in north India. The state chose only two large cities for the study as it wanted to benefit from this work and use the learning to replicate on its own in other ULBs. After initial discussions with sector officials, Bank team visited both Amritsar and Ludhiana cities to identify priority service level, innovations and institutional challenges that have to be addressed under this NLTA for achieving desired transformative change. Considering ongoing state initiatives to improve ULBs' revenue base such as widening property tax base, willingness to move to volumetric water tariffs, willingness to bring in institutional changes and presence of strong ownership of key state institutions viz., Punjab Municipal Infrastructure Development Corporation (PMIDC) and the Department of Urban Local Government (ULG), makes it possible to demonstrate "Urban Transformation" by working in these two cities. The team in consultation with the state and ULB officials decided to pursue the following areas under this task:

- Assess possibility to shift to surface water supply aiming at delivering continuous water supply (24x7)
- Options to reduce vulnerability to flooding from intense storms resulting from climate change
- Action plan for improved urban environment and address point sources of pollution
- Gain understanding of poverty dimension and guide ULBs on addressing it through interventions such as inclusive governance, housing and improved access to services
- Understand ULB level financing and legal issues and
- Guide policy and strategic planning for better service delivery.

## 1.2 Overview of the Technical Assistance:

1.2.3 The objective of the NLTA work is "Support Strategic Assessment to bring innovative and transformative change in delivering Urban Environmental Services in Amritsar and Ludhiana cities". The work will focus at two levels:

1. *Strategic assessments of issues confronting ULBs in delivering environmentally sustainable services to all including the poor.*
2. *Prefeasibility level studies to develop implementable innovative approaches to address climate change concerns while bringing-in transformation in Service delivery in the areas of Water Supply and Drainage*.

## 1.3 Results Framework:

| Intermediate Outcome | Indicator | Result |
|---|---|---|
| Development financing supported | Preparation of new operation informed | The Honorable Chief Minister has consented the client agency PMIDC to seek Bank assistance; request is expected shortly |
| Policy/ Strategy informed | Government policy/ strategy informed, public debate/ initiated. Contributed to stakeholder involvement | Study findings; particularly policy implications are widely discussed at various levels which include presentation to the Chief Minister and Cabinet minister. Widerconsultation with primary stakeholders – more than 10 city level workshops held. |
| Client Capacity Increased | Design Capacity Strengthened | PMIDC actively participated in the studies and has improved capacity to manage such activities |
| Knowledge Deepened | Facilitate exchange of best practices with clients | Best practices on urban water sector from other states (such as Karnataka 24x7) shared |
| Innovative approaches and solutions generated | New/ Innovative approaches fostered | Innovations such as ULB owned utility model, financial model or for sustainability of water operations, climate change friendly approaches in drainage etc supported |

1.3.1 The TA was useful as the state is thinking of requesting for an operation with the Bank Support. Some of the reforms initiated are: measures to collect water tariff from the exempted customers, more detailed studies on environmental issues, seeking allocation of water resources from identified surface water resources etc.

1.3.2 The NLTA work (funded by AusAid and DFID TF) include studying range of environmental services that ULBs are expected to deliver, the issues that have direct impact on the quality of urban living and for improved economic opportunities for its people in these two cities.

## 1.4 Overview of Outputs:

1.4.1 The NLTA supported a range of studies in both cities which included:

1. Technical Feasibility study of 24X7 Water Supply
2. Financial Models for continuous water supply and study of ULB finances
3. Institutional Study of Water and Waste Water services
4. Urban Drainage study in both cities
5. Urban Environmental studies
6. Urban Poverty studies – Addressing services for poor
7. Other individual consultants to guide the studies.

1.4.2 A multidisciplinary team of Bank specialists provided support to these studies and worked with the client agency, Punjab Municipal Infrastructure Development Corporation (PMIDC). The summary findings of these findings are presented in this report.

## 2. OUTPUT 1: DELIVERING CONTINUOUS (24X7) WATER SUPPLY:

2.1.1 Currently, water supply is drawn from hundreds of unprotected bore wells across length and breadth of the city which supply polluted water through an unplanned haphazard network. The system of water supply is operationally inefficient given the low tariffs, large number of unpaid but authorized customers (exempted from paying for water), open taps and high levels of leakages; which result in drawing of high volumes of ground water, ultimately making the system unsustainable. The objective, is to present options to minimize the over dependence on ground water supply from bore wells to reduce vulnerability from climate change and to deliver world class efficient water supply delivery systems using surface water. The tasks include

- Identifying suitable surface water source to supply water in these two cities
- Assess serviceability of existing water assets for reuse under continues water supply regime;
- Indicative investment plan, costs and time lines to implement a program
- Policy changes necessary for sustainable delivery of services

2.1.2 The work has been carried out in three separate but parallel studies: Technical, financial and Institutional. The recommendations of the studies are presented briefly hereunder.

### 2.2 Amritsar Water Supply Technical Feasibility Report:

2.2.1 As per Census 2011 the city has a population 1,132,761 Projected population for the year 2014, 2032 and 2047 has been taken as 1,256,189, 1,791,958 and 2,437,835 respectively. The net rate of water supply adopted as per Central Public Health and Environmental Engineering Organisation (CPHEEO) guidelines is 135 lpcd. The total water demand for the projected population for year 2032 and 2047 works out 300 & 395 MLD, respectively.

2.2.2 The current source of water is ground water. As per MCA, although the city has a production capacity of about 300 MLD water from 350 deep tube wells, supplied on an intermittent basis i.e. 12 hours a day (5 hours in the morning, 2 hours in noon and 5 hours evening) the consumers are not getting adequate and assured 24x7 water supply due to high losses and improper distribution system. Excessive extraction of water in huge quantities from ground is causing depletion of ground water table every year. Also, the ground water is getting contaminated from industrial and other local sources of pollution. There is no metering of water connections in the city. The tariff structures are also based on area of plots with a higher number of customers living in small plots (59%) exempted from any payment, not based on actual usage resulting in poor revenue collection and insufficient funds for O & M of the system.

2.2.3 Now, a surface source based water supply scheme from Main Branch Lower (MBL) canal is proposed for 24x7 water supply all over the city. Offtake works from MBL canal is proposed just in the upstream of Tarowali head regulator. The estimated cost of the proj (including contingencies and price escalation during implementation) will be about ~INR 1386 Crores ($ 230 m) which almost replaces existing system that is built around bore well points. Primary Treatment works and a WTP of 300 MLD is proposed near the Tarowali head regulator itself along the MBL canal on irrigation land. The scheme will have a total of 35 km clear water feeder mains to feed 7 no. of underground service reservoirs (SUGSR) (total capacity 22,500 KL),

40 km rising mains to fill the overhead service reservoirs (OHSR) of 24,000 KL capacity, 960 km distribution network and 65,000 no. house service connections with meters are the main works proposed under the project.

### 2.3 Ludhiana Water Supply Technical Feasibility Report:

2.3.1 As per Census 2011 the city has a population of 1,613,878. Projected population for the year 2017, 2032 and 2047 has been taken as 2,208,914, 3,413,535 and 5,275,090 respectively. The net rate of water supply adopted as per CPHEEO guidelines is 135 lpcd. The total water demand for the projected population for year 2032 and 2047 works out 550 and 855 MLD, respectively.

2.3.2 The current source of water is ground water. As per MCL, although the city has a production capacity of about 530 MLD water from 658 deep and 277 shallow tube wells, supplied on an intermittent basis i.e. 12 hours a day (5 hours in the morning, 2 hours in noon and 5 hours in the evening). The consumers are not getting adequate water pressure due to high losses and improper distribution system. Excessive extraction of huge quantities of water from ground is causing continuous depletion of ground water table. Also, the ground water is getting contaminated from industrial and other pollution. There is no metering of water connections in the city (a few bulk consumers have meters). The tariff structures are also based on area of plots and not on consumption. Further, many customers (47%) living in small residences are exempted from payment. This results in poor revenue collection and insufficient funds for the Municipal Corporation for proper O & M of the system.

2.3.3 Now, a surface source based water supply scheme from Sidhwan canal is proposed for 24x7 water supply all over the city. Offtake works from Sidhwan canal is proposed near Lohara village and in Punjab Agriculture University (PAU). The estimated cost of the project (including contingencies and price escalation during implementation) will be about INR 2100 Crores ($ 350 m) to completely replace existing water supply that is built around each bore well points that pumps water directly to 1.6 million population without any treatment. The proposed scheme proposes primary treatment works and two WTP's of 255 and 295 MLD near Lohara Village & in Punjab Agricultural University (PAU) campus respectively. A total of 40 km clear water feeder mains to feed 11 no. of UGSR (total capacity 72,000 KL), 73 km rising mains to fill the OHSR, new OHSR of total 51,000 KL, 250 km distribution network and 42,000 house service connections with meters are the main works proposed under the project.

2.3.4 As above, both the cities will have to have completely new water supply schemes with investments costing about $ 706 million. To understand financial feasibility, financial modelling was undertaken along with institutional review.

