添付資料３

1 Executive Summary

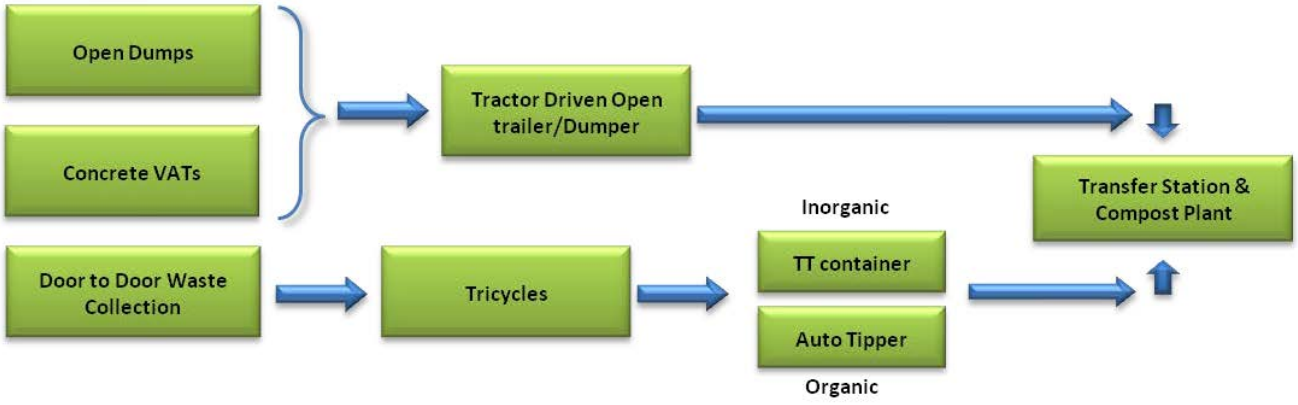
1.1 Project Background

The Government of West Bengal established a comprehensive Solid Waste Management system in a cluster of 6 municipalities (Uttarpara-Kotrung, Konnagar, Rishra, Serampore, Baidyabati and Champdany) of Hooghly. The Project **Kolkata Solid Waste Management Improvement Project (KSWMIP)** came as a boon. KSWMIP was to provide these ULBs with infrastructure facilities together with material support in the form of Equipments and vehicles and up-gradation of skill and efficiency of the ULBs in carrying out SWM effectively, efficiently and fruitfully to provide the citizens with a beautiful, tidy and hygienic environment to live in. Launched in 2007, KMDA established Compost Plant, Transfer Station and a Regional Waste Management Centre (RWMC) for the 6 municipalities to share.

1.2 Solid Waste Management Status

UTTARPARA-KOTRUNG MUNICIPALITY		
Area in Sq Km.	:	12.53
Population in 2019	:	170181
Number of Families	:	50901
Door to Door Collection	:	24 wards
Primary Waste Collectors	:	55nos.(Average 2 for each ward)
Tricycles	:	55 nos.
Battery Operated Vehicles	:	4 nos.
Auto tippers	:	18 nos.
TT Containers	:	29 nos.
Time of Door to door collection	:	6:30 am to 12:00 am (5.30 hours)
Average number of families covered by one waste handler per day	:	200-220
Total Waste Generation in Tonne per day	:	68
Total Waste Collection in Tonne per day	:	64 (94%)
Incoming quantity of Organic waste at Compost plant Tonne/day	:	9.5 (33%)
Average Number of families per ward	:	2120
Total No. of Families covered by door to door collection (both in crude and segregated manner)	:	43265 (85%)

- Primary Waste collection is carried out in 85% area (daily & alternative) of Uttarpara-Kotrung.



1.3 Issues of Primary and Secondary waste collection system

- Working hour of waste handler is far too less. As per manual it should normally be 8 hours per day. But actually it is (6.30 am – 12.00 am) 5.30 hrs only. Only two Waste Handlers are deployed in each ward. One Waste Handler covers approx. 200-220 families.
- Due to inadequate manpower only 70% area is covered through daily waste collection and 15% area gets covered though alternate day collection.
- House to house segregation level is 80-90 percent but during collection and transportation, waste gets mixed.
- Only 33% fresh Organic waste of total generation reaches the CP daily.
- Absence of proper Planning and Management to locate Secondary Waste Storage points and Proper Waste Transportation.
- There are **112 Number of Open dumping places and 15 Nos. of concrete VAT** where residents and waste handlers dump the collected waste. Location of each VAT has been identified and mention on map annexed with this report.
- It was observed that municipality has shortage of TT container, even the containers are erratic placed (some case 3 or more containers at one location). Transportation of TT containers to TS&CP is Irregular.
- Lack of maintenance of equipment's.
- Municipality don't have any initiative or plan regarding social awareness of local people about SWM, They are totally dependent on JPT.
- Lack of monitoring from municipality side.

1.4 Proposed SWM Improvement Plant

- It was observed that segregation is happening at family level, but waste gets mixed during primary and secondary collection and irregular shifting of TT containers to TS&CP. To overcome this predicament and to improve the quality of segregation JPT proposes to have one type of waste (dry or wet) collection per day. This will reduce chances of waste getting mixed and enhance the quantum of compostable reaching the CP every day.

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Type of Waste	Organic	Inorganic	Organic	Organic	Inorganic	Organic

- To avoid mixing of waste at secondary collection point, it is suggested to **Introduce direct transportation system from wards which are nearer to the Transfer Station and Compost Plant through Battery operated vehicles.**
- For the wards which are far from TS & CP, it is suggested to do door to door collection by Tricycles. After collection, collected waste should be stored in properly placed TT containers at SCP which will be later toed by tractor to TS & CP as early as possible according to a plan.
- Municipality must remove of Open dumps and demolition of existing concrete VATs and replacement of the same with TT containers or community bins – are suggested.
- Proper planning for placement of TT containers in consultation with municipality staff (SI and supervisors)
- Deployment of adequate manpower for segregated waste collection and transportation to ensure maximum coverage of families through primary collection and Procurement and supply of Primary Collection and Secondary Transportation vehicles.
- Develop the mechanism of **Ward Committee** and decentralize waste collection system. Municipality should form a Ward Committee chaired by ward councillor and 3 to 4 reputed senior citizens to work as watchdog for segregated waste collection and transportation.
- Municipality should **introduce User fees** for SWM services as per notification of MSW rules 2016, State SWM policy and NGT directives.
- **Develop SWM policy and modify bylaws** to incorporate user fees collection from Commercial and residential establishments

  Phase -I- Commercial establishments (institution, hotel, shops, street vendors, restaurants etc.)

  Phase-II – Residents
- Municipality should prepare **separate SWM budget** comprising of All SWM activities and heads of expenditures.
- Develop **incentive mechanism** for the most efficient Waste Handlers (e.g. if a waste handler covers more than 275 nos. of households per day he will get incentive). Arrange a programme to provide incentives so that others get motivation to perform better.
- **Deployment of permanent social team in municipality which will carry out awareness programme**, monitor waste collection system and resolve issues related to waste collection and segregation. They will act as a link between the citizens and the municipality.
- **Use of municipality waste collection equipments as advertisement medium:** there are many local and national companies who give their advertisement on the local vehicles (TOTO/ tricycle rickshaw) which move inside the municipality. Those agencies can be approached by publishing note in local newspaper or by putting banners in municipality area and propose to utilize municipality vehicles (Tricycle/ Auto tipper/ compactor/ TT containers/ tractors etc) as advertisement medium.
- **Involvement of SHG in waste collection system:** It is proposed to adopt the mechanism to resolve shortfall of manpower issue. Municipality should collect user fees from the residents and involve SHG for collection of waste and pay them from the SWM user fees. This will be a self-sustainable model for waste collection system without putting extra burden on the government.
- **Grievance cell and redressal mechanism:** Municipality should open a Grievance Cell in municipality office. It is proposed to have a SWM mobile based Application by which citizens can put complaints regarding SWM in municipality.

1.4.1 Waste collection plan

Considering the criteria mentioned in the MSW Manual 2016 (page no. 184 Table 2.4, Population of the Municipality between 1 lakhs to 5 lakhs), Collection of primary waste is proposed as follows

- Collection and direct transportation of waste to processing plant – 75% areas should be covered like this. It is proposed to have this collection by battery Operated Vehicles
- Collection and indirect transportation of waste to processing plant - 25% area should be covered by Tricycle

Considering the above criteria, it comes around 17 nos. (Out of 24 nos.) of wards from where we can directly transport waste from residents to Transfer station & Compost plant (TS&CP) and from 7 nos. of wards we can use tricycle for primary collection and storage of waste to TT containers and from there it will be toed by tractor to TS & CP.

Movement of Primary Collection Vehicles in Wards

	Deployment of Battery Operated Vehicles in wards nearest to CP Ward No 8 - 24
	Movement of Tricycles into farthest wards to CP Ward No. 1 - 7

1.5 GAP Analysis

Calculate Optimum Number of Manpower and Equipment's required for Primary and secondary waste collection system and the GAP between Existing and Proposed has been worked out which is as follows

1.5.1 Required Equipments

- **Tricycles** – To collect waste from wards which are far from TS& CP,
- **TT contains**- will be placed in wards which are far from TS & CP where waste is being collected by tricycle. These TT container will be toed by tractor to TS & CP
- **Tractor**- To Toe TT containers to TS & CP
- **Battery Operated ToTo type tipper** - To collect waste form wards which are near to T& CP and direct transport the collected waste to the plant the
- **Community bins** – to install in areas of bulk waste generators like Institution, school, markets etc..
- **Auto Tipper**- to collect waste form community bins and transfer it to TS &CP site

Type of Equipments and vehicles	Numbers required	Numbers available	GAP	Remark
Tricycle	45	55	0	Extra Tricycle can be used as spare
Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	22	0	22	New Procurement need to be done
TT containers	51	40	11	New Procurement need to be done
Tractor	7	18	0	Extra Tractor can be used for other municipal work like Road, Drain cleaning etc
Community bins (pair of 2)	152	0	152	New Procurement need to be done

Type of Equipments and vehicles	Numbers required	Numbers available	GAP	Remark
Auto tippers	5	18	0	Not required

1.5.2 Required Manpower

As proposed collection system is mechanised by introduction of battery operated Toto type vehicle which will reduce the manpower required in the collection system as the vehicles can cover more number for families and easy to operate as waste handler can drive ToTo type vehicle, there is no requirement of specialised driver to drive the vehicles.

Type	Position	Required	Available	Gap	Remark
Tricycle	Waste handler	45	55	-10	10 extra manpower can be used in other work
Battery Operated vehicle	Waste handler	22	0	22	(22+44) = 66 nos. manpower is required; 10 manpower can be used as driver and helper of battery operated vehicle; (66-10) **=56 nos. required**
	Helper	44	0	44	
Tractor	Driver	7	14	-7	7 drivers are available
	Helper	21	21	0	Not required
Auto tipper	Driver	5	5	0	Not required
	Helper	10	5	5	**5 helpers are required**
Supervision	Supervisor	24	14	10	**10 nos. skilful supervisors are required**
Repairing & fitting of vehicles	Mechanics	1	0	1	1 mechanic is required
	Helper	2	0	2	2 helpers are required

1.6 Cost Estimation

To estimate fund requirement for implementation of Proposed SWM system, cost estimation has been carried out as:

- Fund required for procurement of new Equipment/vehicles
- Fund required for O & M of Additional Equipment/vehicles and manpower.

1.6.1 Procurement of new Equipments/vehicles

From GAP analysis three type of equipments /vehicles were required for improvement of waste collection system, the detail O & M cost of these equipments/vehicles are as follows:

Sl. No	Description	Requirement	Available	Gaps	Unit Rate (INR)	Total (INR)
1	Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	22	0	22	200000	4400000.00
2	TT container 2.0 m^3	51	40	11	200000	2200000.00
3	Road side bins with frame- 100 lit capacity PAIR	152	0	152	9500	1444000.00
Total Cost for Procurement of New Equipments						**80,44,000.00**

1.6.2 Operation & Maintenance Cost for Additional Equipments/ Vehicles, Manpower and Social Awareness Programme

For improvement of proposed SWM system, O&M cost for the additional equipments and manpower is calculated considering only additional equipments and manpower because O & M of existing manpower and equipments is being managed by the municipality with their existing funds

The additional O & M Cost includes the following

- O & M cost of additional Equipments
- O & M cost of additional Manpower
- O & M cost of Social Awareness Program

1.6.2.1 Equipments

GAP analysis shows that three types of equipments/vehicles are required. Details O & M cost of these equipments/ vehicles are as follows:

Sl. No	Description	Equipment Numbers	Operation Cost/Month (INR)	Total (INR)	Maintenance Cost/Month (INR)	Total (INR)	O&M Cost per month (INR)	O&M Cost per year (INR)
1	Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	22	3000	66000	1000	22000	88000	1056000
2	TT container 2.0 m^3	11	0	0	1000	11000	11000	132000
Total			**3000**	**66000**	**2000**	**33000**	**99000**	**11,88,000**

1.6.2.2 Manpower

To estimate the cost involved in deployment of additional manpower we have considered minimum wages policy of the government.

Sl No	Equipments	Nos.	Salary*(INR)	Amount per month (INR)	Amount per year (INR)
1	Supervisors	10	8996	89960	1079520
2	Waste Handler (Battery Operated Vehicles)	56	8177	457912	5494944
3	Helper (Auto tipper)	5	8177	40885	490620
4	Mechanic	1	8996	8996	107952
5	Helper (Mechanic)	2	8177	16354	196248
Total				**6,14,107**	**73,69,284**

**Salary As per current minimum wages policy of the government*

1.6.2.3 Social Awareness Programme and Information, Education & Communication (IEC) Materials for next one year

To carryout Social awareness programme after completion of JICA project team we have considered following social awareness programme and calculated cost involvement for the same as follows:

Sl. No.	IEC Materials and Methods for one year Budget	Quantity	Unit cost (INR)	Amount (INR)
IEC Material				
1	Bilingual Leaflet on segregation and related SWM behaviour (One page)	150000	3	450000
2	SWM small booklet for awareness among students/ youth	50000	8	400000
3	Banner (6'-0"x4'-0") flex with frame	100	800	80000
4	Hoarding (20'-0"x10') with frame	15	60000	900000
5	Advertisements through local cable	6	20000	120000
Social Awareness Program				
1	Workshop, Seminars of stakeholder	15	10000	150000
2	Miking per day	24	6000	144000
3	School interaction on environment education	24	6000	144000
4	Wall writing by students and youth	10	2000	20000
5	Street drama	15	10000	150000
6	Student/ youth Rally	5	10000	50000
7	Community level meeting per ward	50	2500	125000
8	Exhibition during local festivals	2	15000	30000
9	Exposure visit for cross fertilization of ideas/ best practices in state	1	50000	50000
10	Capacity building of all stake holders	6	5000	30000
	a) Training and demonstration			
	b) Exposure visit to best practices in India	1	150000	150000
11	Training of Waste Handlers and Supervisors	12	5000	60000
12	Incentive programmes for Best performances among Waste Handlers/ Supervisors	12	8000	96000
Manpower				
1	Social Mobiliser – 6 numbers	12	8000	96000
2	Social Co-ordinator 1 Number	12	15000	180000
Total				**34,25,000**

1.6.3 Summary of Cost

Total cost involved for Improvement of SWM system in the municipality is as follows:

Detail of Items	Cost(INR)
New Procurement	**80,44,000**
O & M Equipment	**11,88,800**
O & M of Manpower	**73,69,284**
Social Awareness programme (one year)	**34,25,000**
Total (ONE YEAR)	**2,00,27,084**

1 Executive Summary

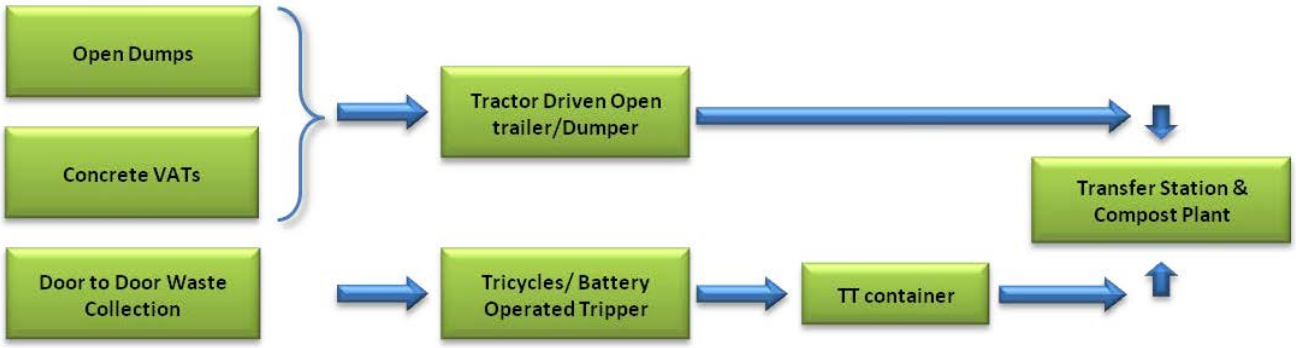
1.1 Project Background

The Government of West Bengal established a comprehensive Solid Waste Management system in a cluster of 6 municipalities (Uttarpara-Kotrung, Konnagar, Rishra, Serampore, Baidyabati and Champdany) of Hooghly. The Project **Kolkata Solid Waste Management Improvement Project (KSWMIP)** came as a boon. KSWMIP was to provide these ULBs with infrastructure facilities together with material support in the form of Equipments and vehicles and up-gradation of skill and efficiency of the ULBs in carrying out SWM effectively, efficiently and fruitfully to provide the citizens with a beautiful, tidy and hygienic environment to live in. Launched in 2007, KMDA established Compost Plant, Transfer Station and a Regional Waste Management Centre (RWMC) for the 6 municipalities to share.