### 2.4 Municipal Financing:

2.4.1 The financial modelling found that 59% of connections in Amritsar and 47% in Ludhiana are exempt from water charges. The general budget has a revenue surplus in both cities, due to VAT surcharge. But is used up in bridging the deficit in water supply and sewage department leaving no room for investment in other urban facilities such as health, education, urban transport etc.

| | Amritsar | | | | Ludhiana | | |
|---|---|---|---|---|---|---|---|
| As of 2014 | | | | | | | |
| Population (2014) | 12,56,189 | | | | 20,60,275 | | |
| Water supply | 300 MLD | | | | 530 MLD | | |
| Size of Household in Marla | Connections | % total | Billing Rs Crs* | | Connections | % total | Billing Rs Crs |
| Domestic | | | | | | | |
| 0-5 | 1,07,434 | 59% | NIL | | 1,08,383 | 47% | NIL |
| 5-10 | 49,997 | 28% | 5.87 | | 77,722 | 34% | 21.92 |
| 10-20 | 7,776 | 4% | 2.25 | | 20,389 | 9% | 1.24 |
| >20 | 1,327 | 1% | 0.52 | | 2,879 | 1% | 0.23 |
| Total | 1,66,534 | 92% | 8.64 | | 2,09,373 | 91% | 23.39 |
| Com. & industrial | 14,598 | 8% | 5.18 | | 19,924 | 9% | 7.43 |
| G.Total | 1,81,132 | | 13.82 | | 2,29,297 | | 30.82 |
| | Rs Crores | | Cost Recovery % | | Rs Crores | | Cost Recovery % |
| WS | | | 28% | | | | 31% |
| Billing Revenue & disposal recov | 13.82 | | | | 37.08 | | |
| O&M Expenses | 58.50 | | | | 120.26 | | |
| O&M Deficit | (44.68) | | | | (83.18) | | |
| Corporation | | | | | | | |
| Revenue | 186.10 | | | | 546.02 | | |
| O&M expenses | 144.11 | | | | 388.65 | | |
| O&M surplus available | 41.99 | | | | 157.37 | | |

Note: * Needs further reconciliation

## 2.5 Financial Sustainability – Amritsar Water and Sewerage Services Delivery:

2.5.1 If the existing policies on water supply is continued, by 2022, cost recovery falls to 21% from current 28% and hence Amritsar Municipal Corporation needs to increase its operational support to Water Services (WS) from current 23% to 31%. Total cross subsidy from general budget by 2022 will be Rs 554 Cr ($ 92 m).

**Water supply account, deficit increases to 95 Cr in year 2022**

| Amritsar WS | | | | | | | | | Rs Crores |
|---|---|---|---|---|---|---|---|---|---|
| | FY 14 | FY 15 | FY 16 | FY 17 | FY 18 | FY 19 | FY 20 | FY 21 | FY 22 |
| Revenue | 16.50 | 20.54 | 21.52 | 28.08 | 23.91 | 24.47 | 24.44 | 24.31 | 24.69 |
| O&M | 58.50 | 67.27 | 74.00 | 82.53 | 89.58 | 96.94 | 103.93 | 111.96 | 119.80 |
| Operating Surplus/(defiit) | (41.99) | (46.73) | (52.48) | (54.45) | (65.66) | (72.47) | (79.49) | (87.65) | (95.11) |
| Deprn, Interest | 2.07 | 3.06 | 5.34 | 6.88 | 35.85 | 37.97 | 36.52 | 42.18 | 41.93 |
| Int on deficit financing | - | 5.89 | 16.23 | 27.13 | 41.54 | 58.89 | 79.28 | 103.20 | 131.14 |
| Net Deficit | (44.06) | (55.68) | (74.05) | (88.46) | (143.05) | (169.34) | (195.29) | (233.03) | (268.17) |
| Cost Recovery (O&M level) | 28% | 31% | 29% | 34% | 27% | 25% | 24% | 22% | 21% |

| Capex Summary | Rs crs |
|---|---|
| HUDCO Projects | 18 |
| JICA | 601 |
| JnNURM II | 333 |
| Total | 951 |

**Rs 554 crores of subsidy required from general budget till year 2022**

| Amritsar Municipal Corporation | | | | | | | | | Rs Crores |
|---|---|---|---|---|---|---|---|---|---|
| | FY 15 | FY 16 | FY 17 | FY 18 | FY 19 | FY 20 | FY 21 | FY 22 | Total |
| Revenue | 195.68 | 218.05 | 234.06 | 244.51 | 258.59 | 273.48 | 288.13 | 302.45 | |
| Expenses | 165.73 | 182.30 | 200.53 | 216.58 | 233.90 | 250.28 | 267.80 | 286.54 | |
| Operating Surplus/(Deficit) | 29.95 | 35.74 | 33.52 | 27.93 | 24.68 | 23.20 | 20.34 | 15.91 | 211.28 |
| Other net flows | (39.96) | (31.08) | (17.20) | (45.40) | (45.58) | 3.90 | 4.04 | 4.12 | |
| Net Surplus/(Deficit) | (10.02) | 4.67 | 16.32 | (17.47) | (20.90) | 27.11 | 24.38 | 20.03 | 44.12 |
| Trf reqd to WS - cover O&M defic | (46.73) | (52.48) | (54.45) | (65.66) | (72.47) | (79.49) | (87.65) | (95.11) | (554.05) |

2.5.2 If, city water supply is converted to 24x7 using surface water supply by investing INR 1359 Crores ($ 226 m) and following volumetric tariff used for bankrolled KUWASIP (24x7 demo project in Karnataka state), deficit can be reduced from Rs 554 Cr to Rs 164 Cr and as observed, fully cost recovery can be achieved from FY 2020. However, this will require careful restructuring and improved policies like

- Volumetric tariff for all – tariff structure reflecting cross subsidy amongst consumers (poor paying lower than the better off)
- Allocating share of VAT (Value Added Tax) transfers to ULB for specific water sector
- Backstopping of loans from the state government in case of failure by ULBs.

| Amritsar WS | | | | | | | | | Rs Crores |
|---|---|---|---|---|---|---|---|---|---|
| | FY 14 | FY 15 | FY 16 | FY 17 | FY 18 | FY 19 | FY 20 | FY 21 | FY 22 |
| Revenue | 16.50 | 20.54 | 21.52 | 36.51 | 45.41 | 59.54 | 118.56 | 120.29 | 122.56 |
| O&M | 58.50 | 67.27 | 74.00 | 81.23 | 86.05 | 90.85 | 95.79 | 103.25 | 110.48 |
| Operating Surplus/(defiit) | (41.99) | (46.73) | (52.48) | (44.72) | (40.65) | (31.31) | 22.77 | 17.04 | 12.08 |
| Deprn, Interest | 2.07 | 3.06 | 5.34 | 16.86 | 51.41 | 63.44 | 69.47 | 69.22 | 105.56 |
| Int on deficit financing | - | 5.89 | 16.23 | 27.18 | 41.24 | 60.15 | 81.34 | 102.66 | 127.02 |
| Net Deficit | (44.06) | (55.68) | (74.05) | (88.75) | (133.30) | (154.90) | (128.04) | (154.84) | (220.50) |
| Cost Recovery (O&M level) | 28% | 31% | 29% | 45% | 53% | 66% | 124% | 117% | 111% |

| Capex Summary | Rs Crs |
|---|---|
| HUDCO Projects | 18 |
| JICA | 601 |
| Full city conversion to 24x7 | 1,386 |
| Total | 2,005 |

Costs contained

| O&M cost - Rs/KL | FY 14 | FY 15 | FY 16 | FY 17 | FY 18 | FY 19 | FY 20 | FY 21 | FY 22 |
|---|---|---|---|---|---|---|---|---|---|
| No conversion | 13.36 | 14.98 | 16.09 | 17.53 | 18.59 | 19.67 | 20.63 | 21.75 | 22.79 |
| Full city conversion | 13.36 | 14.98 | 16.09 | 14.72 | 12.68 | 11.37 | 10.94 | 11.79 | 12.61 |

| Amritsar Municipal Corporation | | | | | | | | | Rs Crores |
|---|---|---|---|---|---|---|---|---|---|
| | FY 15 | FY 16 | FY 17 | FY 18 | FY 19 | FY 20 | FY 21 | FY 22 | Total |
| Revenue | 196.55 | 219.22 | 245.55 | 268.21 | 296.59 | 328.32 | 362.60 | 398.36 | |
| Expenses | 165.73 | 182.30 | 200.53 | 216.58 | 233.90 | 250.28 | 267.80 | 286.54 | |
| Operating Surplus/(Deficit) | 30.82 | 36.92 | 45.02 | 51.63 | 62.69 | 78.04 | 94.81 | 111.82 | 511.75 |
| Other net flows | (21.62) | 3.92 | (51.07) | (79.09) | (79.24) | (51.28) | 4.35 | 4.46 | |
| Net Surplus/(Deficit) | 9.21 | 40.84 | (6.05) | (27.46) | (16.55) | 26.76 | 99.15 | 116.28 | 242.18 |
| Trf reqd to WS - cover O&M defic | (46.73) | (52.48) | (44.72) | (40.65) | (31.31) | 22.77 | 17.04 | 12.08 | (163.99) |

## 2.6 Financial Sustainability – Ludhiana Water and Sewerage Services Delivery

2.6.1 Again, if Ludhiana continues with business as usual, cost recovery falls to 24 % from 31% by 2022. This means, income from water services needs to grow at least three times fr their respective year's levels. Operational support from Municipal budget works out to about 20% in 2022 of its total income and its operational surplus is not adequate to finance this.