1.2 Solid Waste Management Status

KONNAGAR MUNICIPALITY		
Area in Km Sq.	:	5.61
Population in 2019	:	82634
Number of Families	:	24187
Door to Door Collection	:	20 wards
Primary Waste Collectors	:	27 nos.(Average1 for each ward)
Tricycles	:	25 nos.
Battery Operated Vehicles	:	2 nos.
Auto tippers	:	3 nos.
TT Containers	:	24 nos.
Time of Door to door collection	:	7:00 am to 11:00 am (4hours)
Average number of families covered by one waste handler per day	:	180
Total Waste Generation in Tonne per day	:	32
Total Waste Collection in Tonne per day	:	28 (85%)
Incoming quantity of Organic waste at Compost plant Tonne/day	:	3 (21%)
Average Number of families per ward	:	1209
Total No. of Families covered by door to door collection (both in crude and segregated manner)	:	19670 (81%)

- Primary Waste collection is carried out in 81% area (daily & alternative) of Konnagar.



1.3 Issues observed regarding Primary and Secondary waste collection

- Working hour of waste handler is far too less. As per manual it should normally be 8 hours per day. But actually itis (7.00 am – 11.00 am) 4 hrs only. Only one or two Waste Handlers are deployed in each ward. One Waste Handler covers approx. 180 - 200 families.
- Due to inadequate manpower only 35% area is covered through daily waste collection and 50% area gets covered through alternate day collection.
- House to house segregation level is 80-90 percent but during collection and transportation, waste gets mixed.
- Only 20% fresh Organic waste of total generation reaches the CP daily.
- Absence of proper Planning and Management to locate Secondary Waste Storage points and Proper Waste Transportation.
- There are **48 Number of Open dumping places and 70 Nos. of concrete VAT** where residents and waste handlers dump the collected waste. Location of each VAT has been identified and mention on map annexed with this report.
- It was observed that municipality has shortage of TT container, even the containers are erratic placed (some case 3 or more containers at one location). Transportation of TT containers to TS&CP is Irregular.
- Lack of maintenance of equipments.
- Municipality don't have any initiative or plan regarding social awareness of local people about SWM, They are totally dependent on JPT.
- Lack of monitoring from municipality side.

1.4 Proposed SWM Improvement Plan

- It was observed that segregation is happening at family level, but waste gets mixed during primary and secondary collection and irregular shifting of TT containers to TS&CP. To overcome this predicament and to improve the quality of segregation JPT proposes to have one type of waste (dry or wet) collection per day. This will reduce chances of waste getting mixed and enhance the quantum of compostables reaching the CP every day.

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Type of Waste	Organic	Inorganic	Organic	Organic	Inorganic	Organic

- To avoid mixing of waste at secondary collection point, it is suggested to **Introduce direct transportation system from wards which are nearer to the Transfer Station and Compost Plant through Battery operated vehicles.**
- For the wards which are far from TS & CP, it is suggested to do door to door collection by Tricycles. After collection, collected waste should be stored in properly placed TT containers at SCP which will be later toed by tractor to TS & CP as early as possible according to a plan.
- Municipality must remove of Open dumps and demolition of existing concrete VATs and replacement of the same with TT containers or community bins – are suggested.
- Proper planning for placement of TT containers in consultation with municipality staff (SI and supervisors)
- Deployment of adequate manpower for segregated waste collection and transportation to ensure maximum coverage of families through primary collection and Procurement and supply of Primary Collection and Secondary Transportation vehicles.
- Develop the mechanism of **Ward Committee** and decentralize waste collection system. Municipality should form a Ward Committee chaired by ward councillor and 3 to 4 reputed senior citizens, to work as watch dog for segregated waste collection and transportation.
- Municipality should **introduce User fees** for SWM services as per notification of MSW rules 2016, State SWM policy and NGT directives.
- **Develop SWM policy and modify bylaws** to incorporate user fees collection from Commercial and residential establishments

  Phase -I- Commercial establishments (institution, hotel, shops, street vendors, restaurants etc.)

  Phase-II – Residents
- Municipality should prepare **separate SWM budget** comprising of All SWM activities and heads of expenditures. JPT has prepared the draft of it and prepared SWM budget for year 18-19.
- Develop **incentive mechanism** for the most efficient Waste Handlers (e.g. if a waste handler covers more than 275 nos. of households per day he will get incentive). Arrange a programme to provide incentives so that others get motivation to perform better.
- **Deployment of permanent social team in municipality which will carry out awareness programme**, monitor waste collection system and resolve issues related to waste collection and segregation. They will act as a link between the citizens and the municipality.
- **Use of municipality waste collection equipments as advertisement medium:** there are many local and national companies who give their advertisement on the local vehicles (TOTO/ tricycle rickshaw) which move inside the municipality. Those agencies can be approached by publishing note in local newspaper or by putting banners in municipality area and propose to utilize municipality vehicles (Tricycle/ Auto tipper/ compactor/ TT containers/ tractors etc) as advertisement medium.
- **Involvement of SHG in waste collection system:** It is proposed to adopt the mechanism to resolve shortfall of manpower issue. Municipality should collect user fees from the residents and involve SHG for collection of waste and pay them from the SWM user fees. This will be a self-sustainable model for waste collection system without putting extra burden on the government.

- **Grievance cell and redressal mechanism:** Municipality should open a Grievance Cell in municipality office. It is proposed to have a SWM mobile based Application by which citizens can put complaints regarding SWM in municipality.

1.4.1 Waste collection plan

Considering the criteria mentioned in the MSW Manual 2016 (page no. 183 Table 2.4, Population of the Municipality between 0.5 lakhs to 1 lakhs), Collection of primary waste is proposed as follows

- Collection and direct transportation of waste to processing plant – 80% areas should be covered like this. It is proposed to have this collection by battery Operated Vehicles
- Collection and indirect transportation of waste to processing plant - 20% area should be covered by Tricycle

Considering the above criteria, it comes around 14nos. (out of 20 nos.) of wards from where we can directly transport waste from residents to Transfer station & Compost plant (TS& CP) and from 6 nos. of wards we can use tricycle for primary collection and storage of waste to TT containers and from there it will be toed by tractor to TS & CP.

Movement of Primary Collection Vehicles in Wards

	Deployment of Battery Operated Vehicles in wards nearest to CP Ward No 4,5,6,7,8,9,10,11,12,13, 14 ,15,17 and 18
	Movement of Tricycles into farthest wards to CP 1,2,3,16,19,20

1.5 GAP Analysis

Calculate Optimum Number of Manpower and Equipment's required for Primary and secondary waste collection system and the GAP between Existing and Proposed has been worked out which is as follows

1.5.1 Required Equipments

- **Tricycles** – To collect waste from wards which are far from TS& CP,
- **TT contains**- will be placed in wards which are far from TS & CP where waste is being collected by tricycle. These TT container will be toed by tractor to TS & CP
- **Tractor**- To Toe TT containers to TS & CP
- **Battery Operated ToTo type tipper** - To collect waste form wards which are near to T& CP and direct transport the collected waste to the plant the
- **Community bins** – to install in areas of bulk waste generators like Institution, school, markets etc..
- **Auto Tipper**- to collect waste form community bins and transfer it to TS &CP site

Type of Equipments and vehicles	Numbers required	Numbers available	GAP		Remark
Tricycle	19	25	-6		Extra 6 Tricycle can be used as spare
Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	14	2	12		New Procurement need to be done
TT containers	25	24	1	6	New Procurement need to be done
			5		Extra 5 nos. of TTs needed to replace 5 nos. damaged TT

Type of Equipments and vehicles	Numbers required	Numbers available	GAP	Remark
Tractor	4	7	-3	Extra 3 Tractor can be used for other municipal work like Road, Drain cleaning etc
Community bins (pair of 2)	90	80	10	New Procurement need to be done
Auto tippers	3	3	0	No requirement

**As per consultation with Sanitary Inspector, 5 out of 24 nos. of existing TTs are not in good condition.*

1.5.2 Required Manpower

As proposed collection system is mechanised by introduction of battery operated Toto type vehicle which will reduce the manpower required in the collection system as the vehicles can cover more number for families and easy to operate as waste handler can drive ToTo type vehicle, there is no requirement of specialised driver to drive the vehicles.

Type	Position	Required	Available	Gap	Remarks
Tricycle	Waste handler	19	25	-6	6 extra manpower can be used in other work
Battery Operated vehicle	Waste handler	14	2	12	(12+28)= 40 nos. manpower is required; 6 manpower can be used as driver of battery operated vehicle; required no of manpower is = (40-6) = 34 nos.
	Helper	28	0	28	
Tractor	Driver	4	12	0	8 drivers are available
	Helper	12	24	0	12 helpers are available; 12 helper can be used as driver and helper of battery operated vehicle; **(34-12) = 22 nos. helpers are required**.
Auto tipper	Driver	3	3	0	Not required
	Helper	6	5	1	**1 helper is required**
Supervision	Supervision	20	19	1	**1 skilful supervisor is required**
Repairing & fitting of vehicles	Mechanics	1	0	1	1 mechanic is required
	Helper	2	0	2	2 helpers are required

1.6 Cost Estimation

To estimate fund requirement for implementation of Proposed SWM system, cost estimation has been carried out as:

- Fund required for procurement of new Equipment/vehicles
- Fund required for O & M of Additional Equipment/vehicles and manpower.

1.6.1 Procurement of new Equipments/vehicles

From GAP analysis three type of equipments /vehicles are required for improvement of waste collection system, the detail O & M cost of these equipments/vehicles are as follows

Sl. No	Description	Requirement	Available	Gaps	Unit Rate (INR)	Total (INR)
1	Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	14	2	12	200000	2400000
2	TT container 2.0 m3	25+5 = 30	24	6	200000	1200000
3	Road side bins with frame- 100 lit capacity Pair	90	80	10	9500	95000
Total Cost for Procurement of New Equipments						**36,95,000**

1.6.2 Operation & Maintenance Cost for Additional Equipments/Vehicles, Manpower and Social Awareness Programme

For improvement of proposed SWM system, O&M cost for the additional equipments and manpower are calculated considering only additional equipments and manpower because O & M of existing manpower and equipments is being managed by the municipality with their existing funds

The additional O & M Cost includes the following

- O & M cost of additional Equipments
- O & M cost of additional Manpower
- O & M cost of Social Awareness Program

1.6.2.1 Equipments

GAP analysis shows that three types of equipments/vehicles are required. Details O & M cost of these equipments/ vehicles are as follows:

Sl. No	Description	Equipment Numbers	Operation Cost/ Month(INR)	Total (INR)	Maintenance Cost/Month(INR)	Total (INR)	O&M Cost per month (INR)	O&M Cost per year(INR)
1	Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	12	3000	36000	1000	12000	48000	576000
2	TT container 2.0 m3	6	0	0	1000	6000	6000	72000
Total			**3000**	**36000**	**2000**	**18,000**	**54,000**	**6,48,000**

1.6.2.2 Manpower

To estimate the cost involved in deployment of additional manpower we have considered minimum wages policy of the government.

Sl No	Equipments	Nos.	Salary *(INR)	Amount per month(INR)	Amount per year(INR)
1	Supervisors	1	8996	8996	107952
2	Waste Handler (Battery Operated Vehicles)	22	8177	179894	2158728
3	Helper (Auto tipper)	1	8177	8177	98124
4	Mechanic	1	8996	8996	107952
5	Helper (Mechanic)	2	8177	16354	196248
Total				**2,22,417**	**26,69,004**

1.6.2.3 Social Awareness Programme and Information, Education& Communication (IEC) Materials for next one year

To carryout Social awareness programme after completion of JICA project team we have considered following social awareness programme and calculated cost involvement for the same as follows:

Sl No.	IEC Materials and Methods for one year Budget	Quantity	Unit cost(INR)	Amount (INR)
IEC Material				
1	Bilingual Leaflet on segregation and related SWM behaviour (One page)	150000	3	450000
2	SWM small booklet for awareness among students/ youth	50000	8	400000
3	Banner (6'-0"x4'-0") flex with frame	100	800	80000
4	Hoarding (20'-0"x10') with frame	10	60000	600000
5	Advertisements through local cable	4	20000	80000
Social Awareness Program				
1	Workshop, Seminars of stakeholder	10	10000	100000
2	Miking per day	20	6000	120000
3	School interaction on environment education	20	6000	120000
4	Wall writing by students and youth	6	2000	12000
5	Street drama	12	10000	120000
6	Student/ youth Rally	2	10000	20000
7	Community level meeting per ward	50	2500	125000
8	Exhibition during local festivals	2	15000	30000
9	Exposure visit for cross fertilization of ideas/ best practices in state	1	50000	50000
10	Capacity building of all stake holders	4	5000	20000
	a) Training and demonstration			
	b) Exposure visit to best practices in India	1	150000	150000
11	Training of Waste Handlers and Supervisors	12	5000	60000
13	Incentive programmes for Best performances among Waste Handlers/ Supervisors	12	8000	96000
Manpower				
1	Social Mobiliser – 6 numbers	12	8000	96000
2	Social Co-ordinator 1 Number	12	15000	180000
Total				**29,09,000**

1.6.3 Summary of Total Cost

Total cost involved for Improvement of SWM system in the municipality is as follows:

Detail of Items	Cost (INR)
New Procurement	**36,95,000**
O & M Equipment/vehicle	**6,48,000**
O & M of Manpower	**26,69,004**
Social Awareness programme and IEC material (one year)	**29,09,000**
Total (ONE YEAR)	**99,21,004**

1 Executive Summary

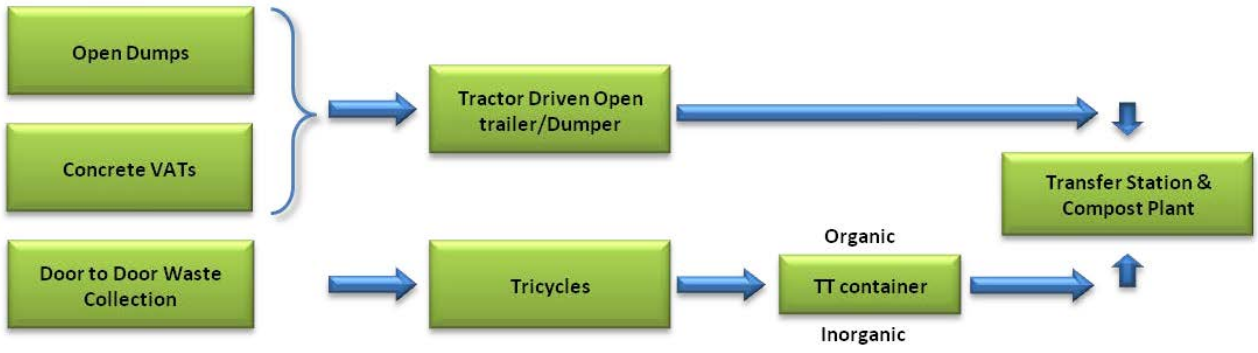
1.1 Project Background

The Government of West Bengal established a comprehensive Solid Waste Management system in a cluster of 6 municipalities (Uttarpara-Kotrung, Konnagar, Rishra, Serampore, Baidyabati and Champdany) of Hooghly. The Project **Kolkata Solid Waste Management Improvement Project (KSWMIP)** came as a boon. KSWMIP was to provide these ULBs with infrastructure facilities together with material support in the form of Equipments and vehicles and up-gradation of skill and efficiency of the ULBs in carrying out SWM effectively, efficiently and fruitfully to provide the citizens with a beautiful, tidy and hygienic environment to live in. Launched in 2007, KMDA established Compost Plant, Transfer Station and a Regional Waste Management Centre (RWMC) for the 6 municipalities to share.

1.2 Solid Waste Management Status

RISHRA MUNICIPALITY		
Area in Sq Km	:	4.71
Population in 2019	:	135914
Number of Families	:	33754
Door to Door Collection	:	17 out of 23 wards
Primary Waste Collectors	:	72nos.(Average 3 for each ward)
Tricycles	:	72 nos.
Battery Operated Vehicles	:	-
Auto tippers	:	6 nos.
TT Containers	:	17 nos.
Time of Door to door collection	:	6:30 am to 11:30 am (5.00 hours)
Average number of families covered by one waste handler per day	:	180-200
Total Waste Generation in Tonne per day	:	50
Total Waste Collection in Tonne per day	:	42 (80%)
Incoming quantity of Organic waste at Compost plant Tonne/day	:	2.5
Average Number of families per ward	:	1470
Total No. of Families covered by door to door collection (both in crude and segregated manner)	:	20250 (60 %)

- Primary Waste collection is carried out in 60% area (daily & alternative) of Rishra.