**Ludhiana's Water supply account, deficit increases to 169 Cr in year 2022**

| Ludhiana WS | | | | | | | | | Rs Crores |
|---|---|---|---|---|---|---|---|---|---|
| | FY 14 | FY 15 | FY 16 | FY 17 | FY 18 | FY 19 | FY 20 | FY 21 | FY 22 |
| Revenue | 37.08 | 41.32 | 41.64 | 43.43 | 48.17 | 46.55 | 48.20 | 54.62 | 53.01 |
| O&M | 120.26 | 132.28 | 145.51 | 157.15 | 169.72 | 181.60 | 194.32 | 207.92 | 222.47 |
| Operating Surplus/(defiit) | (83.18) | (90.96) | (103.87) | (113.72) | (121.55) | (135.06) | (146.12) | (153.30) | (169.46) |
| Deprn, Interest | 27.87 | 26.16 | 24.58 | 23.93 | 24.71 | 23.13 | 21.55 | 19.97 | 18.39 |
| Int on deficit financing | - | 10.36 | 30.76 | 52.58 | 77.97 | 107.72 | 142.60 | 182.80 | 229.30 |
| Net Deficit | (111.05) | (127.47) | (159.21) | (190.23) | (224.23) | (265.91) | (310.27) | (356.08) | (417.16) |
| Cost Recovery (O&M level) | 31% | 31% | 29% | 28% | 28% | 26% | 25% | 26% | 24% |

| Capex Summary | Rs Crs |
|---|---|
| JnNURM II & Others | 117 |
| Total | 117 |

**Rs 1034 crores of subsidy required from general budget till year 2022**

| Ludhiana Municipal Corporation | | | | | | | | | Rs Crores |
|---|---|---|---|---|---|---|---|---|---|
| | FY 15 | FY 16 | FY 17 | FY 18 | FY 19 | FY 20 | FY 21 | FY 22 | Total |
| Revenue | 538.28 | 593.18 | 637.40 | 666.38 | 706.59 | 748.02 | 789.06 | 831.04 | |
| Expenses | 454.29 | 497.58 | 545.05 | 587.84 | 634.00 | 678.38 | 725.86 | 776.67 | |
| Operating Surplus/(Deficit) | 83.99 | 95.59 | 92.35 | 78.54 | 72.59 | 69.64 | 63.20 | 54.36 | 610.26 |
| Other net flows | (5.74) | (2.86) | 22.74 | 21.09 | 21.26 | 21.20 | 21.37 | 22.23 | |
| Net Surplus/(Deficit) | 78.25 | 92.73 | 115.08 | 99.63 | 93.85 | 90.84 | 84.57 | 76.59 | 731.54 |
| Trf reqd to WS - cover O&M defic | (90.96) | (103.87) | (113.72) | (121.55) | (135.06) | (146.12) | (153.30) | (169.46) | (1,034.05) |

2.6.2 If Ludhiana's water supply is converted into 24x7 using surface water replacing existing system; and using Karnataka's KUWASIP volumetric tariff which is considered to be lower than other metro cities tariff, deficit will come down from 1034 cr to 350 cr which is marked by full cost recovery from year 2020. This requires careful restructuring. This should include:

- Volumetric billing for all with built in cross subsidy for the poor.
- Allocating share of VAT to Municipal Corporation for water services
- State guarantees for loans

Ludhiana WS — Rs Crores

| | FY 14 | FY 15 | FY 16 | FY 17 | FY 18 | FY 19 | FY 20 | FY 21 | FY 22 |
|---|---|---|---|---|---|---|---|---|---|
| Revenue | 37.08 | 41.32 | 41.64 | 57.43 | 84.11 | 105.60 | 177.54 | 187.44 | 189.40 |
| O&M | 120.26 | 132.28 | 145.51 | 150.92 | 152.90 | 152.80 | 155.79 | 166.70 | 178.37 |
| Operating Surplus/(defiit) | (83.18) | (90.96) | (103.87) | (93.49) | (68.79) | (47.20) | 21.74 | 20.74 | 11.04 |
| Deprn, Interest | 27.87 | 26.16 | 24.58 | 39.05 | 48.81 | 66.13 | 75.89 | 74.32 | 128.18 |
| Int on deficit financing | - | 10.36 | 30.76 | 52.42 | 76.29 | 106.30 | 140.62 | 175.60 | 214.49 |
| Net Deficit | (111.05) | (127.47) | (159.21) | (184.96) | (193.89) | (219.64) | (194.77) | (229.18) | (331.63) |
| Cost Recovery (O&M level) | 31% | 31% | 29% | 38% | 55% | 69% | 114% | 112% | 106% |

| Capex Summary | Rs crs |
|---|---|
| Full city conversion to 24x7 | 2,100 |
| Total | 2,100 |

Costs contained

| O&M cost - Rs/KL | FY 14 | FY 15 | FY 16 | FY 17 | FY 18 | FY 19 | FY 20 | FY 21 | FY 22 |
|---|---|---|---|---|---|---|---|---|---|
| No conversion | 17.76 | 19.54 | 21.49 | 21.38 | 23.09 | 23.47 | 25.11 | 23.88 | 25.56 |
| Full city conversion | 17.76 | 19.54 | 21.49 | 16.81 | 13.40 | 10.97 | 10.07 | 10.77 | 11.53 |

Ludhiana Municipal Corporation — Rs Crores

| | FY 15 | FY 16 | FY 17 | FY 18 | FY 19 | FY 20 | FY 21 | FY 22 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Revenue | 543.87 | 604.33 | 678.55 | 742.83 | 824.54 | 914.67 | 1,012.43 | 1,117.73 | |
| Expenses | 454.29 | 497.58 | 545.05 | 587.84 | 634.00 | 678.38 | 725.86 | 776.67 | |
| Operating Surplus/(Deficit) | 89.57 | 106.74 | 133.50 | 154.99 | 190.55 | 236.29 | 286.57 | 341.06 | 1,539.27 |
| Other net flows | 16.94 | 19.99 | (60.41) | (103.95) | (103.61) | (61.47) | 22.95 | 24.03 | |
| Net Surplus/(Deficit) | 106.51 | 126.73 | 73.08 | 51.03 | 86.93 | 174.82 | 309.52 | 365.09 | 1,293.72 |
| Trf reqd to WS - cover O&M defic | (90.96) | (103.87) | (93.49) | (68.79) | (47.20) | 21.74 | 20.74 | 11.04 | (350.80) |

## 2.7 Conclusions on Financial Sustainability:

- Current system is environmentally and financially unsustainable
- Surface water based 24 X 7 system can assure quality, reduce costs and improve rever
- Socially and politically acceptable tariff is sufficient to recover O & M costs, as seen in s cities in Karnataka

| Amritsar | Ludhiana |
|---|---|
| • Water account will be in surplus only from 2020 | • Water account can generate surplus from 2017 |
| • Municipal Corporation cannot contribute to capex till the year 2020 | • Municipal Corporation can contribute 30% to 50% capex by borrowing |
| • State Government will have to mobilize the capex, may recover part of it from the Corporation after 2020 | • Commercial borrowing may require escrow of VAT surcharge which may have to be provided by the State Government |

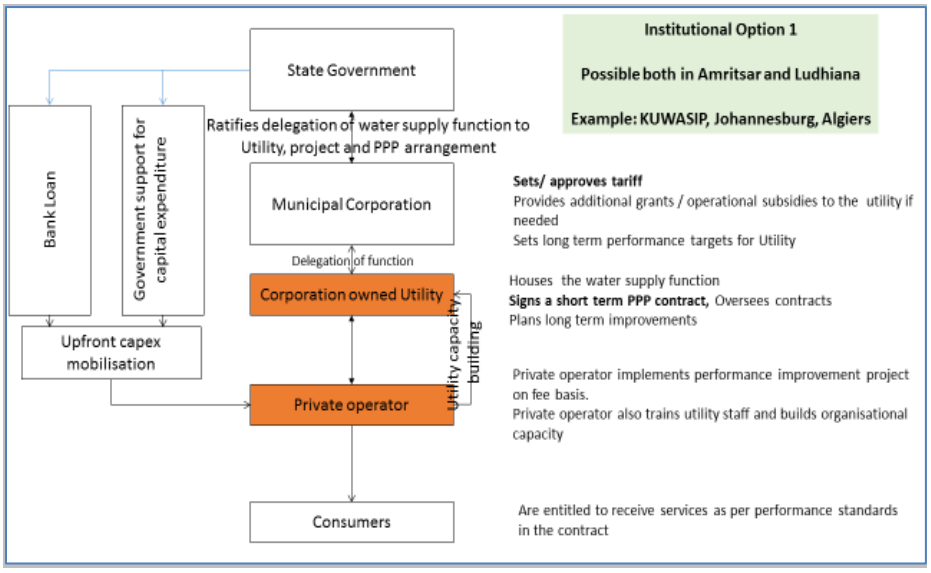
## 2.8 Institutional Analysis:

2.8.1 The Institutional analysis underscored that making water supply operationally and financially sustainable is key and current arrangements of managing water and sewerage services of this scale as part of municipal system is unviable. To delivery efficient services, as a principle, the agency responsible should have financial and managerial autonomy; accountable;, efficient has incentives to perform; and is customer oriented. As such, municipal owned utilities are proposed.

2.8.2 It is observed that:

- Current system has low autonomy
- even day to day procedures require council approval
- financial position is not clear
- WSS has perpetual dependence on municipal corporation and State Government for investments
- Current system has low accountability – poor service and no accountability to its customers
- Not able to attract staff to provide the required quality of service to citizens
- Low efficiency – Non-Revenue Water, poor billing and collection
- Low customer orientation – intermittent supplies, low pressure, poor quality of water .etc

2.8.3 The findings have been discussed and several institutional options have been presented to both the municipalities and to the government that include the Hon'ble Chief Minister of the state. The key principles proposed are: A utility, fully owned by the municipal corporation, will have operational autonomy to manage water and waste water services, whilst still be accountable to the corporation. Financial position will become clear, it can focus on becoming financially self-sustaining. The Utility will make long term plans for water supply and sewage; and with Government support may also be able to mobilize resources, though this is unlikely in the short term in Amritsar A private operator, contracted by the utility, will be responsible for service delivery through a competitively bid (efficiency) performance based (incentives) contract



## 3. OUTPUT 2: IMPROVED STORM DRAINAGE:

3.1.1 Flat terrain and poor investments on drainage make these cities highly vulnerable to flooding. It is now well known that each year during the monsoon season, flooding in these urban areas results in severe disruption to all economic activities and damage to the infrastructure. Most impacted are the poor living in core city areas, which remain partially submerged during such incidences Thus, there is an urgent need to implement state-of-the-art systems to minimize the damage by making the drainage systems more efficient. The objective is "to reduce vulnerability of flooding from climate change, understand city flooding pattern and develop a strategic approach to minimize negative impact of high storms on serviceability of city infrastructure and to reduce inconvenience to public in general". The work includes identifying:

- Understand potential points of flooding, retention time, drainage paths and their run off capacity
- Storms of high intensity and their frequency resulting from climate change. Understand negative impacts of flooding on people, services and serviceability of infrastructure
- Strategic approach to reduce flooding problems and possible coping mechanisms
- Investments planning and indicative costs

### 3.2 Drainage Study for Amritsar and Ludhiana:

3.2.1 At the start, consultations were undertaken with the elected Representatives, Mayor, Councillors, Commissioners, Officials of the Municipal Corporation and other allied Departments involved with the drainage issues in the cities such as State Pollution Control Board, Punjab Water supply and Sewerage and Drainage Board officials, Irrigation Department, Public works Department, Health officials, Agriculture University, general public of both the cities, etc. Structured interviews were also conducted in the city at various locations to know the people's perception towards the drainage system in the city.

3.2.2 The state Policies related to the water supply, sewerage, drainage, solid waste management, effluent disposal from industries, water harvesting structures, recent policy decisions were discussed and studied before undertaking the study

### 3.3 Reconnaissance Survey and Topographic Survey of the Cities

3.3.1 The study teams undertook reconnaissance survey of the cities to assess the existing drainage system – natural and man-made. The natural drainage systems were studied by walk through survey along the banks to study the existing drainage pattern of the cities. Issues which were responsible for the pollution of these natural drains (Nallahs) were identified. The major existing drainage system as constructed by the Municipal Corporation over the past years was studied in detail to assess its discharge carrying capacity. The present condition of the system was also assessed in terms of its silting and carrying capacity. In both the cities, sewerage system is being used to drain out the storm water which began as a temporary measure but now become normal practice (sewers were not designed to carry storm water) in both the cities, it is detrimental to sewers due to silt deposition.

3.3.2 Topographic survey was conducted in the field to plan the drainage network of the city along the major roads. The survey was also conducted along the natural drains like the Ganda Nallah (Amritsar), Tung Dhab (Amritsar) and Buddha Nallah (Ludhiana) to assess their discharge carrying capacities. Survey was also conducted to measure and record the levels, width and length of the major bridges / culverts that have been constructed across these Nallahs.

3.3.3 The cities were traversed to identify the "hot spots" – areas experiencing water logging for periods varying between 1 hour to 4 hours and more. The catchment and sub-catchment basin plans of these areas have been generated and flood maps of the "hot spots" have been developed.

3.3.4 It was seen that the cities are experiencing flooding because of the following major factors:

- The cities are devoid of any systematic drainage system.
- No drains along the city roads / highways passing through the city.
- Poor road geometrics at several places.
- Covering of existing open natural drains (Nallahs).
- Encroachment on banks of Nallahs.
- Heavy silt deposition of Nallahs.

### 3.4 Non-Structural measures

3.4.1 Study was undertaken to assess and recommend the measures required to improve the Institutional setup of the Municipal Corporation for both the cities to operate and maintain the storm water Drainage system during rains. Rain water harvesting regulation is already in force in the state but it needs to be further strengthened and implemented. As such the Institutional setup needs to be strengthened at the Junior Engineer level at grass root level.

### 3.5 Structural measures

3.5.1 Rainfall study has been undertaken for both the cities to assess the rainfall intensity which should be adopted for the design of the drainage system. 30 year hourly rainfall data has been collected from Indian Meteorological Department (IMD) for the city of Amritsar. The daily rainfall data for Ludhiana was collected from the Irrigation department as no other agency including IMD had hourly rainfall data. This data was available for rainy days only. As per the analysis it was found that for most of the rainy days, both the cities experienced rainfall intensity of not more than 25 mm/hour.

3.5.2 The drainage system was designed for both the cities to drain water from the "hot spots" as priority investments. The alignments for the proposed drains was traversed and the outfall points identified. The drains were designed for three rainfall intensities – 25 mm/hour, 38 mm/hour and 51 mm/hour as per the requirement of the Terms of reference using FWHA Urban Drainage Manual. The drains have been designed as closed underground piped system (RCC NP3 IS:458-2000). The slopes were planned so as to avoid dredging / remodelling of Nallahs, though desilting would only add to the discharge carrying capacity of these Nallahs. At a few locations, due to constraint of crossing the railways tracks, irrigation canals; retention /

detention ponds/tanks have been suggested in open spaces or nearby parks. The parks in the cities have been identified and it has been suggested that parks having area of more than 1 ha. (10,000 sq.m) can be developed and used as retention tanks assuming that 50% of the park area shall be available for this activity.

### 3.6 Cost Estimate

3.6.1 The cost estimation of the drainage system to meet short term needs for the rainfall intensity of 25 mm/hour has been prepared from the latest Common Schedule of Rates (CSR), Punjab and Delhi Schedule of Rates (DSR) of Central Public Works Department. The cost includes 5% contingency and 15% management and profit cost. The Cost as anticipated is as under:

| S. No. | Name of the City | Cost of the Priority Improvements (INR) | | |
|---|---|---|---|---|
| | | Civil Works | Institutional Cost | Total Cost |
| 1 | Amritsar | 2,461,279,161 | 82,803,708 | 2,544,082,870 ($ 42.4 m) |
| 2 | Ludhiana | 4,461,652,730 | 40,131,262 | 4,501,783,993 ($ 75.0 m) |

### 3.7 Preliminary Master Plan

3.7.1 Since these cities do not have any drainage plans, it is suggested that the following actions be undertaken immediately for providing a proper drainage system in the city

- Undertake the complete topographic survey of the city
- Provide adequate storm drainage system along the roads.
- Prevent any polluted water from industries / dairies etc. from discharging into Nallahs.
- Data related to the topographic details of all parks, open spaces and other area which could be developed as retention pond/detention basins in the city.
- Promote and educate people on development of rain water harvesting.

### 3.8 Suggestions to Improve Drainage Management:

3.8.1 During the course of study it was noted that there is no established record keeping system. There is a need to keep record in a systematic manner for developing a Detailed Master Plan of Drainage of both the cities. Following suggestions are made

- Maintain a date wise record of precipitation/rainfall (duration, intensity and total rainfall). Some of the data can be in consultation with Agricultural university, Irrigation Department, Airport Authority of India, IMD, Newspaper reports on the following day etc;
- Develop record of areas suffering from water logging, area of water spread, maximum depth of flooding, time taken to drain off either by gravity or by local pumping, the capacity of pump deployed and the time taken for making area free from water logging. Consultant has already prepared a list of such areas and the same can be updated in the next rain;
- The number of complaints received from the affected areas, and relief accorded.

- A meticulous record of pre monsoon desilting of all the drains. This is particularly important in case of Amritsar for Ganda Nallah and Tung Dhab and for Buddha Nallah at Ludhiana where half the length of nallah is under Municipal Corporation and the downstream half with Irrigation Department. Effective desilting of these natural drains is a necessity for the cities to face the monsoons and consequent havocs.

3.8.2 It is suggested that the responsibility of ensuring compliance of above provisions be handled by those responsible for O&M of Storm Water Drainage system. In this way the generation of storm water runoff will be taken care of at the source of generation, thus reducing agony to the residents of the cities. There is need to inform and communicate with the residents for effective implementation of RWH techniques available as per Indian Standards, the Manual of Ground Water Recharge issued by the Central ground Water Board etc.