1.3 Issues of Primary and Secondary waste collection system

- Working hour of waste handler is less. As per manual it should normally be 8 hours per day. But actually it is (6.30 am – 11.30 am) 5 hrs only. Approx three Waste Handlers are deployed in each ward. One Waste Handler covers approx. 180-200 families.
- Due to inadequate manpower, only 30% area is covered through daily waste collection and 30% area gets covered through alternate day collection.
- Some primary collection vehicles do not have provision of separate compartments or bins due to which segregated waste provided by residents gets mixed.
- House to house segregation level is 60-70 percent but during collection and transportation, waste gets mixed.
- Only 10% fresh Organic waste of total generation reaches the CP daily.
- Absence of proper Planning and Management to locate Secondary Waste Storage points and Proper Waste Transportation.
- There are **75 Number of Open dumping places and 54 Nos. of concrete VAT** where residents and waste handlers dump the collected waste. Location of each VAT has been identified and mention on map annexed with this report.
- It was observed that municipality has shortage of TT container, even the containers are erratic placed (some case 3 or more containers at one location). Transportation of TT containers to TS&CP is Irregular.
- Lack of maintenance of equipments.
- Municipality don't have any initiative or plan regarding social awareness of local people about SWM, They are totally dependent on JPT.
- Lack of monitoring from municipality side.

1.4 Proposed SWM Improvement Plan

- It was observed that segregation is happening at family level, but waste gets mixed during primary and secondary collection and irregular shifting of TT containers to TS&CP. To overcome this predicament and to improve the quality of segregation JPT proposes to have one type of waste (dry or wet) collection per day. This will reduce chances of waste getting mixed and enhance the quantum of compostables reaching the CP every day.

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Type of Waste	Organic	Inorganic	Organic	Organic	Inorganic	Organic

- To avoid mixing of waste at secondary collection point, it is suggested to **Introduce direct transportation system from wards which are nearer to the Transfer Station and Compost Plant through Battery operated vehicles.**
- For the wards which are far from TS & CP, it is suggested to do door to door collection by Tricycles. After collection, collected waste should be stored in properly placed TT containers at SCP which will be later toed by tractor to TS & CP as early as possible according to a plan.
- Municipality must remove of Open dumps and demolition of existing concrete VATs and replacement of the same with TT containers or community bins – are suggested.
- Proper planning for placement of TT containers in consultation with municipality staff (SI and supervisors)
- Deployment of adequate manpower for segregated waste collection and transportation to ensure maximum coverage of families through primary collection and Procurement and supply of Primary Collection and Secondary Transportation vehicles.
- Develop the mechanism of **Ward Committee** and decentralize waste collection system. Municipality should form a Ward Committee chaired by ward councillor and 3 to 4 reputed senior citizens, to work as watch dog for segregated waste collection and transportation.
- Municipality should **introduce User fees** for SWM services as per notification of MSW rules 2016, State SWM policy and NGT directives.
- Municipality should prepare **separate SWM budget** comprising of All SWM activities and heads of expenditures.
- **Develop SWM policy and modify bylaws** to incorporate user fees collection from Commercial and residential establishments

  Phase -I- Commercial establishments (institution, hotel, shops, street vendors, restaurants etc.)

  Phase-II – Residents
- Municipality should prepare **separate SWM budget** comprising of All SWM activities and heads of expenditures. JPT has prepared the draft of it and prepared SWM budget for year 18-19.
- Develop **incentive mechanism** for the most efficient Waste Handlers (e.g. if a waste handler covers more than 275 nos. of households per day he will get incentive). Arrange a programme to provide incentives so that others get motivation to perform better.
- **Deployment of permanent social team in municipality which will carry out awareness programme**, monitor waste collection system and resolve issues related to waste collection and segregation. They will act as a link between the citizens and the municipality.
- **Use of municipality waste collection equipments as advertisement medium:** there are many local and national companies who give their advertisement on the local vehicles (TOTO/ tricycle rickshaw) which move inside the municipality. Those agencies can be approached by publishing note in local newspaper or by putting banners in municipality area and propose to utilize municipality vehicles (Tricycle/ Auto tipper/ compactor/ TT containers/ tractors etc) as advertisement medium.
- **Involvement of SHG in waste collection system:** It is proposed to adopt the mechanism to resolve shortfall of manpower issue. Municipality should collect user fees from the residents and involve SHG for collection of waste

and pay them from the SWM user fees. This will be a self-sustainable model for waste collection system without putting extra burden on the government.

- **Grievance cell and redressal mechanism:** Municipality should open a Grievance Cell in municipality office. It is proposed to have a SWM mobile based Application by which citizens can put complaints regarding SWM in municipality.

1.4.1 Waste collection plan

Considering the criteria mentioned in the MSW Manual 2016 (page no. 184 Table 2.4, Population of the Municipality between 1 lakhs to 5 lakhs), Collection of primary waste is proposed as follows

- Collection and direct transportation of waste to processing plant – 75% areas should be covered like this. It is proposed to have this collection by battery Operated Vehicles
- Collection and indirect transportation of waste to processing plant - 25% area should be covered by Tricycle

Considering the above criteria, it comes around 16 nos. (Out of 23 nos.) of wards from where we can directly transport waste from residents to Transfer station & Compost plant (TS&CP) and from 6 nos. of wards we can use tricycle for primary collection and storage of waste to TT containers and from there it will be toed by tractor to TS & CP.

Movement of Primary Collection Vehicles in Wards

	Deployment of Battery Operated Vehicles in wards nearest to CP Ward No 1-10,16,17,20-23
	Movement of Tricycles into farthest wards to CP Ward No. 11-15,18,19

1.5 GAP Analysis

Calculate Optimum Number of Manpower and Equipments required for Primary and secondary waste collection system and the GAP between Existing and Proposed has been worked out which is as follows:

1.5.1 Required Equipments

- **Tricycles** – To collect waste from wards which are far from TS& CP,
- **TT contains**- will be placed in wards which are far from TS & CP where waste is being collected by tricycle. These TT container will be toed by tractor to TS & CP
- **Tractor**- To Toe TT containers to TS & CP
- **Battery Operated ToTo type tipper** - To collect waste form wards which are near to T& CP and direct transport the collected waste to the plant the
- **Community bins** – to install in areas of bulk waste generators like Institution, school, markets etc.
- **Auto Tipper**- to collect waste form community bins and transfer it to TS &CP site

Type of Equipments and vehicles	Numbers required	Numbers available	GAP	Remark
Tricycle	40	72	0	Extra Tricycle will be used for collection of street sweeping waste and Drain cleaning waste.

Type of Equipments and vehicles	Numbers required	Numbers available	GAP	Remark
6 nos. 40 lit Bins for existing tricycle	= 40 x 6 = 240	0	240	New Procurement; provide 6 nos. 40 lit bins into 40 nos. existing tricycle
Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	19	0	19	New Procurement need to be done
TT containers	33	17	16	New Procurement need to be done
Tractor	5	13	0	Extra Tractor can be used in Road and Drain cleaning work
Community bins (pair of 2)	184	0	184	New Procurement need to be done
Auto tippers	6	6	0	Balanced

1.5.2 Required Manpower

As proposed collection system is mechanised (by introduction of battery operated Toto type vehicle which will reduce the manpower required in the collection system as the vehicles can cover more number for families and easy to operate as waste handler can drive ToTo type vehicle, there is no requirement of specialised driver to drive the vehicles.

Position	Position	Required	Available	Gap	Remark
Tricycle	Waste handler	40	72	-32	32 extra manpower can be used in other work
Battery Operated vehicle	Waste handler	19	0	19	(19+38) = 57 nos. manpower is required; 32 manpower can be used as driver and helper of battery operated vehicle; (57-32) =25 nos. required
	Helper	38	0	38	
Tractor	Driver	5	9	0	4 drivers are available
	Helper	15	28	-13	13 helpers are available; 13 helpers can be used as helper of battery operated vehicle = (25-13) = **12 nos. are required**
Auto tipper	Driver	6	4	2	**2 skilful driver is required**
	Helper	12	8	4	**4 helpers are required;**
Supervision	Supervisor	23	28	0	Not required
Repairing & fitting of vehicles	Mechanics	1	0	1	1 mechanic is required
	Helper	2	0	2	2 helpers are required

1.6 Cost Estimation

To estimate fund requirement for implementation of Proposed SWM system, cost estimation has been carried out as:

- Fund required for procurement of new Equipment/vehicles
- Fund required for O & M of Additional Equipment/vehicles and manpower.

1.6.1 Procurement of new Equipments/Vehicles

From GAP analysis three types of equipments /vehicles are required for improvement of waste collection system; the detail O & M cost of these equipments/vehicles is as follows:

Sl. No	Description	Requirement	Available	Gaps	Unit Rate (INR)	Total (INR)
1	Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	19	0	19	200000	3800000.00
2	6 nos. 40 lit bins	240	0	240	870	208800.00
3	TT container 2.0 m3	33	17	16	200000	3200000.00
4	Road side bins- 100 lit capacity pair	184	-	184	9500	1748000.00
Total Cost for Procurement of New Equipments						**89,56,800.00**

1.6.2 Operation & Maintenance Cost for Additional Equipments/Vehicles, Manpower and Social Awareness Programme

For improvement of proposed SWM system, O&M cost for the additional equipments and manpower is calculated considering only additional equipments and manpower because O & M of existing manpower and equipments is being managed by the municipality with their existing funds

The additional O & M Cost includes the following

- O & M cost of additional Equipments
- O & M cost of additional Manpower
- O & M cost of Social Awareness Program

1.6.2.1 Equipments

GAP analysis shows that three types of equipments/vehicles are required. Detail O & M cost of these equipments/ vehicles are as follows:

Sl. No	Description	Equipment Numbers	Operation Cost/month	Total (INR)	Maintenance Cost/month	Total (INR)	O&M Cost per month (INR)	O&M Cost per year (INR)
1	Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	19	3000	57000	1000	19000	76000	912000
2	TT container 2.0 m3	16	0	0	1000	16000	16000	192000
Total			**3000**	**57000**	**2000**	**35000**	**92000**	**11,04,000**

1.6.2.2 Manpower

To estimate the cost involved in deployment of additional manpower we have considered minimum wages policy of the government.

Sl No	Manpower	Nos.	Salary (INR)	Amount per month (INR)	Amount per year (INR)
1	Helper (Tractor)	12	8177	98124	1177488

Sl No	Manpower	Nos.	Salary (INR)	Amount per month (INR)	Amount per year (INR)
2	Driver (Auto tipper)	2	8996	17992	215904
3	Helper (Auto tipper)	4	8177	32708	392496
4	Mechanic	1	8996	8996	107952
5	Helper (Mechanic)	2	8177	16354	196248
Total				**1,74,174**	**20,90,088**

**Salary As per current minimum wage policy of the government*

1.6.2.3 Social Awareness Programme and Information, Education& Communication (IEC) Materials for next one year

To carryout Social awareness programme after completion of JICA project team we have considered following social awareness programme and calculated cost involvement for the same as follows

Sl.No.	IEC Materials and Methods for one year Budget	Quantity	Unit cost (INR)	Amount (INR)
IEC Material				
1	Bilingual Leaflet on segregation and related SWM behaviour (One page)	150000	3	450000
2	SWM small booklet for awareness among students/ youth	50000	8	400000
3	Banner (6'-0"x4'-0") flex with frame	100	800	80000
4	Hoarding (20'-0"x10') with frame	12	60000	720000
5	Advertisements through local cable	4	20000	80000
Social Awareness Program				
1	Workshop, Seminars of stakeholder	15	10000	150000
2	Miking per day	23	6000	138000
3	School interaction on environment education	23	6000	138000
4	Wall writing by students and youth	10	2000	20000
5	Street drama	12	10000	120000
6	Student/ youth Rally	3	10000	30000
7	Community level meeting per ward	50	2500	125000
8	Exhibition during local festivals	2	15000	30000
9	Exposure visit for cross fertilization of ideas/ best practices in state	1	50000	50000
10	Capacity building of all stake holders	5	5000	25000
	a) Training and demonstration			
	b) Exposure visit to best practices in India	1	150000	150000
11	Training of Waste Handlers and Supervisors	12	5000	60000
12	Incentive programmes for Best performances among Waste Handlers/ Supervisors	12	8000	96000
Manpower				
1	Social Mobiliser – 6 numbers	12	8000	96000
2	Social Co-ordinator 1 Number	12	15000	180000
Total				**31,38,000**

1.6.3 Summary of Cost

Total cost involved for Improvement of SWM system in the municipality is as follows:

Detail of Items	Cost (INR)
New Procurement	**89,56,800**
O & M Equipment	**11,04,000**
O & M of Manpower	**20,90,088**
Social Awareness programme (one year)	**31,38,000**
Total (ONE YEAR)	**1,52,88,888**

1 Executive Summary

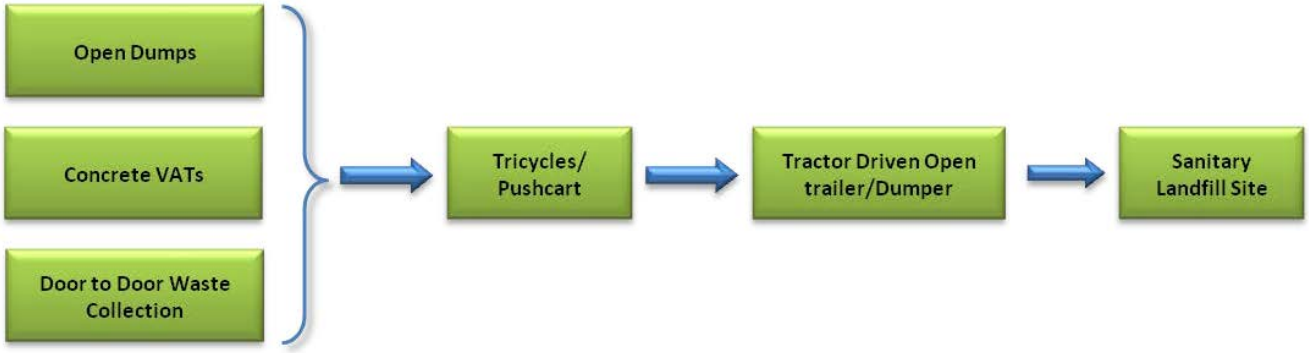
1.1 Project Background

The Government of West Bengal established a comprehensive Solid Waste Management system in a cluster of 6 municipalities (Uttarpara-Kotrung, Konnagar, Rishra, Serampore, Baidyabati and Champdany) of Hooghly. The Project **Kolkata Solid Waste Management Improvement Project (KSWMIP)** came as a boon. KSWMIP was to provide these ULBs with infrastructure facilities together with material support in the form of Equipments and vehicles and up-gradation of skill and efficiency of the ULBs in carrying out SWM effectively, efficiently and fruitfully to provide the citizens with a beautiful, tidy and hygienic environment to live in. Launched in 2007, KMDA established Compost Plant, Transfer Station and a Regional Waste Management Centre (RWMC) for the 6 municipalities to share.

1.2 Solid Waste Management Status

SERAMPORE MUNICIPALITY		
Area in Km Sq.	:	11.60
Population in 2019	:	183068
Number of Families	:	Approx 42662
Door to Door Collection	:	29 wards
Primary Waste Collectors	:	84 nos.(Average 3 for each ward)
Tricycles	:	13 nos.
Battery Operated Vehicles	:	0 nos.
Auto tippers	:	6 nos.
TT Containers	:	10 nos.
Time of Door to door collection	:	7:00 am to 11:30 am (4.30hours)
Average number of families covered by one waste handler per day	:	100-120 nos.
Total Waste Generation in Tonne per day	:	72
Total Waste Collection in Tonne per day	:	65 (93%)
Incoming quantity of Organic waste at Compost plant Tonne/day	:	Approx 2-3
Average Number of families per ward	:	1468
Total No. of Families covered by door to door mixed &crude waste collection	:	34060 (80%)

- Primary Waste collection is carried out in 80% area (daily & alternative) of Serampore.



1.3 Issues observed regarding Primary and Secondary waste collection

- Absence of proper Planning and Management to locate Secondary Waste Storage points and Proper Waste Transportation.
- Working hour of waste handler is far too less. As per manual it should normally be 8 hours per day. But actually itis (7.00 am – 11.30 am) 4.30hrs only. Only two or three Waste Handlers are deployed in each ward. One Waste Handler covers approx. 100 - 120 families.
- Due to inadequate manpower only 50% area is covered through daily waste collection and 30% area gets covered through alternate day collection.
- Waste segregation is not happening in 29 wards. Waste Handlers collecting mixed waste from families and clearing concrete vat and open dumped waste together.
- Municipality has 13 tricycles and 71 pushcarts for waste collection. The vehicles do not have provision of separate compartments or bins to receive segregated waste.
- Municipality don't have sufficient TT container to place Secondary Waste Storage points. They are using big Concrete vat as a Secondary Waste Storage points where all door to door collectors and street sweepers dumped waste after collection.
- There are **225 Number of Open dumping places and 316 Nos. of concrete VAT**where residents dump the collected waste. Location of each VAT has been identified and mention on map annexed with this report.
- Lack of maintenance of equipment's.
- Municipality doesn't have any initiative or plan regarding social awareness of local people about SWM.
- Lack of monitoring from municipality side.