## 4. OUTPUT 3: IMPROVED URBAN ENVIRONMENT:

4.1.1 While on one hand, Ludhiana is considered an attractive destination for business, it is also considered one of the lowest ranking cities in terms of pollution – degradation in air and water quality (both ground and local water bodies) is attributed to age old unregulated small industries. The lone water channel known as Gandha Nallah is highly polluted and presence of heavy metals in ground water is also attributed to indiscriminate disposal of industrial effluent. Similarly, the city of Amritsar is most important religious place for the Sikh Community, but faces number of urban environmental management issues with regard to pollution around the Golden Temple. The objective of the proposed work is "to identify strategies that would reduce pollution and sustain positive environment that is healthy and development supportive through policy intervention and supportive investments".

- Understand key sources of pollution, nature of environmental damage/ concerns in both the cities and its impact
- Understand development actions to improve vulnerable water bodies such as Buddha Nallah and Gandha Nallah and strategies to improve water quality in these bodies
- Improved environmental management monitoring tools and interventions – outline Environmental Management Plan (EMP)
- Identify options for progressive relocation of a few industrial clusters and the benefits likely to accrue (optional)

4.1.2 The study is therefore intended to form basis for Government of Punjab (GoP) to identify issues with the existing urban services, local environment and potential for improvement in future. The study has the following key outputs:

- Urban Environmental Profiles for the cities which includes state of environment in both cities, review of on-going efforts to reduce pollution in the cities and issues with performance in key urban sectors.
- Urban Environmental Management Action Plan (EMAP) that suggests strategies that can be adopted at the institutional level. It also provides sector wise solution which the cities can implement based on their requirements.

4.1.3 The project was initiated in the month of August, 2014 with a background study aiming to collect information available from various sources. With the gathered information, the urban stat of the urban services and issues associated were documented and were discussed during the first City Level Meetings. Three city visits were conducted to engage with relevant stakeholders, and to ascertain and collect required information. During these two city visits, the team interacted with officials from the Municipal Corporation, Punjab Pollution Control Board (PPCB), Punjab Water Supply and Sewerage Board (PWSSB), Punjab State Power Corporation Limited (PSPCL), Punjab Urban Development Authority (PUDA), etc. The team also interacted with non-governmental organizations (NGOs) working towards the improvement of the cities. Based on this Urban Environmental Profiles for Amritsar and Ludhiana were finalized and a draft Environmental Management Action Plan was prepared.

4.2.4 The information used in the profiles is based on secondary sources and supplemented with observations from field visits. The third city visits primarily focussed on understanding the

on-ground realities and assessing the potential of the draft actions listed in the management action plan. The team visited the STPs, CETPs, disposal points along drains, dumpsites and mapped nuisance areas in the old city area. Following this, the EMAP for both the cities were finalised and submitted.

## 4.2 Observations in the Project Cities - Amritsar

4.2.1 Amritsar, the city of Golden Temple, is a widely known spiritual centre of Punjab. It is the second largest metropolitan city in the state of Punjab. The city is located in Amritsar Distric in the North Western part of the state of Punjab and spreads across an area of 142.37 sq. km. It is visited by about 10,000 tourists daily. Increasing population and demand for urban services are putting pressure on urban infrastructure services and environment in the city.

## 4.3 Status of Urban Services

4.3.1 The water supply system in Amritsar covers about 80% of the area and population, supplying around 91 lpcd which is much less than the prescribed norm of 135 lpcd. The city also faces high unaccounted for water and non-revenue water. The water supply system is inadequate and entirely dependent on ground water. The sewerage system in the city covers only 65% of the population and disposes the collected sewage directly into the natural drains without treatment due to absence of a proper treatment system. The sewerage system in the city is also highly insufficient. The sewage is mixed with storm water due to absence of a proper storm water network. The network exists in only 20% of the area and leads to flooding of low lying areas during heavy rainfalls.

4.3.2 About 600 tonnes of MSW is generated in the city per day which is dumped directly at the designated dumpsite at Bhagtanwala. There is no segregation of used batteries, electronic waste, CFC gases, fused tubes, CFL bulbs, etc. to control mercury and other emissions/resultant leachate post disposal. 10% of the total waste collected is from scattered small scale industries. Municipal Solid Waste (MSW) in the city is also managed poorly. With regards to Hazardous waste approximately 25 tonnes from 127 industries is collected and transported to a common treatment, storage and disposal facility at Nimbuan in Mohali district since 2008. Also about 2500 kg/day of bio-medical waste from 702 health care facilities is managed by a private operator.

4.3.3 With the increase in population, energy consumption in the city has also increased from 635.2 million kWh in the year 2011-12 to 700.7 million kWh in the year 2013-14 with an annual average growth rate of 5.2%. The use of renewable resources for green energy generation and energy efficient technology for energy conservation is limited in the city.

4.3.4 The predominant mode of transport in the city is two wheelers followed by three wheelers and cars. There has been a considerable increase in vehicles from 493,399 in 2005 to 751,371 in 2012. Increase in auto-rickshaws is mainly because the existing public transport system is not adequate and they are the only easily accessible motorized transport for public. The city also lacks designated parking spaces which lead to congestion on roads.

4.3.5 The existing urban services in the city are unplanned and insufficient. The gap between services demanded and services supplied in Amritsar city will only increase with time. Increasing industrial and tourism activities in the city are putting additional pressure on resources

in terms of quantity and quality. This would have significant impacts on the environmental resources and quality of life of the residents.

## 4.4 Status of Environment

### Water Environment

4.4.1 Ground water has been over extracted for water supply. According to the Master Plan Report, 2010, ground water is available throughout the city at a depth of 15-40 m bgl. About 350 tube wells extract about 290 million litres daily. Inadequate water supply coverage leads to unregulated extraction in unserved areas. Efforts are being taken to augment surface water for 24X7 water supply and to achieve 100% coverage in the city. The only source of surface water in the city is the main branch lower of Upper Bari Doab Canal which is a distributary of the river Ravi.

4.4.2 Apart from this, the city also has a natural network of open storm water drains. These drains merge into three drains Ganda Nallah, Gumatal Drain and Tung Dhab drain which finally discharge into one large drain to the West of the city known as Hudiara drain.

### Water Pollution

4.4.3 According to the information collected from the Punjab Pollution Control Board (PPCB), effluents in the Tung dhab drain and Gumtala drain are objectionable in various aspects as colour, odour, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Bio-chemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and microbial contamination. The samples do not meet the meet the water quality criteria of Central Pollution Control Board (CPCB) for Class B Water (outdoor bathing quality). Also, significant increase is observed in these parameters after the confluence of the municipal outlet with the Tung dhab drain. The natural drains in the city are severely polluted and unfit for human use.

4.4.4 The main contributor to their contamination is direct discharge of untreated sewage and industrial effluents in these drains. The sewerage network covers only 65% of the population. Also there are no treatment facilities to treat the collected sewage and industrial effluents, and is discharged directly into the natural drains. The natural drains are carrying storm water mixed with sewage and industrial effluents, which due to absence of an adequate drainage network, are leading to accumulation of waste water in low lying areas, affecting the health of communities.

4.4.5 In order to control water pollution, work for completion of the sewerage network and STPs has been undertaken. The design standards used for designing of the STPs are in accordance with the standards for environmental pollutants given in the Environment Protection Rules, 1986. But these plants designed for treating domestic sewage will not be able to effectively treat the waste water mixed with industrial effluents. This would again result in discharge of partially treated water into the natural drains.

4.4.6 Seepage of polluted water from natural drains is also causing deterioration of ground water. As per PPCB data for ground water quality, it is observed that the values of parameters like TDS, Total Hardness, Total Alkalinity, Calcium (Ca), Magnesium (Mg), Iron (Fe), Manganese (Mn) and Lead (Pb) in a few samples are above the acceptable level prescribed in the drinking water supply guidelines given in CPHEEO Manual. The values of TDS, Total Hardness

and Total Alkalinity are observed to be higher than the acceptable limit in almost all the samples while values of Ca, Mg, Fe, Mn and Pb are observed to be higher in a few.

4.4.7 Open dumping of mixed waste is another major reason for soil and ground water pollution. Inadequate collection of waste leads to dumping of waste in vacant plots and open areas. Also, the collected waste is dumped at three open dumpsites located at Bhagtanwala, Jhabal Road and Naraingarhwhich have reached their full capacities and have already taken city and the waste is being dumped either in vacant plots or at the existing dumpsites. Open dumping of waste in an unscientific manner generates leachate which percolates through the soil and reaches the ground water. Leachate logging at a few points was observed at Bhagtanwala during the field visit.

4.4.8 To better manage municipal waste, Amritsar Municipal Corporation initiated an Integrated Municipal Solid Waste Management Project in 2011. Despite of adequate funds and environmental clearances, project has not been implemented since 3 years which shows lack of efficient governance. Therefore, it is important to efficiently manage the urban services like storm water drains, sewerage system and municipal solid waste management to improve city's water resources.

**Air Pollution**

4.4.9 As per the PPCB data, the concentration of Sulphur Dioxide ($SO_2$) is within the permissible limits as per the National Ambient Air Quality Standards (NAAQS) prescribed by CPCB while Nitrogen Dioxide (NOx) levels are increasing gradually and are close to the prescribed limit. Respirable Suspended Particulate Matter (RSPM) levels are much higher than the prescribed limit and may affect the surrounding residential areas in absence of a suitable buffer. High concentration of RSPM is also a result of unmanaged urban activities in the city.

4.4.10 Transportation in the city is characterized by high use of private vehicles and auto rickshaw which is mainly due to an unreliable public bus service system. Increased use of private vehicles and auto rickshaws using kerosene fuel is the main cause of release of gases such as CO, $NO_X$ and $CO_2$. Increased use of fuels in vehicles led to approximately 51,288 tonnes of carbon emissions in the year 2010. Also, presence of air polluting industries with no proper control mechanism is another reason for degradation of city's air environment. Amritsar city's high dependence upon grid supply of power also contributes to GHG emissions in the city. Electricity consumption in the city is responsible for emitting 576,481 tonnes of carbon emissions. The city is also subjected to frequent power cuts which lead to increased use of diesel generatorsets in commercial areas and industries. Also, burning of waste at the dumpsite leads to release of greenhouse gases into the atmosphere causing air pollution.

4.4.11 Apart from this, various tourism related activities in and around the Golden temple are putting pressure on these services and considerably adding to the environmental degradation especially in the vicinity of the Golden temple. Increasing levels of air pollution are said to have significant impacts on the marble and golden shrine of the Golden Temple. Air pollution also impacts the health of people in the city. In this context it becomes necessary to identify urban activities resulting in degrading air quality and adopt appropriate actions to mitigate

4.4.12 Bus Rapid Transition System (BRTS) is one of the major initiatives taken towards reducing air pollution in the city. Industries are also being monitored closely by PPCB to control industrial air pollution. Efforts are also being taken to decongest the walled city.

## 4.5 Observations in the Project Cities - Ludhiana

4.5.1 Ludhiana is the first and largest metropolitan city in the state of Punjab. It is one of the prominent industrial centres of Northern India having around 37,000 units of industries. The city spreads across an area of 159.4 sq. km. Increasing population in the city and demand for urban services is exerting pressure on infrastructure services and environmental resources.

## 4.6 Status of Urban Services

4.6.1 The existing water supply system in the city is entirely based on ground water and covers around 85% of the area and population. Water supplied in the city is observed to be much higher than the prescribed norm of 135 lpcd. High unaccounted for water and non-revenue water is witnessed in the city. The water supply system in the city is inadequate and requires improvement. The sewerage system in the city underground sewerage network covers 77% of the city area and about 13% of the population is dependent on soak pits/septic tanks. The sewerage network in Ludhiana is insufficient. The city has five STPs located at Jamalpur, Bhattian and Balloke. In addition to the STPs, a CETP has also been installed in order to treat the effluents from electroplating industries. The storm water network also covers a mere 11% of the city area serving 15% of the city population. The condition of existing storm water drainage system is poor and in need of rehabilitation.

4.6.2 About 1100 metric tonnes of municipal solid waste is generated in Ludhiana daily. The waste generated is observed to be heterogeneous comprising of both toxic and non-toxic waste which is dumped at Jamalpur and Jainpur dumpsites without segregation. Municipal solid waste management in the city is poor. With regards to Hazardous waste, approximately 5,000 MT of hazardous waste out of total 5,498 MT is being transported to the common treatment, storage and disposal facility at Nimbuan in Mohali district. About 2.2 TPD of bio-medical waste generated by 245 health care establishments is transported and treated at a common waste treatment facility.

4.6.3 Energy consumption in the city has increased from 4287.13 million kWh in the year 2010-11 to 4,988.58 million kWh in the year 2012-13 with an annual average growth rate of 5%. The use of renewable resources for energy generation or use of energy efficient technology is limited in the city.

4.6.4 A phenomenal increase in the number of vehicles has been witnessed in Ludhiana, i.e. from 680,494 in year 2001 to 1,161,988 in year 2013, at an average annual growth rate of 7.2%. Out of the total vehicles, two wheelers accounted for more than 70% of the vehicles registered in the year 2013 followed by four wheelers which accounted for 25% of the total vehicles registered. This is due to lack of a reliable and efficient transportation system for public. Also, there are very few formal parking spaces in the city leading to congestion, especially in the old city area.

4.6.5 Urban services in Ludhiana are highly inadequate. Growing infrastructure requirements in the city coupled with insufficient service provision has significant impact on environment resources in the city. Also, increasing industrial activities are putting additional pressure on infrastructure and environmental resources in terms of quantity and quality. It would also have significant impacts on the quality of life of the residents in Ludhiana.

## 4.7 Status of Environment

4.7.1 According to the CPCB and Ministry of Environment and Forests (MoEF), Ludhiana's industrial cluster is one of the 88 critically polluted industrial clusters identified in the country. The Comprehensive Environmental Pollution Index (CEPI) score for Ludhiana is 81.66 as computed by CPCB in its study "*Action Plan for Abatement of Pollution in Critically Polluted Area of Ludhiana City*" in the year 2010.

### Water Environment

4.7.2 Ground water is the source for fresh water in Ludhiana city which is available throughout the city at a depth of 55 to 122 meters. Ground water table is rapidly decreasing due to high extraction for domestic water supply. Ludhiana Municipal Corporation supplies domestic water supply through 935 tube-wells spread throughout the city extracting a total of 532 million litres per day (MLD). As the entire city is dependent on ground water, the ground water level has been depleting at an alarming rate of 1.25 meters per month.

4.7.3 Efforts have been taken to augment surface water for 24X7 water supply in the city. Water from Sindhwan canal and Sirhind canal crossing through the city has been planned to be used since there is no perennial source of surface water.

4.7.4 River Sutlej flowing along the Northern side of the city, approximately 15 km from the city centre is dry most of the year. The city also has an extensive network of storm water drains which finally join the Buddha Nallah, running parallel to River Sutlej on its South. The width of the canal varies from place to place.

### Water Pollution

4.7.5 Ludhiana City has a high CEPI score of 66 for surface water pollution and 64.75 for soil and ground water pollution as calculated by CPCB. The surface water analysis conducted by the PPCB for the Buddha Nallah reveals considerable presence of suspended/dissolved solids, heavy metals and total and faecal coliform due to the sewage and industrial effluent carried by the Nallah. The level of pollution in the Buddha Nallah is particularly high near the points of disposal of industrial effluent and raw sewage, with high levels of coliform and BOD values. High heavy metal concentrations of Zinc, Iron and Manganese in the Buddha Nallah render it unsuitable for supporting aquatic life.

4.7.6 The main reasons for surface water pollution in Ludhiana are direct discharge of effluents from industries, direct discharge of untreated domestic sewage, inadequate sewerage and drainage infrastructure and direct disposal of effluent from dairy complexes into the Buddha Nallah. About 200 MLD of wastewater is generated by 1,060 water polluting industries containing heavy metals such as iron, cadmium, lead, manganese, zinc, copper, chromium, nickel, mercury and arsenic. The two major dairy complexes, located along the start and end point of the Buddha Nallah on the Tajpur Road and Humbran Road, are also discharging waste water mixed with cow dung in the nallah. Effluent Treatment Plants (ETPs) have been installed in about 390 units out of 1000 units requiring ETPs. (40%) units out of the 390 units still require upgradein-order to achieve the prescribed standards for discharge into Buddha Nallah. The CETP installed for treating wastewater from 482 electroplating industries scattered within

the city has limited coverage. More than 800 industries lack effluent treatment facilities and discharge considerable amounts of untreated effluent into the Buddha Nallah.

4.7.7 Apart from this inadequate sewerage and drainage infrastructure also contaminates natural drains. Sewage generated in the city is about 488 MLD. The sewerage network in the city covers 85% of the city area. For sewage treatment, PWSSB has already setup five STPs with total capacity of 466 MLD. The existing STP capacity indicates a shortfall of 22 MLD. MCL has proposed to set up a 50 MLD STP at Bhattian to accommodate the shortfall and additional future flows. The performance of the existing STPs at Jamalpur and Balloke is questionable with regard to wastewater treatment and treated wastewater does not meet the design standards. The discharge from these STPs is characterized by high levels of biological coliform and suspended solids. The 200 MLD of effluent is also currently flowing into the domestic sewer network, overloading the system. Three CETPs are being constructed having a cumulative capacity of 130 MLD. More efforts in terms of performance and quality need to be taken to ensure disposal of treated water in the drains. About 16 temporary disposal points have been identified as critical points disposing large quantities of untreated sewage directly into the Buddha Nallah, including disposal from sewage pumping stations operated by the MCL. The MCL has confirmed the closure of four points while closure of six points is under progress.

4.7.8 Many initiatives to improve the existing conditions of the drain have been taken, apart from improving upon the urban infrastructure. One of the major initiatives is ecological restoration of the nallah through in situ bioremediation for the treatment of sewage. Three porous green bridges have been installed and water quality tests conducted on the Buddha Nallah demonstrate substantial improvement in water quality through this technology. Also, a detailed project report is being finalized by the MCL with the help of a consulting firm for planning and development of Buddha Nallah.