1.4 Proposed SWM Improvement Plan

- It was observed that segregation is happening at family level, but waste gets mixed during primary and secondary collection and irregular shifting of TT containers to TS&CP. To overcome this predicament and to improve the quality of segregation JPT proposes to have one type of waste (dry or wet) collection per day. This will reduce chances of waste getting mixed and enhance the quantum of compostables reaching the CP every day.

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Type of Waste	Organic	Inorganic	Organic	Organic	Inorganic	Organic

- To avoid mixing of waste at secondary collection point, it is suggested to **Introduce direct transportation system from wards which are nearer to the Transfer Station and Compost Plant through Battery operated vehicles.**
- For the wards which are far from TS & CP, it is suggested to do door to door collection by Tricycles. After collection, collected waste should be stored in properly placed TT containers at SCP which will be later toed by tractor to TS & CP as early as possible according to a plan.
- Municipality must remove of Open dumps and demolition of existing concrete VATs and replacement of the same with TT containers or community bins – are suggested.
- Proper planning for placement of TT containers in consultation with municipality staff (SI and supervisors)
- Deployment of adequate manpower for segregated waste collection and transportation to ensure maximum coverage of families through primary collection and Procurement and supply of Primary Collection and Secondary Transportation vehicles.
- Develop the mechanism of **Ward Committee** and decentralize waste collection system. Municipality should form a Ward Committee chaired by ward councillor and 3 to 4 reputed senior citizens, to work as watch dog for segregated waste collection and transportation.
- Municipality should **introduce User fees** for SWM services as per notification of MSW rules 2016, State SWM policy and NGT directives.
- **Develop SWM policy and modify bylaws** to incorporate user fees collection from Commercial and residential establishments

  Phase -I- Commercial establishments (institution, hotel, shops, street vendors, restaurants etc.)

  Phase-II – Residents
- Municipality should prepare **separate SWM budget** comprising of All SWM activities and heads of expenditures. JPT has prepared the draft of it and prepared SWM budget for year 18-19.
- Develop **incentive mechanism** for the most efficient Waste Handlers (e.g. if a waste handler covers more than 275 nos. of households per day he will get incentive). Arrange a programme to provide incentives so that others get motivation to perform better.
- **Deployment of permanent social team in municipality which will carry out awareness programme**, monitor waste collection system and resolve issues related to waste collection and segregation. They will act as a link between the citizens and the municipality.
- **Use of municipality waste collection equipments as advertisement medium:** there are many local and national companies who give their advertisement on the local vehicles (TOTO/ tricycle rickshaw) which move inside the municipality. Those agencies can be approached by publishing note in local newspaper or by putting banners in municipality area and propose to utilize municipality vehicles (Tricycle/ Auto tipper/ compactor/ TT containers/ tractors etc) as advertisement medium.
- **Involvement of SHG in waste collection system:** It is proposed to adopt the mechanism to resolve shortfall of manpower issue. Municipality should collect user fees from the residents and involve SHG for collection of waste and pay them from the SWM user fees. This will be a self-sustainable model for waste collection system without putting extra burden on the government.

- **Grievance cell and redressal mechanism:** Municipality should open a Grievance Cell in municipality office. It is proposed to have a SWM mobile based Application by which citizens can put complaints regarding SWM in municipality.

1.4.1 Waste collection plan

Considering the criteria mentioned in the MSW Manual 2016 (page no. 183 Table 2.4, Population of the Municipality between 1lakhs to 5 lakhs), Collection of primary waste is proposed as follows

- Collection and direct transportation of waste to processing plant – 75% areas should be covered like this. It is proposed to have this collection by battery Operated Vehicles
- Collection and indirect transportation of waste to processing plant - 25% area should be covered by Tricycle

Considering the above criteria, it comes around 22nos. (out of 29 nos.) of wards from where we can directly transport waste from residents to Transfer station & Compost plant (TS& CP) and from 7 nos. of wards we can use tricycle for primary collection and storage of waste to TT containers and from there it will be toed by tractor to TS & CP.

Movement of Primary Collection Vehicles in Wards

	Deployment of Battery Operated Vehicles in wards nearest to CP Ward No 8-29
	Movement of Tricycles into farthest wards to CP 1-7

1.5 GAP Analysis

Calculate Optimum Number of Manpower and Equipments required for Primary and secondary waste collection system and the GAP between Existing and Proposed have been worked out which is as follows:

1.5.1 Required Equipments

- **Tricycles** – To collect waste from wards which are far from TS & CP,
- **TT containers**- will be placed in wards which are far from TS & CP where waste is being collected by tricycle. These TT container will be toed by tractor to TS & CP
- **Tractor**- To Toe TT containers to TS & CP
- **Battery Operated ToTo type tipper** - To collect waste from wards which are near to TS & CP and direct transport the collected waste to the plant
- **Community bins** – to install in areas of bulk waste generators like Institution, school, shops etc.
- **Auto Tipper**- to collect waste form community bins and transfer it to TS &CP site

Type of Equipments and vehicles	Numbers required	Numbers available	GAP	Remark
Tricycle	39	13	26	New Procurement need to be done
6 nos. 40 lit bins	13x6= 78	0	78	Procurement of new bins for available tricycles
Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	27	0	27	New Procurement need to be done

Type of Equipments and vehicles	Numbers required	Numbers available	GAP	Remark
TT containers	49	10	39	New Procurement need to be done
Tractor	7	12	0	Extra Tractor can be used for other municipal work like Road, Drain cleaning etc.
Community bins 100 lit(pair of 2)	187	0	187	New Procurement need to be done
Auto tippers	5	6	0	Extra auto tipper can be used for other municipal work

1.5.2 Required Manpower

As proposed collection system is mechanised by introduction of battery operated Toto type vehicle which will reduce the manpower required in the collection system as the vehicles can cover more number for families and easy to operate as waste handler can drive ToTo type vehicle, there is no requirement of specialised driver to drive the vehicles.

Type	Position	Required	Available	Gap	Remark
Tricycle/ Battery operated vehicle	Waste handler/ ToTo driver	39	84	-45	45 extra manpower can be used in other work
Battery Operated vehicle	Waste handler	27	0	27	(27+54) = 81 nos. manpower is required; 45 manpower can be used as driver and helper of battery operated vehicle; (81-45) =36 nos. are required
	Helper	54	0	54	
Tractor	Driver	7	12	-5	Not Required
	Helper	21	36	-15	15 helpers are available; 18 helpers can be used as helper of battery operated vehicle; (36-15)=**21 nos. are required**
Auto tipper	Driver	5	1	4	**4 skilful drivers are required**
	Helper	10	2	8	**8 helpers are required;**
Supervision	Supervision	29	41	0	Not Required
Repairing & fitting of vehicles	Mechanics	1	0	1	1 mechanic is required
	Helper	2	0	2	2 helpers are required

1.6 Cost Estimation

To estimate fund requirement for implementation of Proposed SWM system, cost estimation has been carried out as:

- Fund required for procurement of new Equipment/vehicles
- Fund required for O & M of Additional Equipment/vehicles and manpower.

1.6.1 Procurement of new Equipments/vehicles

From GAP analysis three types of equipments /vehicles are required for improvement of waste collection system, the details O & M cost of these equipments/vehicles are as follows:

Sl. No	Description	Requirement	Available	Gaps	Unit Rate (INR)	Total (INR)
1	Tricycle with 6 nos. 40 lit bins	39	13	26	31860	828360
2	6 nos. 40 lit bins	13x6=78	0	78	870	67860
3	Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	27	0	27	200000	5400000

4	TT container 2.0 m3	49	10	39	200000	7800000
5	Road side bins with frame- 100 lit capacity Pair (2 nos.)	187	0	187	9500	1776500
Total Cost for Procurement of New Equipments						**1,58,72,720**

1.6.2 Operation & Maintenance Cost for Additional Equipments/Vehicles, Manpower and Social Awareness Programme

For improvement of proposed SWM system, O&M cost for the additional equipments and manpower is calculated considering only additional equipments and manpower because O & M of existing manpower and equipments is being managed by the municipality with their existing funds

The additional O & M Cost includes the following

- O & M cost of additional Equipments
- O & M cost of additional Manpower
- O & M cost of Social Awareness Program

1.6.2.1 Equipments

GAP analysis shows that three types of equipments/vehicles are required. Details O & M cost of these equipments/ vehicles are as follows:

Sl. No	Description	Equipment Numbers	Operation Cost/ Month(INR)	Total (INR)	Maintenance Cost/Month(INR)	Total (INR)	O&M Cost per month (INR)	O&M Cost per year (INR)
1	Tricycle with 6 nos. 40 lit bins	26	0	0	1000	26000	26000	312000
2	Battery Operated Toto Type Tipperwith 8 nos. of 60 lit Bins	27	3000	81000	1000	27000	108000	1296000
3	TT container 2.0 m3	39	0	0	1000	39000	39000	468000
Total			**3000**	**81,000**	**3,000**	**92,000**	**1,73,000**	**20,76,000**

1.6.2.2 Manpower

To estimate the cost involved in deployment of additional manpower we have considered minimum wages policy of the government.

Sl. No.	Equipments	Nos.	Salary *(INR)	Amount per month (INR)	Amount per year (INR)
1	Helper (Tractor)	18	8177	147186	1766232
2	Driver (Auto tipper)	4	8996	35984	431808
3	Helper (Auto tipper)	8	8177	65416	784992
4	Mechanic	1	8996	8996	107952
5	Helper (Mechanic)	2	8177	16354	196248
Total				**2,73,936**	**32,87,232**

1.6.2.3 Social Awareness Programme and Information, Education& Communication (IEC) Materials for next one year

To carryout Social awareness programme after completion of JICA project team we have considered following social awareness programme and calculated cost involvement for the same as follows

Sl.No.	IEC Materials and Methods for one year Budget	Quantity	Unit cost(INR)	Amount (INR)
IEC Material				
1	Bilingual Leaflet on segregation and related SWM behaviour (One page)	160000	3	480000
2	SWM small booklet for awareness among students/ youth	70000	8	560000
3	Banner (6'-0"x4'-0") flex with frame	110	800	88000
4	Hoarding (20'-0"x10') with frame	15	60000	900000
5	Advertisements through local cable	4	20000	80000
Social Awareness Program				
1	Workshop, Seminars of stakeholder	10	10000	100000
2	Miking per day	29	6000	174000
3	School interaction on environment education	29	6000	174000
4	Wall writing by students and youth	10	2000	20000
5	Street drama	15	10000	150000
6	Student/ youth Rally	4	10000	40000
7	Community level meeting per ward	58	2500	145000
8	Exhibition during local festivals	2	15000	30000
9	Exposure visit for cross fertilization of ideas/ best practices in state	1	50000	50000
10	Capacity building of all stake holders	6	5000	30000
	a) Training and demonstration			
	b) Exposure visit to best practices in India	1	150000	150000
11	Training of Waste Handlers and Supervisors	14	5000	70000
13	Incentive programmes for Best performances among Waste Handlers/ Supervisors	15	8000	120000
Manpower				
1	Social Mobiliser – 6 numbers	12	8000	96000
2	Social Co-ordinator 1 Number	12	15000	180000
Total				**36,37,000**

1.6.3 Summary of Total Cost

Total cost involved for Improvement of SWM system in the municipality is as follows:

Detail of Items	Cost (INR)
New Procurement	**1,58,72,720**
O & M Equipment/vehicle	**20,76,000**
O & M of Manpower	**32,87,232**
Social Awareness programme and IEC material (one year)	**36,37,000**
Total (ONE YEAR)	**2,48,72,952**

1 Executive Summary

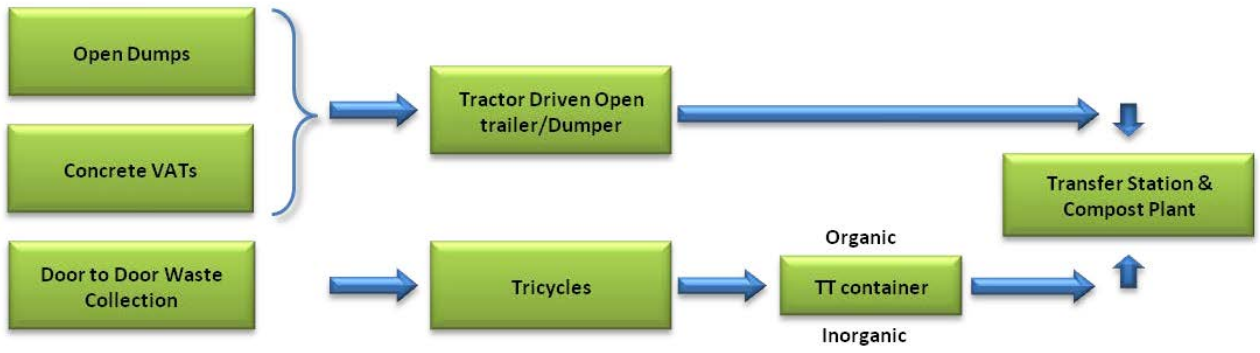
1.1 Project Background

The Government of West Bengal established a comprehensive Solid Waste Management system in a cluster of 6 municipalities (Uttarpara-Kotrung, Konnagar, Rishra, Serampore, Baidyabati and Champdany) of Hooghly. The Project **Kolkata Solid Waste Management Improvement Project (KSWMIP)** came as a boon. KSWMIP was to provide these ULBs with infrastructure facilities together with material support in the form of equipments and vehicles and up-gradation of skill and efficiency of the ULBs in carrying out SWM effectively, efficiently and fruitfully to provide the citizens with a beautiful, tidy and hygienic environment to live in. Launched in 2007, KMDA established Compost Plant, Transfer Station and Regional Waste Management Centre (RWMC) for the 6 municipalities to share.

1.2 Solid Waste Management Status

BAIDYABATI MUNICIPALITY		
Area in Sq Km.	:	13.34
Population in 2019		133059
Number of Families		35865
Door to Door Collection	:	23 wards
Primary Waste Collectors	:	94 nos.(Average 4 for each ward)
Tricycles	:	90 nos.
Battery Operated Vehicles	:	-
Auto tippers	:	4 nos.
TT Containers	:	41 nos.
Time of Door to door collection	:	6:30 am to 10:30 am (4.00 hours)
Average number of families covered by one waste handler per day	:	180-200
Total Waste Generation in Tonne per day	:	50
Total Waste Collection in Tonne per day	:	44 (88%)
Incoming quantity of Organic waste at Compost plant Tonne/day	:	8 (36%)
Average Number of families per ward	:	1559
Total No. of Families covered by door to door collection (both in crude and segregated manner)	:	30485 (85%)

- Primary Waste collection is carried out in 85% (daily & alternative) area of Baidyabati.



1.3 Issues of Primary and Secondary waste collection system

- Working hour of waste handler is far too less as per manual it should normally be 8 hours per day. But actually it is (6.30 am – 10.30 am) 4.00 hrs only. Approx four Waste Handlers are deployed in each ward. One Waste Handler covers approx. 180-200 families.
- Due to inadequate manpower, only 40% area is covered through daily waste collection and 45% area gets covered through alternate day collection.
- House to house segregation level is 60-70 percent but during collection and transportation, waste gets mixed.
- Only 40% fresh Organic waste of total generation reaches the CP daily.
- Absence of proper Planning and Management to locate Secondary Waste Storage points and Proper Waste Transportation.
- There are **203 Number of Open dumping places and 60 Nos. of concrete VAT** where residents and waste handlers dump the collected waste. Location of each VAT has been identified and mention on map annexed with this report.
- It was observed that municipality has shortage of TT container, even the containers are erratic placed (some case 3 or more containers at one location). Transportation of TT containers to TSCP Irregular.
- Lack of maintenance of equipment's.
- Municipality don't have any initiative or plan regarding social awareness of local people about SWM, They are totally dependent on JPT.
- Lack of monitoring from municipality side.

1.4 Proposed SWM Improvement Plan

- It was observed that segregation is happening at family level, but waste gets mixed during primary and secondary collection and irregular shifting of TT containers to TS&CP. To overcome this predicament and to improve the quality of segregation.JPT proposes to have one type of waste (dry or wet) collection per day. This will reduce chances of waste getting mixed and enhance the quantum of compostables reaching the CP every day.

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Type of Waste	Organic	Inorganic	Organic	Organic	Inorganic	Organic

- To avoid mixing of waste at secondary collection point, it is suggested to **Introduce direct transportation system from wards which are nearer to the Transfer Station and Compost Plant through Battery operated vehicles.**.
- For the wards which are far from TS & CP, it is suggested to do door to door collection by Tricycles. After collection, collected waste should be stored in properly placed TT containers at SCP which will be later toed by tractor to TS & CP as early as possible according to a plan.
- Municipality must remove of Open dumps and demolition of existing concrete VATs and replacement of the same with TT containers or community bins – are suggested.
- Proper planning for placement of TT containers in consultation with municipality staff (SI and supervisors)
- Deployment of adequate manpower for segregated waste collection and transportation to ensure maximum coverage of families through primary collection and Procurement and supply of Primary Collection and Secondary Transportation vehicles.
- Develop the mechanism of **Ward Committee** and decentralize waste collection system. Municipality should form a Ward Committee chaired by ward councillor and 3 to 4 reputed senior citizens, to work as watch dog for segregated waste collection and transportation.
- Municipality should **introduce User fees** for SWM services as per notification of MSW rules 2016, State SWM policy and NGT directives.
- **Develop SWM policy and modify bylaws** to incorporate user fees collection from Commercial and residential establishments

  Phase -I- Commercial establishments (institution, hotel, shops, street vendors, restaurants etc.)

  Phase-II – Residents
- Municipality should prepare **separate SWM budget** comprising of All SWM activities and heads of expenditures. JPT has prepared the draft of it and prepared SWM budget for year 18-19.
- Develop **incentive mechanism** for the most efficient Waste Handlers (e.g. if a waste handler covers more than 275 nos. of households per day he will get incentive). Arrange a programme to provide incentives so that others get motivation to perform better.
- **Deployment of permanent social team in municipality which will carry out awareness programme**, monitor waste collection system and resolve issues related to waste collection and segregation. They will act as a link between the citizens and the municipality.
- **Use of municipality waste collection equipments as advertisement medium:** there are many local and national companies who give their advertisement on the local vehicle (TOTO/ tricycle rickshaw) which move inside the municipality. Those agencies can be approached by publishing note in local newspaper or by putting banners in municipality area and propose to utilize municipality vehicles (Tricycle/ Auto tipper/ compactor/ TT containers/ tractors etc) as advertisement medium.
- **Involvement of SHG in waste collection system:** It is proposed to adopt the mechanism to resolve shortfall of manpower issue. Municipality should collect user fees from the residents and involve SHG for collection of waste and pay them from the SWM user fees. This will be a self-sustainable model for waste collection system without putting extra burden on the government.
- **Grievance cell and redressal mechanism:** Municipality should open a Grievance Cell in municipality office. It is proposed to have a SWM mobile based Application by which citizens can put complaints regarding SWM in municipality.

1.4.1 Waste collection plan

Considering the criteria mentioned in the MSW Manual 2016 (page no. 184 Table 2.4, Population of the Municipality between 1 lakhs to 5 lakhs) Collection of primary waste is proposed as follows

- Collection and direct transportation of waste to processing plant – 75% areas should be covered like this. It is proposed to have this collection by battery Operated Vehicles
- Collection and indirect transportation of waste to processing plant - 25% area should be covered by Tricycle

Considering the above criteria, it comes around 16 nos. (Out of 23 nos.) of wards from where we can directly transport waste from residents to Transfer station & Compost plant (TS&CP) and from 6 nos. of wards we can use tricycle for primary collection and storage of waste to TT containers and from there it will be toed by tractor to TS & CP.

Movement of Primary Collection Vehicles in Wards

	Deployment of Battery Operated Vehicles in wards nearest to CP Ward No 5-10,12-18,21,22,23
	Movement of Tricycles into farthest wards to CP Ward No. 1-4,11,19,20

1.5 GAP Analysis

Calculate Optimum Number of Manpower and Equipments required for Primary and secondary waste collection system and the GAP between Existing and Proposed has been worked out which is as follows

1.5.1 Required Equipments

- **Tricycles** – To collect waste from wards which are far from TS& CP,
- **TT contains**- will be placed in wards which are far from TS & CP where waste is being collected by tricycle. These TT container will be toed by tractor to TS & CP
- **Tractor**- To Toe TT containers to TS & CP
- **Battery Operated ToTo type tipper** - To collect waste form wards which are near to T& CP and direct transport the collected waste to the plant the
- **Community bins** – to install in areas of bulk waste generators like Institution, school, markets etc.
- **Auto Tipper**- to collect waste form community bins and transfer it to TS &CP site

Type of Equipments and vehicles	Numbers required	Numbers available	GAP		Remark
Tricycle	33	90	-57		The existing tricycle is used for road Sweeping waste collection, drain cleaning waste collection etc.
Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	21	0	21		New Procurement need to be done
TT containers	42	41	1	6	New Procurement need to be done
			5		Extra 5 nos. of TTs needed to replace 5 nos. damaged TTs
Tractor	6	12	-6		Extra Tractor can be used in Road and Drain cleaning work
Community bins (pair of 2)	176	0	176		New Procurement need to be done

Type of Equipments and vehicles	Numbers required	Numbers available	GAP	Remark
Auto tippers	6	4	2	New Procurement need to be done

**As per consultation with Sanitary Inspector, 5 out of 24 nos. of existing TTs are not in good condition.*

1.5.2 Required Manpower

As proposed collection system is mechanised (by introduction of battery operated Toto type vehicle which will reduce the manpower required in the collection system as the vehicles can cover more number for families and easy to operate as waste handler can drive ToTo type vehicle, there is no requirement of specialised driver to drive the vehicles.

Type	Position	Required	Available	Gap	Remark
Tricycle	Waste handler	33	94	-61	61 extra manpower can be used in other work
Battery Operated vehicle	Waste handler	21	0	21	(42+21) = 63 nos. manpower is required; 61 manpower can be used as driver and helper of battery operated vehicle; (63-61) =**2nos. required**
	Helper	42	0	42	
Tractor	Driver	6	5	1	**1 skilful driver is required**
	Helper	18	10	8	**8 helpers are required**
Auto tipper	Driver	6	5	1	**1 skilful driver is required**
	Helper	12	10	2	**2 helpers are required**
Supervision	Supervisor	23	15	8	**8 nos. skilful supervisors are required**
Repairing & fitting of vehicles	Mechanics	1	0	1	1 mechanic is required
	Helper	2	0	2	2 helpers are required

1.6 Cost Estimation

To estimate fund requirement for implementation of Proposed SWM system, cost estimation has been carried out as:

- Fund required for procurement of new Equipment/vehicles
- Fund required for O & M of Additional Equipment/vehicles and manpower.

1.6.1 Procurement of new Equipments/vehicles

From GAP analysis three types of equipments /vehicles are required for improvement of waste collection system, the detail O & M cost of these equipments/vehicles are as follows:

Sl. No	Description	Requirement	Available	Gaps	Unit Rate (INR)	Total (INR)
1	Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	21	0	21	200000	4200000.00
2	TT container 2.0 m^3	42+5 = 47	41	6	200000	1200000.00
3	Auto tipper	6	4	2	900000	1800000.00
4	Road side bins with frame- 100 lit capacity PAIR	176	-	176	9500	1672000.00
Total Cost for Procurement of New Equipments						**88,72,000.00**

1.6.2 Operation & Maintenance Cost for Additional Equipments/Vehicles, Manpower and Social Awareness Programme

For improvement of proposed SWM system, O&M cost for the additional equipments and manpower is calculated considering only additional equipments and manpower because O & M of existing manpower and equipments is being managed by the municipality with their existing funds

The additional O & M Cost includes the following

- O & M cost of additional Equipments
- O & M cost of additional Manpower
- O & M cost of Social Awareness Program

1.6.2.1 Equipments

GAP analysis shows that three types of equipments/vehicles are required. Details O & M cost of these equipments/ vehicles are as follows:

Sl. No	Description	Equipment Numbers	Operation Cost/month (INR)	Total (INR)	Maintenance Cost/month (INR)	Total (INR)	O&M Cost per month (INR)	O&M Cost per year (INR)
1	Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	21	3000	63000	1000	21000	84000	1008000
2	TT container 2.0 m^3	6	0	0	1000	6000	6000	72000
3	Auto tipper	2	13500	27000	1350	2700	29700	356400
Total			**16500**	**90000**	**3350**	**29700**	**119700**	**14,36,400**

1.6.2.2 Manpower

To estimate the cost involved in deployment of additional manpower we have considered **minimum wages policy of the government.*

Sl No	Manpower	Nos.	Salary (INR)	Amount per month (INR)	Amount per year (INR)
1	Supervisor	8	8996	71968	863616
2	Battery Operated (Helper)	2	8177	16354	196248
3	Driver (Tractor)	1	8996	8996	107952
4	Helper (Tractor)	8	8177	65416	784992
5	Driver (Auto tipper)	1	8996	8996	107952
6	Helper (Auto tipper)	2	8177	16354	196248
7	Mechanic	1	8996	8996	107952
8	Helper (Mechanic)	2	8177	16354	196248
Total				**2,13,434**	**25,61,208**

**Salary As per current minimum wage policy of the government*

1.6.2.3 Social Awareness Programmeand Information, Education& Communication (IEC) Materials for next one year

Sl. No.	IEC Materials and Methods for one year Budget	Quantity	Unit cost (INR)	Amount (INR)
IEC Material				
1	Bilingual Leaflet on segregation and related SWM behaviour (One page)	150000	3	450000
2	SWM small booklet for awareness among students/ youth	50000	8	400000
3	Banner (6'-0"x4'-0") flex with frame	100	800	80000
4	Hoarding (20'-0"x10') with frame	12	60000	720000
5	Advertisements through local cable	4	20000	80000
Social Awareness Program				
1	Workshop, Seminars of stake holder	15	10000	150000
2	Miking per day	23	6000	138000
3	School interaction on environment education	23	6000	138000
4	Wall writing by students and youth	10	2000	20000
5	Street drama	12	10000	120000
6	Student/ youth Rally	3	10000	30000
7	Community level meeting per ward	50	2500	125000
8	Exhibition during local festivals	2	15000	30000
9	Exposure visit for cross fertilization of ideas/ best practices in state	1	50000	50000
10	Capacity building of all stake holders	5	5000	25000
	a) Training and demonstration			
	b) Exposure visit to best practices in India	1	150000	150000
11	Training of Waste Handlers and Supervisors	12	5000	60000
12	Incentive programmes for Best performances among Waste Handlers/ Supervisors	12	8000	96000
Manpower				
1	Social Mobiliser – 6 numbers	12	8000	96000
2	Social Co-ordinator 1 Number	12	15000	180000
Total				**31,38,000**

1.6.3 Summary of Cost

Total cost involved for Improvement of SWM system in the municipality is as follows:

Detail of Items	Cost (INR)
New Procurement	**88,72,000**
O & M Equipment	**14,36,400**
O & M of Manpower	**25,61,208**
Social Awareness programme (one year)	**31,38,000**
Total (ONE YEAR)	**1,60,07,608**

1 Executive Summary

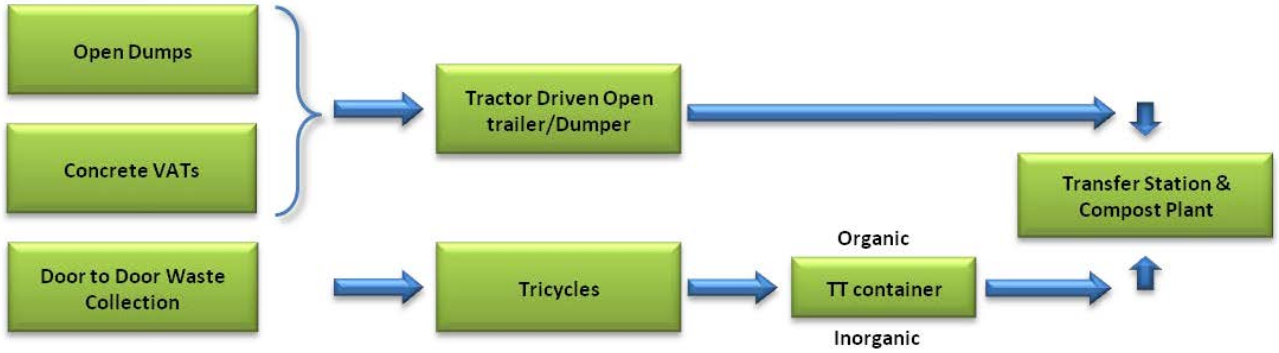
1.1 Project Background

The Government of West Bengal established a comprehensive Solid Waste Management system in a cluster of 6 municipalities (Uttarpara-Kotrung, Konnagar, Rishra, Serampore, Baidyabati and Champdany) of Hooghly. The Project **Kolkata Solid Waste Management Improvement Project (KSWMIP)** came as a boon. KSWMIP was to provide these ULBs with infrastructure facilities together with material support in the form of equipments and vehicles and up-gradation of skill and efficiency of the ULBs in carrying out SWM effectively, efficiently and fruitfully to provide the citizens with a beautiful, tidy and hygienic environment to live in. Launched in 2007, KMDA established Compost Plant, Transfer Station and Regional Waste Management Centre (RWMC) for the 6 municipalities to share.

1.2 Solid Waste Management Status

CHAMPDANY MUNICIPALITY		
Area in Sq Km.	:	6.37
Population in 2019	:	111251
Number of Families	:	27911
Door to Door Collection	:	9 out of 22 wards
Primary Waste Collectors	:	12 nos.
Tricycles	:	12 nos.
Battery Operated Vehicles	:	2 nos.
Auto tippers	:	2 nos.
TT Containers	:	14 nos.
Time of Door to door collection	:	7:00 am to 10:00 am (3.00 hours)
Average number of families covered by one waste handler per day	:	150-160
Total Waste Generation in Tonne per day	:	41
Total Waste Collection in Tonne per day	:	13 (31%)
Incoming quantity of Organic waste at Compost plant Tonne/day	:	0.5 (4%)
Average Number of families per ward	:	1268
Total No. of Families covered by door to door collection (both in crude and segregated manner)	:	2200 (10%)

- Primary Waste collection is carried out in 10% area (daily & alternative) of Champdany.



1.3 Issues of Primary and Secondary waste collection system

- Working hour of waste handler is far too less. As per manual it should normally be 8 hours per day. But actually it is (7.00 am – 10.00 am) 4hrs only. Municipality has only deployed one waste handler in 9 wards and there is no door to door collection in 13 numbers of wards. Even one Waste Handler covers approx. 150-160 families per day and other area of the wards remain uncollected.
- Due to inadequate manpower, only 10% area is covered through daily waste collection and remaining 90% area remain uncovered.
- House to house segregation level in areas where primary collection happens is 60-70 percent but these numbers are very less. Also these segregated waste is get mixed during collection and transportation as.
- Only 3-5% fresh Organic waste of total generation reaches the CP daily.
- Absence of proper Planning and Management to locate Secondary Waste Storage points and Proper Waste Transportation.
- There are **388 Number of Open dumping places and 33 Nos. of concrete VAT** where residents and waste handlers dump the collected waste. Location of each VAT has been identified and mention on map annexed with this report.
- It was observed that municipality has shortage of TT container; even the containers are erratic placed. Transportation of TT containers to TS&CP is Irregular.
- Lack of maintenance of equipments.
- Municipality don't have any initiative or plan regarding social awareness of local people about SWM, They are totally dependent on JPT.
- Lack of monitoring from municipality side.

1.4 Proposed SWM Improvement Plan

- It was observed that segregation is happening at family level, but waste gets mixed during primary and secondary collection and irregular shifting of TT containers to TS&CP. To overcome this predicament and to improve the quality of segregation JPT proposes to have one type of waste (dry or wet) collection per day. This will reduce chances of waste getting mixed and enhance the quantum of compostables reaching the CP every day.

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Type of Waste	Organic	Inorganic	Organic	Organic	Inorganic	Organic

- To avoid mixing of waste at secondary collection point, it is suggested to **Introduce direct transportation system from wards which are nearer to the Transfer Station and Compost Plant through Battery operated vehicles.**
- For the wards which are far from TS & CP, it is suggested to do door to door collection by Tricycles. After collection, collected waste should be stored in properly placed TT containers at SCP which will be later toed by tractor to TS & CP as early as possible according to a plan.
- Municipality must remove of Open dumps and demolition of existing concrete VATs and replacement of the same with TT containers or community bins – are suggested.
- Proper planning for placement of TT containers in consultation with municipality staff (SI and supervisors)
- Deployment of adequate manpower for segregated waste collection and transportation to ensure maximum coverage of families through primary collection and Procurement and supply of Primary Collection and Secondary Transportation vehicles.
- Develop the mechanism of **Ward Committee** and decentralize waste collection system. Municipality should form a Ward Committee chaired by the ward Councillor and 3 to 4 reputed senior citizens, to work as watch dog for segregated waste collection and transportation.
- Municipality should **introduce User fees** for SWM services as per notification of MSW rules 2016, State SWM policy and NGT directives.
- Municipality should prepare **separate SWM budget** comprising of All SWM activities and heads of expenditures.
- **Develop SWM policy and modify bylaws** to incorporate user fees collection from Commercial and residential establishments

  Phase -I- Commercial establishments (institution, hotel, shops, street vendors, restaurants etc.)