4.7.9 Seepage of polluted water from natural drains also leads to contamination of ground water. Groundwater monitoring data under the National Water Monitoring Programme indicates deterioration of groundwater quality. Ground water quality at all the 4 locations is by and large within the acceptable limit. Total Dissolved Solids (TDS) in two samples near Haibowal Dairy Complex and Dusshera Ground Industrial Estate is higher than the acceptable limit but within the permissible limit. Ground water in most of the industrial estates and areas having mixed land use has become unfit for potable use, having traces of toxic pollutants like cyanide and hexavalent chromium.

4.7.10 One major reason for soil and ground water pollution in the city is the absence of a scientific solid waste management system. About 1100 metric tonnes per day (MTD) of solid waste is generated in the city which is dumped at the Jamalpur dumpsite in an unscientific manner without any segregation and processing/treatment. Construction and demolition waste is also found mixed in the MSW collected from the city. 20% of the total waste is from scattered small-scale industries. Lack of segregation at source is leading to waste items such as batteries, chemical and pesticide containers being dumped together with organic waste at the dumpsites. This is causing substantial environmental degradation.

4.7.11 An Environment Site Assessment study conducted by the PPCB indicates that the soil and groundwater at both the dumpsites have been impacted as high values of BOD, COD, TOC, TDS, hardness, alkalinity and iron have been reported. An integrated MSW processing facility

having capacity 1200 TPD for Ludhiana cluster is being set up at the Jamalpur dumpsite by A2Z Waste Management to better manage the municipal solid waste.

4.7.12 Unplanned and inadequate urban services have led to significant degradation of local environmental conditions in the city. To prevent further deterioration it is extremely important to efficiently manage the urban services.

**Air Pollution**

4.7.13 As per CPCB report, the CEPI for air has been calculated as 68, on the basis of which Ludhiana has been declared as critically polluted area. As per the PPCB data, concentration of $SO_2$ and $NO_X$ is within the permissible limit as per NAAQS prescribed by CPCB, whereas RSPM levels are much higher than the permissible limit.

4.7.14 The major sources of air pollution in the city are recorded to be from Industrial and Transportation sectors, emitting high levels of Carbon Monoxide (CO) and Hydro Carbons (HC), Sulphur Dioxide, Nitrogen Oxides (NO), VOCs and acid mist. It is observed that neither buffer zones nor appropriate green belts are provided to mitigate the impact of air pollution in the city. Inappropriate solid waste management practices like regular burning of waste, adds to the pollution load in the city.

4.7.15 PPCB has identified 994 air polluting industries in the city. Inadequate/irregular operation of air pollution control systems in the industrial units is considered to be one of the major contributors to pollution. Also, the use of unauthorized fuels like plastic material, tyres and municipal solid waste refuse by a few industries. These emissions cannot be controlled with the help of existing air pollution control devices. Although measures have been taken to monitor and control air pollution in the city, especially in the industrial clusters more efforts are required.

4.7.16 Also, with increasing consumption of power, the carbon emissions released in the air are also increasing. Emissions released due to power consumption in the city were 4,104,500 tonnes in the year 2013-14. Apart from this, frequent power cuts also lead to air pollution in the city by increasing use of diesel generator sets especially in the commercial and industrial areas. Emissions are also due to increased use of private vehicles and cycle rickshaws that leads to release of pollutants like Carbon Monoxide (CO), Particulate Matter (PM), Nitrogen Oxide ($NO_X$) and Carbon Dioxide ($CO_2$). About 76,897 tonnes of carbon emissions were released in the year 2009-10. The city in order to improve the public transportation system and reduce use of private vehicles has initiated BRTS project. The project is under progress and is expected to significantly reduce pollution due to private vehicles. The city is also planning to create additional infrastructure like roads and parking to enable free traffic movement and avoid congestion.

4.7.17 Air pollution impacts the health of people in the city. Therefore it is important to identify urban activities degrading the air quality and adopt appropriate measures.

## 4.8 Conclusions

4.8.1 Increasing urbanization and industrialization along with unplanned development in the two cities have adversely impacted the quality of cities' local environment. Inadequate basic urban services and their improper management have also led to highly negative impacts on

environment and quality of life of the people residing there. Even though the issues of environmental degradation in the two cities are known, their intensity is not yet recognized. There exists no consolidated database in both the cities regarding the nature and extent of environmental resources, sources of its contamination and actions taken thereby. The information available in both the cities is incomplete and scattered at various sources. Different organizations/departments are responsible for different activities and lack coordination and integration.

4.8.2 Both the cities are of strategic economic and cultural importance to the state and would soon like to be transformed into smart cities where smart infrastructure i.e. environmentally efficient infrastructure development is envisaged. It would target changes in all sectors i.e. water, waste water, solid waste management, transportation, power, etc. Considering the existing situation where multiple authorities are responsible for managing development in both the cities, this transformation to smart city would be slow and disorganized, if not closely coordinated. Therefore, an integrated approach based on consolidated information for better management of these services is required.

## 4.9 Environmental Management Action Plan (EMAP)

4.9.1 The Environment Management Action Plans for both the cities aims to suggest requisite actions and measures integrating the urban services and environmental resources. The first and foremost step towards this should be to develop a common consolidated database where all information regarding the nature and extent of environmental resources in city, sources of its contamination and actions taken are uploaded on a regular basis.

4.9.2 Information on various sectors in the two cities are interlinked but scattered amongst various authorities responsible for particular sectors. In order to understand the functioning and performance of each sector and its impacts on environmental resources, information has to be collected from various authorities. Therefore, it is necessary to develop an integrated data base at city level where information from various departments would be present for use by all departments.

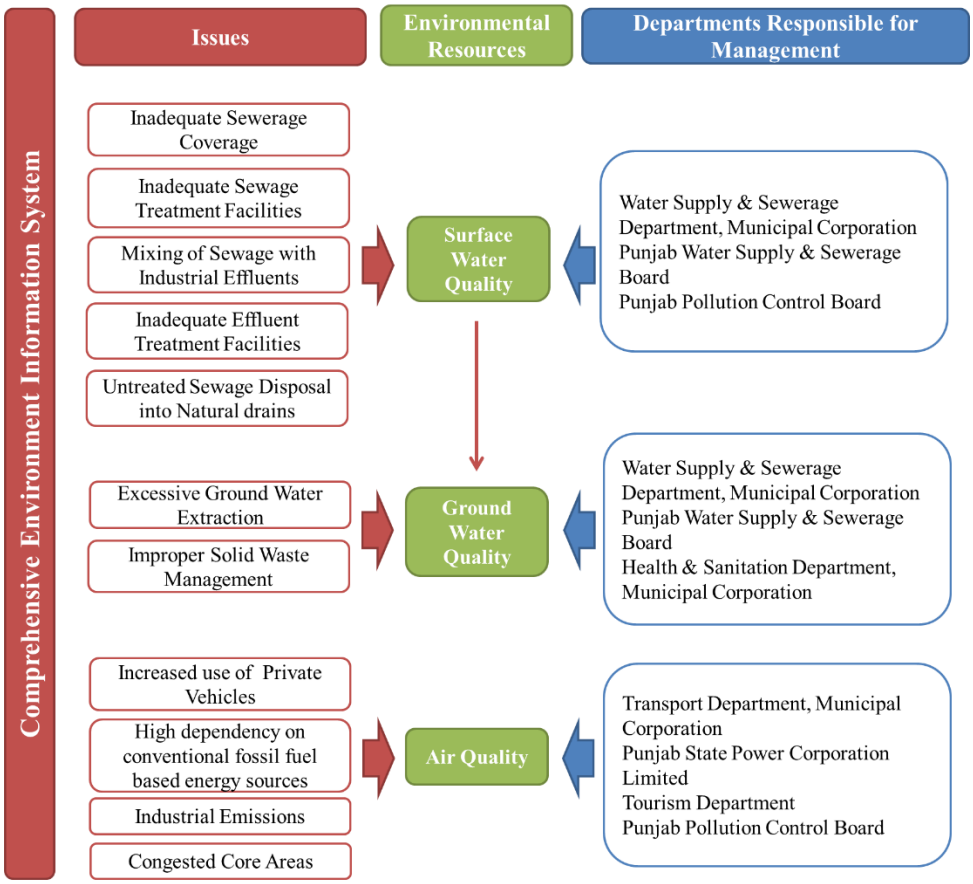
4.9.3 A **Comprehensive Environment Management Information System** is proposed, that would be a web based platform consisting of consolidated information regarding all urban services and environmental resources in both cities. All information like the availability, current status, on-going initiatives, relevant studies conducted etc. of the urban services as well as environmental services would be collected from various departments and uploaded on this platform. A framework indicating various departments that should contribute to the system has been given below. An example of a few sectors is depicted in the framework.

4.9.4 This web based information system would be a useful data base for relevant departments and lead to better decision-making. Relevant part of this information could also be made public

4.9.5 In addition to the environmental management information system efforts need to be taken under each sector to mitigate environmental pollution. Measures suggested for both cities mainly focus on mitigating air pollution by decongesting the old city area, promoting non-motorized transport, promoting clean fuel and improving the air quality monitoring system. With regard to water pollution, the cities should consider promoting treatment and recycling of water, increasing

ground water recharge by increasing pervious areas and reduce contamination of natural drains by closing the discharge points.