  Phase-II – Residents
- Municipality should prepare **separate SWM budget** comprising of All SWM activities and heads of expenditures. JPT has prepared the draft of it and prepared SWM budget for year 18-19.
- Develop **incentive mechanism** for the most efficient Waste Handlers (e.g. if a waste handler covers more than 275 nos. of households per day he will get incentive). Arrange a programme to provide incentives so that others get motivation to perform better.
- **Deployment of permanent social team in municipality which will carry out awareness programme**, monitor waste collection system and resolve issues related to waste collection and segregation. They will act as a link between the citizens and the municipality.
- **Use of municipality waste collection equipments as advertisement medium:** there are many local and national companies who give their advertisement on the local vehicles (TOTO/ tricycle rickshaw) which move inside the municipality. Those agencies can be approached by publishing note in local newspaper or by putting banners in municipality area and propose to utilize municipality vehicles (Tricycle/ Auto tipper/ compactor/ TT containers/ tractors etc) as advertisement medium.
- **Involvement of SHG in waste collection system:** It is proposed to adopt the mechanism to resolve shortfall of manpower issue. Municipality should collect user fees from the residents and involve SHG for collection of waste

and pay them from the SWM user fees. This will be a self-sustainable model for waste collection system without putting extra burden on the government.

- **Grievance cell and redressal mechanism:** Municipality should open a Grievance Cell in municipality office. It is proposed to have a SWM mobile based Application by which citizens can put complaints regarding SWM in municipality.

1.4.1 Waste collection plan

Considering the criteria mentioned in the MSW Manual 2016 (page no. 184 Table 2.4, Population of the Municipality between 1 lakhs to 5 lakhs), Collection of primary waste is proposed as follows

- Collection and direct transportation of waste to processing plant – 75% areas should be covered like this. It is proposed to have this collection by battery Operated Vehicles
- Collection and indirect transportation of waste to processing plant - 25% area should be covered by Tricycle

Considering the above criteria, it comes around 16 nos. (Out of 22 nos.) Of wards from where we can directly transport waste from residents to Transfer station & Compost plant (TS&CP) and from 6 nos. of wards we can use tricycle for primary collection and storage of waste to TT containers and from there it will be toed by tractor to TS & CP.

Movement of Primary Collection Vehicles in Wards

	Deployment of Battery Operated Vehicles in wards nearest to CP Ward No 1-13,18-20
	Movement of Tricycles into farthest wards to CP Ward No. 14-17,21,22

1.5 GAP Analysis

Calculate Optimum Number of Manpower and Equipments required for Primary and secondary waste collection system and the GAP between Existing and Proposed has been worked out which is as follows

1.5.1 Required Equipments

- **Tricycles** – To collect waste from wards which are far from TS& CP,
- **TT contains**- will be placed in wards which are far from TS & CP where waste is being collected by tricycle. These TT container will be toed by tractor to TS & CP
- **Tractor**- To Toe TT containers to TS & CP
- **Battery Operated ToTo type tipper** - To collect waste form wards which are near to T& CP and direct transport the collected waste to the plant the
- **Community bins** – to install in areas of bulk waste generators like Institution, school, markets etc..
- **Auto Tipper**- to collect waste form community bins and transfer it to TS &CP site

Type of Equipments and vehicles	Numbers required	Numbers available	GAP	Remark
Tricycle	24	12	12	New Procurement need to be done
Battery Operated Toto Type Tipper with 8 nos of 60 lit Bins	19	0	19	New Procurement need to be done
TT containers	23	40	0	New Procurement need to be done

Type of Equipments and vehicles	Numbers required	Numbers available	GAP	Remark
Tractor	3	7	0	Extra Tractor will be used in Road and Drain cleaning work
Community bins (pair of 2)	158	0	158	New Procurement need to be done
Auto tippers	5	2	3	New Procurement need to be done

1.5.2 Required Manpower

As proposed collection system is mechanised by introduction of battery operated Toto type vehicle which will reduce manpower required in the collection system as the vehicles can cover more number for families and easy to operate as waste handler can drive ToTo type vehicle, there is no requirement of specialised driver to drive the vehicles.

Type	Position	Required	Available	Gap	Remark
Tricycle	Waste handler	24	12	12	Additional required
Battery Operated vehicle	Waste handler	19	0	19	(19+38) = 57 waste handlers and helpers are required
	Helper	38	0	38	
Tractor	Driver	3	3	0	Additional required
	Helper	9	3	6	
Auto tipper	Driver	5	0	5	Additional required
	Helper	10	0	10	Additional required
Supervision	Supervisors	22	36	0	No requirement
Repairing & fitting of vehicles	Mechanics	1	0	1	1 mechanic is required
	Helper	2	0	2	2 helpers are required

1.6 Cost Estimation

To estimate fund requirement for implementation of Proposed SWM system, cost estimation has been carried out as:

- Fund required for procurement of new Equipment/vehicles
- Fund required for O & M of Additional Equipment/vehicles and manpower.

1.6.1 Procurement of new Equipments/vehicles

From GAP analysis three types of equipments /vehicles are required for improvement of waste collection system; the detail O & M cost of these equipments/vehicles are as follows:

Sl. No	Description	Requirement	Available	Gaps	Unit Rate (INR)	Total (INR)
1	Tricycle	24	12	12	31860	382320.00
2	Battery Operated Toto Type Tipper with 8 nos. of 60 lit Bins	19	0	19	200000	3800000.00

Sl. No	Description	Requirement	Available	Gaps	Unit Rate (INR)	Total (INR)
3	Auto tipper	5	2	3	900000	2700000.00
4	Road side bins- 100 lit capacity pair	158	0	158	9500	1501000.00
Total Cost for Procurement of New Equipments						**83,83,320.00**

1.6.2 Operation & Maintenance Cost for Additional equipments/Vehicles, Manpower and Social Awareness Programme

For improvement of proposed SWM system, O&M cost for the additional equipments and manpower is calculated considering only additional equipments and manpower because O & M of existing manpower and equipments is being managed by the municipality with their existing funds

The additional O & M Cost includes the following

- O & M cost of additional Equipments
- O & M cost of additional Manpower
- O & M cost of Social Awareness Program

1.6.2.1 Equipments

GAP analysis shows that three types of equipments/vehicles are required. Details O & M cost of these equipments/ vehicles are as follows:

Sl. No	Description	Equipment Numbers	Operation Cost (INR)	Total (INR)	Maintenance Cost (INR)	Total (INR)	O&M Cost per month (INR)	O&M Cost per year (INR)
1	Tricycle	12	0	0	500	6000	6000	72000
2	Battery Operated Toto Type Tipper with 8 nos. of 60 lit	19	3000	57000	1000	19000	76000	912000
3	Auto tipper	3	13500	40500	1350	4050	44550	534600
Total			**16500**	**97500**	**2850**	**29050**	**126550**	**15,18,600**

1.6.2.2 Manpower

To estimate the cost involved in deployment of additional manpower we have considered minimum wages policy of the government.

Sl. No	Manpower	Nos.	Salary (INR)	Amount per month (INR)	Amount per year (INR)
1	Waste Handler (Tricycle)	12	8177	98124	1177488
2	Waste Handler & Helper (Battery)	57	8177	466089	5593068
3	Helper (Tractor)	6	8177	49062	588744
4	Driver (Auto tipper)	5	8996	44980	539760

Sl. No	Manpower	Nos.	Salary (INR)	Amount per month (INR)	Amount per year (INR)
5	Helper (Auto tipper)	10	8177	81770	981240
6	Mechanic	1	8996	8996	107952
7	Helper (Mechanic)	2	8177	16354	196248
Total				**7,65,375**	**91,84,500**

*Salary As per current minimum wages policy of the government

1.6.2.3 Social Awareness Programme and Information, Education& Communication (IEC) Materials for next one year

To carryout Social awareness programme after completion of JICA project team we have considered following social awareness programme and calculated cost involvement for the same as follows

Sl. No.	IEC Materials and Methods for one year Budget	Quantity	Unit cost (INR)	Amount (INR)
IEC Material				
1	Bilingual Leaflet on segregation and related SWM behaviour (One page)	150000	3	450000
2	SWM small booklet for awareness among students/ youth	50000	8	400000
3	Banner (6'-0"x4'-0") flex with frame	100	800	80000
4	Hoarding (20'-0"x10') with frame	12	60000	720000
5	Advertisements through local cable	4	20000	80000
Social Awareness Program				
1	Workshop, Seminars of stakeholder	15	10000	150000
2	Miking per day	22	6000	132000
3	School interaction on environment education	22	6000	132000
4	Wall writing by students and youth	10	2000	20000
5	Street drama	12	10000	120000
6	Student/ youth Rally	3	10000	30000
7	Community level meeting per ward	50	2500	125000
8	Exhibition during local festivals	2	15000	30000
9	Exposure visit for cross fertilization of ideas/ best practices in state	1	50000	50000
10	Capacity building of all stake holders	5	5000	25000
	a) Training and demonstration			
	b) Exposure visit to best practices in India	1	150000	150000
11	Training of Waste Handlers and Supervisors	12	5000	60000
12	Incentive programmes for Best performances among Waste Handlers/ Supervisors	12	8000	96000
Manpower				
1	Social Mobiliser – 6 numbers	12	8000	96000
2	Social Co-ordinator 1 Number	12	15000	180000
Total in INR				**31,26,000**

1.6.3 Summary of Cost

Total cost involved for Improvement of SWM system in the municipality is as follows:

Detail of Items	Cost (INR)
New Procurement	**83,83,320**
O & M Equipment	**15,18,600**
O & M of Manpower	**91,84,500**
Social Awareness programme (one year)	**31,26,000**
Total (ONE YEAR)	**2,22,12,420**

添付資料４

業務従事者の従事計画／実績表

案件名：インド国コルカタ都市圏廃棄物管理改善事業促進業務（フェーズ2）

	氏名（担当）	格付		渡航回数	2018 4	5	6	7	8	9	10	11	12	2019 1	2	3	4	5	6	7	8	9	10	11	12	2020 1	2	3	日数 合計	合計（人／月） 現地	国内
現地業務	齋藤　正浩（総括／廃棄物管理計画／廃棄物管理システム維持管理指導）	2	計画	10	(26)			(25)			(25)		(25)		(25)			(15)		(25)	(25)			(25)				(25)		241	8.03	
			実績	10	4/7-5/2 (26)			7/18-8/11 (25)			9/20-10/12 (23)		11/29-12/22 (24)		2/7-3/2 (24)			5/5-5/29 (25)			7/29-8/29 (32)			10/16-11/9 (25)	11/29-12/21 (23)			2/14-2/29 (16)		243	8.10	
	永平 晃造（廃棄物処理施設維持管理指導）	6	計画	4	(20)						(20)							(14)									(12)		66	2.20	
			実績	5	4/7-5/2 (20) 6日間自社負担					9/20-10/6 (17)											7/29-8/17 (20)			11/4-11/30 (27)			1/26-2/19 (25)			109	3.63	
	長下部 昇（組織・財務指導）	3	計画	9		(25)				(25)			(25)	(25)		(21)			(21)			(21)			(21)			(15)		199	6.63	
			実績	8		5/16-6/9 (25)				8/28-9/22 (26)	10/24-11/14 (22)			1/15-2/8 (25)				5/23-6/14 (23)				8/29-9/21 (24)		11/9-12/1 (23)		1/8-2/5 (29)			197	6.57	
	伊藤 依理（環境教育、分別指導／汚泥処理）	5	計画	5				(20)				(20)				(15)					(10)				(10)				75	2.50	
			実績	1				7/18-8/4 (18)																					18	0.60	
	矢尾　和也（環境教育、分別指導／汚泥処理）	5	計画	0																									0	0.00	
			実績	1									12/9-12/22 (14)																14	0.47	
																													581	19.36	
																													581	19.37	
国内業務	永平 晃造（廃棄物処理施設維持管理指導）	6	計画	－																(5.3)									5.3		0.27
			実績	－																7/22-7/27 (5.2)									5.2		0.26
																													5		0.27
																													5		0.26

＜凡例＞　■：業務従事実績　□：業務従事計画　▨：自社負担

合計		
	計画	19.63
	実績	19.63

添付資料５

Japan International Cooperation Agency (JICA)

Technical Assistance for Kolkata Solid Waste Management Improvement Project (Phase-2)

SOLID WASTE MANAGEMENT BUSINESS TOUR in JAPAN 2019




JULY 2019

JICA PROJECT TEAM
Yachiyo Engineering Co., Ltd.

1. Purpose

Solid waste management business tour in Japan 2019 has been conducted for the "Technical Assistance for Kolkata Solid Waste Management Improvement Project" (hereinafter referred to as the "Project") for the following two purposes.

1.1 Build Network of SWM

Tokyo is a member of C40 which is C40 Cities Climate Leadership Group having honored cities implementing outstanding efforts against climate change since 2013, named as C40 Cities Awards, which the Project won the prestigious "Solid Waste Management Category Award" in 2016. Tokyo, until now, has tackled and solved many problems in regard to Solid Waste Management (hereinafter referred as the "SWM").

Consequently, JPT will provide opportunities for exchange of opinions between the target 6 municipalities and Tokyo, and they will build network of SWM with a city of Japan in order to be able to receive advice of SWM from Tokyo after the Project completed. In addition, since mayors of the municipalities and a chief engineer of Kolkata Metropolitan Development Authority (hereinafter referred as the "KMDA") will participate, it is expected that they will promote the Project after they learned SWM such as collection of source separation and collection, transportation, recycling and final disposal in Japan and acquire the knowledge.

1.2 Business Matching with Japanese Companies

The target 6 municipalities are considering construction of medical waste management facilities such as small scale incinerator and autoclave, and they are strengthening recycling of plastic as a waste countermeasure in line with the declaration "India will abolish all single-use plastic by 2022" by Indian Prime Minister Narendra Modi and considering adopting the crushing and compaction equipment of plastic. Thus, JPT will set up a place where the target 6 municipalities can do business marching by introducing them Japanese companies having the recycling technology.

2. Schedule

The business tour was conducted for 6 days including travel days from 22nd to 27th July, 2019. Detail schedule of the business tour is shown in Table 1.

Table 1 Schedule of Business Tour

No. of Day	Date		Time	Activity	Lodging Place
1	22nd July	MON	AM	- Leave Kolkata for Hong Kong Airport at 1:15 am by CX5169	Tokyo
			PM	- Arrive at Narita Airport at 2:30 pm - Hotel check-in and briefing of business tour	
2	23th July	TUE	AM	- Visit to incineration plant of medical waste and conduct business matching	Tokyo

3	24th July	WED	AM	- Visit to compressed package and plastic crusher equipment of plastic, bin, can and PET conduct business matching	Tokyo
			PM	- Visit to compressed package and crusher equipment of plastic, bin, can and PET and conduct business matching	
4	25th July	THU	AM	- Visit to Arakawa Recycling Center	Tokyo
			PM	- Visit to Adachi Incineration Plant - Lecture on Waste Management Policy in Tokyo by Clean Authority of Tokyo (CAT) - Make a presentation of KSWMIP to CAT - Exchange opinion with CAT	
5	26th July	FRI	AM	- Exchange opinion on future plan of solid waste management in Yachiyo Headquarter	Tokyo
			PM	- Leave Haneda for Hong Kong Airport at 4:25 pm by CX549	
6	27th July	SAT	AM	- Arrive at Kolkata Airport at 00:20 am	—
			PM		

3. Participants

List of the Participants is shown in Table 2. Chairman of Uttarpara-Kotrung who was going to participate the business tour could not have attended suddenly.

Table 2 List of Participants

No.	Full Name	Organisation	Position
Participant			
1	Mr. Amiya Mukherjee	Serampore Municipality	Chairman
2	Mr. Arindam Guin	Baidyabati Municipality	Chairman
3	Mr. Tapas Ghosh	Rishra Municipality	Conservancy Staff
4	Mr. Alok Mukherjee	Konnagar Municipality	Conservancy Manager
5	Mr. Sisir Kumar Baidya	Kplkata Metropolitan Development Authority	Chief Engineer
6	Mr. Ajeet Singh	JICA Project Team	Leader of Local Staff
7	Mr. Biswadwip Bardhan*1	JICA Project Team	Local Staff
Attendants			
8	Mr. Kozo Nagahira	JICA Project Team	Staff
9	Mr. Hiroki Ishihara	Yachiyo Engineering Co., Ltd.	Staff
10	Mr. Takahiro Taguchi	-	Interpreter

*1 : Consultant's own cost

4. Implementation of Business Tour

Through the implementation of the business tour, a lot of opinions and good questions were raised from the Participants. Details are as follows:

Date	Contents
23 July	***1. Business Matching for Incineration Plant of Medical Waste*** ***2. Company Name: REST LTD.*** ***3. Site Summary*** The incineration plant was established in the year 1991. The capacity of this plant is 48 ton per day. The company is collecting plastic waste, oil waste, acid waste, paper, wood, textile, metal, glass, concrete, ceramic and some industrial waste from hospitals and industrial factories etc. Among them contaminated medical waste, oil waste and polluted sludge deposited into incinerator for burning. And the whole material filtrated by a filtration chamber or dust collector to get fresh air which comes out through exhaust. ***4. Questions from the Participants*** The Participants asked the following questions. • How much is initial and O&M cost? • How much cost collected by company for transportation of waste? • Is it possible if we have decided to install the plant, you will come to Kolkata for technical support? • How often is the plant maintained? • How many workers are working in the site? • What kind of training is being done for the staff? • What is the composition of incoming waste and capacity of plant? • How much quantity of gas generated from plant? • What kind of emission standards is the incineration plant complied? ***5. Results of Business Matching*** As a result of business matching with the company, the Participants concluded that there is a possibility to install the small-scale incineration plant of medical waste with Japanese technology in the future with the cooperation of the company in the future.
24 July	***1. Business Matching for compressed package and crusher equipment of plastic, bin, can and PET bottle*** ***2. Company Name: Koyo Service Corporation.*** ***3. Site Summary*** The company is collecting waste such as plastic, PET bottle, glass and can from business entities like supermarket by collecting charges of transportation and

	processing of waste. The waste is being processed by compressed package and crusher equipment. ***4. Questions from the Participants*** The Participants asked the following questions. • How much is initial and O&M cost? • How much cost collected by company for transportation of waste? • Is it possible if we have decided to install the plant, you will come to Kolkata for technical support? • How many workers are working in the site? • What is the size of each package for sale and how much quantity of packaged daily produced? ***5. Results of Business Matching*** As a result of business matching with the company, the Participants concluded that there is a possibility to install the equipment with Japanese technology in the future with the cooperation of the company. The company has expressed their willingness for the cooperation.
	1. Business Matching for compressed package and crusher equipment of plastic, bin, can and PET bottle ***2. Company Name: Nihonkyoryoku Corporation.*** ***3. Site Summary*** The company is collecting waste such as plastic, PET bottle, glass and can from business entities like supermarket by collecting charges of transportation and processing of waste. The waste is being processed by compressed package and crusher equipment. ***4. Questions from the Participants*** The Participants asked the following questions. • How much is initial and O&M cost? • How much cost collected by company for transportation of waste? • Is it possible if we have decided to install the plant, you will come to Kolkata for technical support? • How many workers are working in the site? • How long the plant is worked every day? • What is the size of each package for sale and how much quantity of packaged daily produced? ***5. Presentation of KSWMIP*** As a result of business matching with the company, the Participants concluded that there is a possibility to install the equipment with Japanese technology in the future

	with the cooperation of the company. The company has expressed their willingness for the cooperation.
	1. Business Matching for compressed package and crusher equipment of plastic, bin, can and PET ***2. Company Name: Sanyu Environmental Services Co., Ltd.*** ***3. Site Summary*** The company as well as Koyo Service is collecting waste such as plastic, PET, glass and can from business entities like supermarket by collecting charges of transportation and processing of waste. The waste is being processed by compressed package and crusher equipment. ***4. Questions from the Participants*** The Participants asked the following questions. • How much is initial and O&M cost? • How much cost collected by company for transportation of waste? • Is it possible if we have decided to install the plant, you will come to Kolkata for technical support? • How many workers are working in the site? • What type of business entities are you collecting the waste? • What is the size of each package for sale and how much quantity of packaged daily produced? ***5. Results of Business Matching*** As a result of business matching with the company, the Participants concluded that there is a possibility to install the equipment with Japanese technology in the future with the cooperation of the company. The company has expressed their willingness for the cooperation.
25 July	***1. Build network at Arakawa Recycling Center*** ***2. Ward Name: Arakawa Ward*** ***3. Site Summary*** This center which is managed by Arakawa ward is compressing and crushing recyclable waste such as bin, can, PET and white polystyrene foam food tray carried from households. There are lecture room and craft room for the public awareness to the residents. ***4. Questions from the Participants*** The Participants asked the following questions. • How much is O&M cost like electricity? • How much is income and expenditure?

	• Is it possible if we have decided to install the plant, you will come to Kolkata from a government perspective? • How many workers are working in the site? • How much recyclable waste is being collected every day? ***5. Results of Discussion*** As a result of discussion with staff of Arakawa ward and the CAT, the Participants concluded that it would be quite effective if the Arakawa ward and the CAT could support us not only for technical perspective but government perspective for public awareness in the future. The CAP has answered that we will willingly support you as much as we can do.
	1. Build network at Adachi Incineration Plant ***2. Authority Name: Clean Authority of Tokyo*** ***3. Site Summary*** Purpose of Adachi incineration plant is to reduce the amount and volume of collected combustible wastes except industrial waste by burning them. In order to preserve environment and keep on having good relationship with residents living around the area, waste heat generated by the plant is being reused in the public swim sports center which is located next to the plant. Furthermore Adachi incineration plant is generating electricity by using steam, and the electricity is being sold to an electricity power company. ***4. Questions from the Participants*** The Participants asked the following questions. • How much is construction and O&M cost? • How much is income and expenditure? • What kind of public awareness activity is being conducted? • Is it possible if we have decided to support us from a government perspective? • How many workers are working in the site? • How much combustible waste is being brought to the plant every day? ***5. Presentation of KSWMIP*** The Participants has made a presentation about Kolkata Solid Waste Management Improvement Project (hereinafter referred as the "KSWMIP") to the CAT. The CAT has clearly understood activities of KSWMIP and the Project. In addition, the CAT has also been impressed because KSWMIP and the Project are implementing public awareness activities like Tokyo. ***6. Results of Discussion*** As a result of discussion with the CAT, the Participants concluded that it would be quite effective if the CAT could support us not only for technical perspective but government perspective for public awareness in the future. The CAP has answered that we will willingly support you as much as we can do.

26 June	***1. Exchange opinion on future plan of SWM*** ***2. Company Name: Yachiyo Engineering Co., Ltd.*** ***3. Minutes of Discussion*** The Participants and Masahiro Saito, Project Manager of the Project, discussed the following • All the Participants commented that this business tour was quite effective for us to not only make network and connection with the CAT and Japanese companies for our future SWM but also make comparison of the situation of SWM between India and Japan. • JPT asked the Participants how they will reflect what they have learned in Japan for the future SWM. • The Participants have understood that the most important thing for SWM is segregation at source of waste generation, and the Participants stated that they would like to put effort into waste segregation after they will return to India. • Chief Engineer of KMDA requested for JICA support for the project of construction of incinerator in Kolkata. • JPT told the Participants that it is quite tough for the target 6 municipalities to install such an incineration plant now as the O&M cost is too expensive. In addition, JPT also told them that generating electricity cannot be expected as the waste characteristic of the target 6 municipalities is mainly kitchen waste and calorific value of waste is very low. • JPT proposed the Participants to discuss the current issues of SWM of the target 6 municipalities during their stay in Japan as they are too busy when they are in Kolkata to have time for the discussion. • In regard to the insufficient manpower and equipment, Chief Engineer confirmed that he received equipment and demand list from the six municipalities. He is comparing rate of each items with quotations and then send it to UD&MA. • JPT asked conservancy manager of Konnagar repair of transfer station wall and use of battery operated vehicles. He replied Konnagar assured that they will repair wall of TS and proper use of battery vehicles. • JPT raised issues like engagement of rag pickers into TS, operation of battery operated vehicles and most important allow social mobilization activities in other wards. Conservancy staff of Rishra assured us that he will discuss with Chairman and solve all issues. • JPT informed Chairman of Serampore that several times JPT requested to allow start social mobilization activities in wards. The Chairman informed that they have already started collecting segregated waste from 3 wards and collecting and allowed us to start social mobilization activities as soon as possible. • Chairman of Baidyabati assured that he will instruct private agency to put soil cover over cell-1 in the beginning of August 2019 and instruct to private agency of CP to follow windrow system properly.

	• JPT informed the Chief Engineer of meagre situation of Champdani in terms of segregated waste collection, transportation, O&M of TS&CP etc. Chief Engineer replied that he will send Executive Engineer to TS&CP of Champdani to check the current situation. • JPT requested Chief Engineer of KMDA to report the business tour to JICA and Ministry of UD& MAD in a coordination meeting which will be held in the beginning of August 2019. • Chief Engineer of KMDA has accepted the above request.

5. Achievement

Through the discussion of the CAT, the Participants and the CAT promised to have network of SWM from now on. It is expected that they will build good relationship for their future SWM by email.
In regard to business matching, all the private companies have willingly stated that they would like to keep on having a relationship with the Participants. The Participants have also expressed appreciation since they could have made a relationship with some Japanese companies. It is expected that the Participants will contact the companies in the future if they decided to install such a plant.

Appendix Photos

Photos of the business tour are shown below.

<table>
<tr><td>  </td><td> 
</td></tr>
<tr><td>Business matching with Rest Ltd.</td><td>Incinerator of medical waste at Rest Ltd.</td></tr>
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<tr><td>  </td><td>  </td></tr>
<tr><td>Participants studied about magnetic separator facility at Nihonkyoroku Corporation</td><td>Business matching with Nihonkyoroku Corporation</td></tr>
</table>

	
Discussion at Arakawa Recycle Center	Separated crushed bottles according to color at Arakawa Recycle Center
	
Picture of Adachi incineration plant	Presentation about KSWMIP to the CAT
	
Discussion with the CAT	Discussion at HQ of Yachiyo Engineering Co., Ltd.

添付資料６

Japan International Cooperation Agency (JICA)

Technical Assistance for Kolkata Solid Waste Management Improvement Project (Phase-2)

SOLID WASTE MANAGEMENT EXPOSURE TOUR in SURAT 2019

DECEMBER 2019

JICA PROJECT TEAM

Yachiyo Engineering Co., Ltd.

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1 Purpose

Soild waste management exposure tour in Surat 2019 has been conducted for the "Technical Assistance for Kolkata Solid Waste Management Improvement Project" for the following purpose:

Surat is honoured as 2nd cleanest city in India, 2019. Surat experience has demonstrated that urban local governments in the developing countries have the capacity to face the challenges of rapid urbanization and improve the quality of life of all the residents. This publication describes the various initiatives taken by the Surat Municipal Corporation in the last two years.

JICA Project Team has provided opportunities for exchange of opinions between the six target municipalities and Surat officials to build network of SWM with Surat city in order to be able to receive advice of SWM from Surat after completion of project. Sanitary Inspector of six municipalities have participated to learn SWM such as collection of source separation and collection, transportation, recycling and final disposal in Surat and acquire the knowledge.

Thus JPT has set up a stage where the target six municipalities learned on SWM and will implemented in their municipal areas for improvement of SWM system.

2 Schedule

The exposure tour was conducted for 2.5 days including travel days from 16th Dec'19 to 18th Dec'19. Detail schedule of the exposure tour has been shown in **Table 1**.

Table 1: Schedule of Exposure Tour

No. of days	Date	Time	Activities	Lodging Place
1	16th December, 2019	PM	• Leaving from Kolkata for Surat Airport at 4.40 pm	Surat
		PM	• Arrival at Surat Airport on 7.25 pm • Hotel check in and briefing of exposure tour	Surat
2	17th December, 2019	AM	• Visiting Surat Municipal Corporation to meet with Solid Waste Manager of SMC • Visiting West zone of SMC to observe Door to Door Waste collection and conducting discussion sessions with SMC officials about collection system • Visiting Transfer Station of South West zone of SMC to observe Separation and Transportation of Waste.	Surat
		PM	• Visiting Construction & Demolition Waste Plant of SMC • Visiting Bio-methanation plant of SMC and exchanging opinion with SMC officials.	Surat
3	18th December,2019	AM	• Visiting Compost Plant and RDF Plant of Khajod • Visiting Closure Dumpsite of Khajod	Surat
		PM	• Visiting Scientific Landfill of Khajod • Visiting Plastic Recycling Facility of SMC and exchanging opinion with SMC officials.	Surat

No. of days	Date	Time	Activities	Lodging Place
			♦ Departure from Surat for Kolkata Airport at 5.30 pm ♦ Arrival at Kolkata Airport at 10.50 pm	

3 Participants

List of Participants is shown in Table 2.

Table 2: List of Participants

No.	Full Name	Organisation	Position
1	Mr. Anjan Banik	Uttarpara-Kotrung Municipality	Sanitary Inspector
2	Mr. Alok Mukherjee	Konnagar Municipality	Conservancy Manager
3	Mr. Pulin Das	Rishra Municipality	Sanitary Inspector
4	Mr. Anuj Banerjee	Serampore Municipality	Sanitary Inspector
5	Mr. Krishnendu Kundu	Baidyabati Municipality	Sanitary Inspector
6	Mr. Shisham Jaiswal	Champdani Municipality	Sanitary Inspector
7	Mrs. Mita Dhar	JICA Project Team	Social Coordinator*1
8	Mr. Mithun Patra	JICA Project Team	Social Coordinator*1
9	Mr. Biswadwip Bardhan	JICA Project Team	Expert of SWM Treatment Facility*1

**1: Consultants Own Cost*

4 Introduction of Exposure Tour

- In the morning, the team met with Sanitary Inspector of Surat Municipal Corporation (SMC) at Office on 8.30 am and exchanged some opinion about Solid Waste Management system.
- Team collected some information from SI of SMC regarding Solid Waste management system, Staff Infrastructure of SMC, Equipments of SMC, etc.
- SMC divided into 8 zones. Each zone has 12-15 wards, consisting of 11-12 ward offices in each ward. Approximate population for each zone is near about 5-6 lakhs.
- Every zone has individual Sanitary Inspector, two Sub-Inspectors and two Supervisors.
- SMC contracted with different private agencies via tendering, for individual conservancy works like Door to Door to Collection, Operation and Maintenance of Compost Plant, RDF Plant, Sanitary Landfill, Biomethanation plant etc. for the duration of 3-5 years. After that tender process renewed again.
    - SMC carries out following operations –
    - Door to door collection of wastes
    - Operation of Transfer Station
    - Operation of compost plant

- Operation of landfill site
- Operation of C &D waste plant
- Manual Street Sweeping & Mechanical Street Sweeping
- Operation of Biomethanation plant
- Operation of Plastic Recycling Facility

- These are run by private agencies and monitored by respective zonal Sanitary Inspector and Sanitary Sub inspectors.
- Each zone has separate gardens where Organic Waste Garden Composting (OWGC) is carried out. This compost generated from the waste coming from garden itself. A chemical is being mixed with garden raw waste in composting cell. Duration of mature of compost is approx 15 days which are used for manure of individual garden itself.
- SMC provided small containers into road side where local street shops and street waste dumped there. These waste collected by tractor open trailer vehicle in afternoon and transported to nearer transfer station.

Pictures are shown in below:

Discussed with SMC Officials about SWM system

Garden Waste Composting

4.1 Door to door collection

- Door to door collection of wastes and their transportation work is performed in two shifts. First shift starts from 7.00 am upto 11.00 am and another shift from 2.00 pm to 5.00 pm.

- According to SMC officials, each household having green and blue bins for biodegradable and non-biodegradable wastes respectively. Residents keep those wastes separately into respective bins and hand over to waste handlers everyday.
- SMC engaged Autotipper (4-wheeler) vehicles for door to door collection of wastes. According to SMC officials, each zone having approximately 80-100 numbers of Autotippers depending upon the population of each zone. Each vehicle has 1 driver and 2 helpers. Each vehicle collects waste from 3000-3500 houses per day.
- SMC installed GPS system in each vehicle to monitor routes of vehicle, collection and transportation time etc. which they check by online system.
- Collection & transportation route of each Autotipper is fixed.
- SMC collects user fee annually for SWM. This user fee is included in total Tax amount which they have collected once in a year.
- If any waste handler or a person take leave from duty then private agency should engage another person in place of empty person i.e., private agency should have sufficient manpower so that the whole collection system is going smoothly. This criterion is mentioned in contract document.

Pictures are shown in below:

Segregated waste at door to door level

Auto tipper is used for door to door collection

4.2 Transfer Station

- SMC handed over to private agency for operation and maintenance of TS.
- Each zone having one Transfer Station (TS) capacity is approx 200 – 220 Tonne.
- Agency deployed 15 numbers of manpower for weighbridge operation, machineries operation, supervisors etc and 15 rag pickers for collection of recyclables only.
- Collected wastes from household are directly transported to Transfer Station by Autotippers.
- Weighing of waste takes place at weighbridge before disposal. Total quantity of incoming wastes, type of vehicle, vehicle number, ward number, zone number, etc. are recorded.
- TS is a two storied building. All incoming vehicles climb up by RCC Ram to reach the upper floor. There are two hoppers- one for biodegradable wastes and other for non-biodegradable wastes.

- Vehicles unload wastes at hopper whose end portion reaches ground floor. Big containers are mounted on trucks which are placed below hopper machine, receive all waste coming through the pipe and transported to SLF.
- Capacity of one container is approximately 14-16 m3. Each zone having approximately 5 numbers of big trucks. Each truck carries out 3-4 trips to transfer the waste from TS to SLF.
- SMC employed waste pickers at TS to collect recyclable items from waste and sell to market.