**Framework for Comprehensive Environment Management Information System**




## 4.10 Way Forward

4.11 Planned infrastructure developments also results in environmental improvement in the city. However, a sustained focus on improvement of environmental quality is required and specific actions targeted towards the same should be undertaken. Currently, information on the status of environment is at best scattered across various departments. Therefore, the both the cities should design and adopt the comprehensive environmental information system as is defined in the previous section. This system would provide information on the current status of environmental resources in the cities and will help collect and analyse information on critical sectors impacting the same. It would also document and inform on the extent of improvements due to efforts underway.

4.12 The cities have already headed towards transforming themselves into smart cities i.e. environmentally efficient cities and this kind of an integrated database would be extremely

useful in assessing priorities and mainstreaming an environmental conscious, resource efficient development. Therefore, the authors of the report urge the city decision makers and the state government to take steps to operationalize the recommended information system on priority on an eplatform in order to improve local environment.

## 5. OUTPUT 4: ADDRESSING SERVICES FOR URBAN POOR:

5.1.1 The ULBs don't have any tailor made policy to address poverty and to provide basic urban services in the slums. Presence of small scale and informal industries in Ludhiana aggravate the problems as migrant labor share small tenements coupled with poor living conditions. The objective of this work is "guidance to ULBs for improved living conditions of the poor living in slums and other forms of informal shelters".

- Understanding dimension of poverty and vulnerability; current policies of ULBs and safety nets available
- Policy guidance to ULBs to improve living conditions and quality of life through service level improvements and extending civic infrastructure facilities to reduce vulnerability
- Any interventions that ULBs can consider for reduced poverty and improved quality of life.

### 5.2 Amritsar Poverty Study Summary

**5.2.1 Overview of slums and poverty** - Amritsar is a religious, cultural, commercial and industrial centre with a population of 1.13 million. 61% of the city has grown informally with a deficiency of physical and social infrastructure, uncontrolled expansion into peri-urban areas and informal and underserved housing. The low-income families have no access to formal housing and 30% of the city's population lives in 63 notified slums, all of which have some sort of tenure security but are deficient in basic services. Although Amritsar Municipal Corporation (MCA) has been implementing slum upgrading programmes since the 1980s, there are unserviced areas because of densification and expansion of slums. Poor maintenance and continued problems of waterlogging and solid waste management along with the presence of dairies and polluting industries have added to environmental problems. There is substantial investment on plots, but the predominantly permanent building stock is of poor quality. The poorest live as tenants in slums and in the walled city and in "jhuggis" along canals and railway lines. Employment opportunities have kept poverty levels relatively low (9.0% below poverty line in 2002) but there is evidence of increasing social vulnerability because of multiple causes such as growing informality in the job market and drug addiction among youth.

5.2.2 **Opportunities and constraints:** There are a number of opportunities for bringing about substantial change for the better. Recent schemes of the central government make substantial funding available for improving conditions of housing, water and sanitation, health and livelihood supports for the poor. The Government of Punjab has its own social development and protection schemes and a number of NGOs and charitable organisations are also active in this field. Land is reserved for housing the poor in private layouts and projects in dispersed locations in the city's periphery as part of the state government policy. There are clear possibilities of mobilising Corporate Social Responsibility (CSR) funds as well as NRI funds for poverty reduction and environmental improvement. However, a key constraint is the past weakness of Municipal Corporation and state institutions to effectively take forward slum upgrading, slum

prevention and poverty reduction. A review of institutional roles shows that inadequate manpower, lack of community involvement and stand-alone implementation of programmes with limited scale and impact, and fractured and overlapping roles of institutions in the urban sector at city and state level in general can be held responsible for poor performance.

**5.2.3 Strategic approach to integrating the poor and marginalised with the city:** Based on these findings the study proposes a strategic approach to integrating the poor and marginalised with the city by building on opportunities provided by land availability, tenure security and funding sources, while overcoming institutional capacity constraints in a phased manner. The focus is on specific key actions which can lead to maximum benefits with the least possible additional investment. The key elements of the strategy are: 1) building the capacity of MCA to anchor poverty reduction activities through working with poor communities and harnessing resources and coordinating with government institutions, corporate sector and civil society organisations; 2) including slums and underserved areas in the walled city in service networks and drainage plans under the principle of 'universal access'; 3) making finance with technical assistance available for shelter improvement; 4) recognising and planning for mixed use and space for social services in low income areas; 5) making land available for new housing for the poor in the periphery using approaches such as guided land development and land reservation in private projects; and 6) developing state level institutions to professionalise poverty reduction and support MCA and district organisations.

## 5.3 Ludhiana Poverty Study Summary

**5.3.1 Overview of slums and poverty:** Rapid economic growth over the last three decades has attracted migrant workers and kept poverty levels low (9.7% population below poverty line in 2007) in Ludhiana. But low income families below and above the poverty line continue to face multiple deprivations and poor quality of life. The most vulnerable are migrant labour, particularly women construction workers and informal workers; child labour and the homeless. Economic development and population growth have not been matched by planned urban development: 48% of the city has grown informally with a severe deficiency of physical and social infrastructure, uncontrolled expansion into peri-urban areas, industrial pollution and informal and underserved housing. 22.5% of the city's population of 1.62 million lives in 218 slums of which 209 have been notified. Most slum dwellers own their plots. But the poorest live in insecure slums along polluted waterways and roadsides. About 200,000 migrant workers live in overcrowded cheap rental rooms with very poor services in 850 'vehras' built by private land owners. Ludhiana Municipal Corporation (MCL) has been implementing slum upgrading programmes in notified slums since the 1990s but waterlogging, inadequate waste management and poor sanitation persist. Vehras with far worse conditions, have not received any attention except punitive action during disease outbreaks. No organisation has the mandate to provide municipal services to slums in peri-urban areas.

**5.3.2 Opportunities and constraints:** Secure land tenure and access to livelihoods has resulted in investment on plots but has produced an incrementally built, poor stock of pucca houses. Providing services and technical and financial assistance can contribute to improve living conditions. There is significant private stock of cheap rental housing for migrant workers, which can be improved upon. Punjab government has some progressive PPP policies which together with a buoyant real estate market will make land available for new housing for the poor. More than 75 hectares of land has already been reserved in dispersed peri-urban locations in

private real estate projects. The forthcoming centrally sponsored schemes will make substantial resources available for slum upgrading, affordable housing and poverty reduction. The Slum Free City Plan of Action is expected to provide a framework for action. Apart from these, there are a large number of social development and entitlement programmes implemented by government departments and NGOs. There are also underutilised resources such as labour cess and CSR funds of corporate houses in Ludhiana. However, a key constraint is the past weakness of MCL and state institutions to effectively take forward slum upgrading, slum prevention and poverty reduction. A review of institutional issues shows that poor performance can be attributed to inadequate manpower, lack of community involvement, standalone implementation of programmes with limited scale and impact, and fractured and overlapping roles of institutions in the urban sector at city and state level in general. .

**5.3.3 Strategic approach to integrating the poor and marginalised with the city:** The strategic approach to integrating the poor and marginalised with the city seeks to build on opportunities provided by land availability, tenure security, private supply of cheap rental housing and funding sources, while overcoming institutional capacity constraints in a phased manner. The focus is on specific key actions which can lead to maximum benefits with the least possible additional investment. The key elements of the strategy are: 1) building the capacity of MCL to integrate poor communities with the city by working with poor communities and harnessing resources and coordinating with government institutions, corporate sector and civil society organisations; 2) including slums, vehras and underserved areas in service networks and drainage plans under the principle of 'universal access'; 3) relocating people from unsafe and polluted sites; 4) making finance with technical assistance available for shelter improvement; 5) recognising and planning for mixed use and space for social services in low income areas; 6) using regulations and incentives for private land owners to improve vehras; 7) utilising and sustaining land availability for new housing for the poor, including rental options, in the periphery through policies of guided land development, land pooling and land reservation in private projects; and 8) developing state level institutions to professionalise poverty reduction and support MCA and district organisations.

## 6. LEARNING AND RECOMMENDATIONS:

6.1.1 Both the prefeasibility level and strategic assessment studies deliver recommendations (refer outputs 1-4) which will help the GoP and Municipal Corporations to deliver services that are innovative and transformative and meet aspirations of its citizens. The key learning are:

a. Identified sustainable surface water sources to reduce dependence on depleting and low quality ground water resources in these two cities and found that it is feasible to supply 24x7 water.
b. Models have been developed to deliver water services which, if implemented, would improve water use efficiency by reducing physical and commercial losses (also improves energy use efficiency)
c. Institutional design to support innovative service delivery of water and sewerage services. Given understanding on the scale and range of reforms needed for sustainability
d. Innovative options to finance and deliver capital investment programs – policy on cost recovery, improved municipal finances and use of appropriate PPP models
e. Options have been developed to address vulnerability of urban infrastructure and livelihoods from frequent flooding by improving capacity of drainage system
f. Proposed approach with costs to reduce flooding in susceptible pockets in these two cities
g. Developed city profiles on environmental issues and mainstreaming environmental management plan at ULB level particularly to address pollution in water bodies.
h. Strategies to improve living conditions in slums and capacity building for ULBs to address poverty.
i. It has been proved that environmental improvements, addressing poverty and flooding wouldn't require huge costs but institutional capacity is critical. However, water services improvement needs huge investments as existing system is unsystematically developed.

End