Pictures are shown in below:

SURAT MUNICIPAL CORPORATION
SOLID WASTE MANAGEMENT DEPARTMENT
PAL TRANSFER STATION

Slip no.	203152	Trip no. 1	Waste type	M.S.W	
Vehicle no.	GJ05JS0996		Vendor name	SMC TRACTOR	
Veh. type	TRACTOR		Driver name	WITH DRIVER	
Pickup from	WEST ZONE				
Gross weight	4080 KG	Time	17-12-2019 10:26:51 AM	Is RFID entry	No
Tare weight	3250 KG	Time	17-12-2019 10:33:36 AM	Is RFID entry	No
Net weight	830				

Data Recorded at Weighbridge of TS

Transfer Station of SMC

Photograph with SMC Officials

Hopper Chamber at first floor

A container connected with hopper at ground floor

4.3 Construction and Demolition waste

- These wastes are generated in construction and demolition operation of buildings. These wastes mainly consist of granular inorganic substances.
- SMC have only single C & D waste plant in entire zone. This plant has an area capacity of 13000 Sqm.
- Daily 300-400 tonnes of wastes reach C &D plant from all over the city.
- The responsibility of locating C & D waste production site, collecting the wastes and transporting the waste into C & D the plant entirely depends on the private agency. SMC provide Rs. 333/- for each trip.
- This plant consists of Crushing machine where particles are crushed. After crushing, particles having size greater than 80 mm are recrushed and particles whose size are less than 80 mm are washed and separated into four categories-
- Particles having sizes from 45 mm to 20 mm are collected and are used as Granular Sub-base or as Water Bound Macadam
- Particles having sizes from 20 mm to 6 mm are collected and are used in Precast Concreting.
- Particles having sizes from 5 mm to 3 mm are collected and are used as coarse sand.
- Particles whose size is less than 3 mm are used as plaster sand.
- After washing, all liquid collected in a tank where sludge deposited and fresh water in upper layer bring back for washing of particles again. In this way, water recycled and control the requirement of water needed for washing of crushed particles.
- This plant has machineries worth Rs. 12-14 lakhs with 12 numbers of manpower.
- Operation and maintenance of this plant costs Rs. 7-8 lakhs monthly.

Pictures are shown in below:

Washing Machine of C&D Plant

Crushing Machine of C&D Plant

4.4 Biomethanation

- Biomethanation plant is located at APMC market which is a wholesale vegetable market. The rotten and wastage vegetables are collected, crushed and mixed with water in a digester. Anaerobic decomposition takes place at the sludge digestion chamber. Gases released during the digestion are purified where CO, CO2, H2S gases are separated and methane gas is collected.

- 20-22 tonnes of wastes are received in Biomethanation plant daily.
- Capacity of Digester is 1700 m3/day.
- It generates about 1000 m3 of gas per day, which after purification reduces to 500 m3/day.
- Capital cost of this plant is about 7 crores (except land cost). It takes about 7-8 lakhs for operation and maintenance of this plant.
- The gas produced from the plant has a cost of Rs. 20/- per cubic meter. The remaining sludge is used as fertilizer whose price is Rs. 5/- per liter.

Pictures are shown in below:

Organic waste feed into cutting machine

Good quality Organic waste come to Plant

Discussion on Opertion of Biomethanation Plant

Co2, H2S gas removal and extraction of CH4

4.5 Organic Waste Collector (OWC)

- OWC is operated at the basement of each housing apartment where all the domestic wastes generated by the residents of the apartment are collected and fed to it. These wastes are mixed with a chemical (unknown) and digested for 15 days to form compost.
- For 70 kgs of waste input, OWC can generate up to 4-5kgs of compost.
- OWC has a capacity of 100 kgs per day.
- The cost of installation is Rs. 4.5 lakhs.
- The annual operation and maintenance cost of OWC is Rs.10,000/- to Rs. 12,000/- which is collected from the residents of the apartment.

Pictures are shown in below:

Organic Waste Composter machine

Discussion on operation of machine with SMC offcials

4.6 Street Sweeping

- Manual street sweeping works are carried out at night time from 10.00 PM to 2.00 AM.
- There are approx 2200 workers working in SMC for street sweeping only.
- They are paid Rs. 160/- only per day.
- According to SMC sub inspector, 250 meters of road is allocated for each worker.
- 3-wheeler tempo vehicles are used for carrying the wastes.
- Rs. 275/- is provided to each vehicle for collection and transportation of Waste to Transfer Station.
- Mechanical Sweeper
- There are total 3 numbers of mechanical sweepers working on 8 zones.
- Sweeping is carried out at night from 10.00 PM and continued up to 5.00 AM at the morning
- 28 kms of road are swept daily.
- Each road is swept once in a week.
- Mechanical sweeper swept road along with spraying water together to reduce dust formation in surrounding air.

Pictures are shown in below:

Manual Sweeping Work at Night

Mechanical Sweeper

4.7 Compost Plant

- Incoming waste in this plant is around 1000-1100 TPD.
- 3 Supervisors and 12 labours work in this plant.
- After weighing, the incoming waste is fed into machine having 120 mm screen to separate materials whose particle size are larger than 120 mm that are transferred to RDF Plant. Capacity of 120 mm screening machine is 30 tonnes/hour.
- Particle size lesser than 120 mm are placed on windrows platform for degradation.
- After 45 days, they are transferred to monsoon shed for another degradation and reduction of moisture.
- From monsoon shed, it fed into 25 mm screen machine to separate particles larger than 25 mm which are transferred to SLF.
- Particle size lesser than 25 mm are fed into final machine. From the final machine, particle size more than 4 mm are again transferred to SLF and lesser than 4 mm particles are taken away for packaging in the godown.
- 80 to 90 tonnes of compost are generated regularly. Agency contracted with buyers of compost manure and sells it regularly.
- In RDF plant, larger particles having size more than 120 mm fed into 8mm, 6mm and 4mm screen size hopper. Lesser than 4mm particles are come out and fed into cutting machine for cut of particles.
- Agencies sale it to industries as per their requirement.

Pictures are shown in below:

120mm screen machine in processing plant

Cutting Materials for RDF

25mm screen machine in compost plant

Windrows platform of SMC compost plant

Compost manure for sale

Photographs with SMC Officials

4.8 Sanitary Landfill Site

- All mixed waste, Road side waste are come to SLF for disposal. Area of SLF is about 26921 square meter inner side and periphery 1500 meter.
- It has a capacity of 8,50,000 cubic meter with a life span of 5 years (Already 3 months completed).
- Approx 10-15 nos. workers working at landfill site
- All incoming waste dozed and chained by heavy vehicles at landfill.
- Generated leachate is protected by liner system consisting of geo membrane and geotextile.

Pictures are shown in below:

Sanitary Landfill site

Discussion on operation of landfill site

4.9 Closure Landfill Site

According to SMC officials, 15 years old waste dumped in this site.

The whole area divided into two cells. One cell has an area capacity of 1,52,000 square meter and another has capacity of 1,59,000 square meter.

The dumped wastes are overtopped with 450 mm of gravel layer followed by 1.5mm geo membrane, above which 600 mm thick clay layer is deposited. The final surface layer consists of 300 mm yellow soil.

Pipeline is connected from top of the liner membrane to release internal gases.

Bolder is provided along the periphery of both cells that resists by gabion boxes.

It takes approximately 2.5 years to prepare this waste facility.

Pictures are shown in below:

Closure site of remediation

Gabion boxes with bolder provided along the periphery of site

Photographs with SMC Officials

Inspection road

4.10 Plastic Recycling Facility

- Wastes coming from different zones of SMC are segregated here depending upon the type and quality of plastic waste.
- All plastic fed into cutting machine then followed by washing. Clean plastics are collected and fed into drying machine.
- Agromaching is used to convert dried plastics into powder form.
- Excruder is used to provide a general shape to the plastics which followed by a cutting machine to get that plastic in dana form. This dana form materials are usually sale to the market.
- Approx 40 nos. of manpower are working in the plant.

Pictures are shown in below:

Washing Machine of Plastic recycling Unit

Photograph with SMC officials

Plastic in cutting form

Plastic in liquid form

Plastic in powder form

5 Exchange opinion with Surat Municipal Corporation

All the Participants and SMC officials had discussed on following matters:

- SMC officials informed their Organisation structure and SWM system elaborately.
- All the participants commented that this exposure tour was quite effective to make comparison between existing situation of target six municipalities and Surat Municipal Corporation.
- Participants have understood that most important part of SWM system is source separation of waste and participants stated that they will put more effort on household waste segregation.
- Participants checked online monitoring system through GPS by which SMC controlling and monitoring waste collection and transportation system.

- Participants discussed that SMC has huge manpower and equipments to collect waste from cities and transported to SLF. In this regard they are failed to collect waste in segregated way because of shortage of manpower and equipments.
- JPT proposed Sanitary Inspectors of Uttarpara, Konnagar, Rishra, Baidyabati & Champdani to use Battery operated vehicles or Auto tippers to collect segregated waste directly from households and transported to TSCP to reduce chances of waste getting mixed in midway. In replied all SIs stated that they will require some drivers and helpers to operate above vehicles.
- JPT requested SI of Serampore to start social awareness programme in each ward. He asked for household bins, TT containers, manpower etc and informed that he will discuss with chairman regarding this after reach at Kolkata.
- Participants are very much interested about RDF materials which coming from processing plant and after cutting all materials has been sold in the market. Baidyabati SI raised an idea to set up RDF machinery in RWMC (Regional Waste Management Center, Kolkata) where separation can be done through RDF machine to reduce quantum of waste going to SLF results increase of life of landfill.

6 Achievement

Through the discussion between Participants and SMC officials, both promised to build a good relationship by phone or mail regarding SWM in future. Participants expressed that they will learn few good things from here and they will try to implement in their municipality after discussion with Chairman and if require, they will discuss with SMC officials to solve problem and SMC officials accepted it.

添付資料 7

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नमूना का विशिष्टि (यदि हो) Product Specification (If any)	Nil.
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नमूना प्रक्रिया यहाँ प्रासंगिक हो Sampling Procedure where relevant	NA

Tested By	Checked By	Approved By
Sayantan Saha	Dr. Anath Bandhu Mondal	Dr. S. N. Bandyopadhyay
SA(Chemical)	Scientist- B (Chemical)	Scientist- C (Chemical)

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ANNEXURE-1

Results of Chemical Analysis of Solid waste of Uttarpara Kotrung Municipality :

Tested Parameters	Observed Value
1. Moisture , % by weight	: 11.21
2. Colour	: Black
3. Odour	: No Odour
4. Bulk density (gm/cm^3)	: 0.5
5. Total organic carbon, % by weight	: 33.0
6. Total Nitrogen (as N) , % by weight	: 2.08
7. Total phosphates (as P_2O_5), % by weight	: 2.3
8. Total potash (as K_2O), % by weight	: 3.66
9. C : N ratio	: 15.87
10. pH	: 8.87
11. Conductivity (as ds/m)	: 3.84
12. Arsenic (as As_2O_3), mg/kg	: Practically nil.
13. Cadmium (as Cd) , mg/kg	: 2.0
14. Copper (as Cu) , mg /kg	: 64.21
15. Chromium (as Cr) , mg/kg	: 23.1
16. Mercury (as Hg) , mg/kg	: 0.05
17. Nickel (as Ni) , mg/kg	: 16.0
18. Lead (as Pb) , mg/kg	: 38.14
19. Zinc (as Zn) , mg/kg	: 335

Tested by

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Dr. Anath Bandhu Mondal
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परीक्षण सामग्री का पहचान Identification of Test Item	Sample received in a packet marked as Konnagar Municipality dated 16/11/2019.
नमूना का विशिष्टि (यदि हो) Product Specification (If any)	Nil.
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नमूना प्रकिया जहाँ प्रासंगिक हो Sampling Procedure where relevant	NA

Tested By
Sayantan Saha

Checked By
Dr. Anath Bandhu Mondal

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ANNEXURE-1

Results of Chemical Analysis of Solid waste of Konnagar Municipality :

Tested Parameters	Observed Value
1. Moisture , % by weight	: 4.91
2. Colour	: Black
3. Odour	: No Odour
4. Bulk density (gm/cm^3)	: 0.73
5. Total organic carbon, % by weight	: 20.7
6. Total Nitrogen (as N) , % by weight	: 1.11
7. Total phosphates (as P_2O_5), % by weight	: 2.12
8. Total potash (as K_2O), % by weight	: 3.08
9. C : N ratio	: 18.65
10. pH	: 8.37
11. Conductivity (as ds/m)	: >4.0
12. Arsenic (as As_2O_3), mg/kg	: Practically nil.
13. Cadmium (as Cd) , mg/kg	: 2.23
14. Copper (as Cu) , mg /kg	: 76.34
15. Chromium (as Cr) , mg/kg	: 25.45
16. Mercury (as Hg) , mg/kg	: 0.07
17. Nickel (as Ni) , mg/kg	: 16.59
18. Lead (as Pb) , mg/kg	: 27.1
19. Zinc (as Zn) , mg/kg	: 480

Tested by	Checked by	Approved by
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नमूना प्रक्रिया यहाँ प्रासंगिक हो Sampling Procedure where relevant	NA

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ANNEXURE-I

Results of Chemical Analysis of Solid waste of Rishra Municipality :

Tested Parameters	Observed Value
1. Moisture , % by weight	: 3.17
2. Colour	: Black
3. Odour	: No Odour
4. Bulk density (gm/cm^3)	: 0.88
5. Total organic carbon, % by weight	: 12.85
6. Total Nitrogen (as N) , % by weight	: 1.10
7. Total phosphates (as P_2O_5), % by weight	: 1.84
8. Total potash (as K_2O), % by weight	: 0.90
9. C : N ratio	: 11.68
10. pH	: 8.25
11. Conductivity (as ds/m)	: 2.3
12. Arsenic (as As_2O_3), mg/kg	: Practically nil.
13. Cadmium (as Cd) , mg/kg	: 1.57
14. Copper (as Cu) , mg /kg	: 70.2
15. Chromium (as Cr) , mg/kg	: 78.23
16. Mercury (as Hg) , mg/kg	: 0.08
17. Nickel (as Ni) , mg/kg	: 19.66
18. Lead (as Pb) , mg/kg	: 34.91
19. Zinc (as Zn) , mg/kg	: 329

Tested by

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परीक्षण सामग्री का पहचान Identification of Test Item	:	Sample received in a poly packet marked as Serampore Municipality dated 19/11/2019.
नमूना का विशिष्टि (यदि हो) Product Specification (If any)	:	Nil.
नमूना प्राप्ति की तिथि Date of Receipt of the Test Item	:	27/11/2019
कार्य सम्पादन की तिथि Date(s) of Performance of Tests	:	From: 29/11/2019 To: 24/12/2019
व्यावहृत प्रणाली का पहचान Method(s) Used for Test	:	On the lines of FCO 1985.
नमूना प्रकिया यहाँ प्रासंगिक हों Sampling Procedure where relevant	:	NA

Tested By	Checked By	Approved By
Sayantan Saha	Dr. Anath Bandhu Mondal	Dr. S. N. Bandyopadhyay
SA(Chemical)	Scientist- B (Chemical)	Scientist- C (Chemical)

FORM NO : NTH/SL/F/5

भारत सरकार
Government of India
राष्ट्रीय परीक्षण शाला (पूर्वी क्षेत्र)
National Test House (Eastern Region)
ब्लॉक सी पी, सेक्टर - V, साल्ट लेक सिटी, कोलकाता - 700 091
Block-CP, Sector-V, Salt Lake City, Kolkata - 700 091

Test Certificate No.	Date of Issue	Code No.	Page	No. of Pages
NTH(ER)/CH(S)/2019/602	26/12/2019	1574836719564	1	1

ANNEXURE-1

Results of Chemical Analysis of Solid waste of Serampore Municipality :

Tested Parameters	Observed Value
1. Moisture , % by weight	: 8.03
2. Colour	: Black
3. Odour	: No significant odour
4. Bulk density (gm/cm^3)	: 0.97
5. Total organic carbon, % by weight	: 10.7
6. Total Nitrogen (as N) , % by weight	: 0.54
7. Total phosphates (as P_2O_5), % by weight	: 1.22
8. Total potash (as K_2O), % by weight	: 0.44
9. C : N ratio	: 19.81
10. pH	: 7.63
11. Conductivity (as ds/m)	: 3.4
12. Arsenic (as As_2O_3), mg/kg	: Practically nil.
13. Cadmium (as Cd) , mg/kg	: 2.24
14. Copper (as Cu) , mg /kg	: 192
15. Chromium (as Cr) , mg/kg	: 66.44
16. Mercury (as Hg) , mg/kg	: 0.2
17. Nickel (as Ni) , mg/kg	: 24.12
18. Lead (as Pb) , mg/kg	: 46.14
19. Zinc (as Zn) , mg/kg	: 350

Tested by

Sayantan Saha
SA (Chemical)

Checked by

Dr. Anath Bandhu Mondal
Scientist B (Chemical)

Approved by

Dr. S. N. Bandyopadhyay
Scientist C (Chemical)

FORM NO : NTH/SL/F/5

भारत सरकार
Government of India

राष्ट्रीय परीक्षण शाला (पूर्वी क्षेत्र)
National Test House (Eastern Region)

ब्लॉक - सी पी, सेक्टर - 5, साल्ट लेक सीटी, कोलकाता - 700 091
Block-CP, Sector-V, Salt Lake City, Kolkata - 700 091

सत्यमेव जयते

परीक्षण प्रमाण पत्र
TEST CERTIFICATE

INTERIM/FINAL REPORT

Number of Copies issued परीक्षण प्रमाण पत्र सं	जारी होने की तिथि Date of Issue	कोड नं Code No	पृष्ठ Page	पृष्ठों की संख्या No of Pages
Single	26/12/2019	1574857289786	1	2
Test Certificate No NTH(ER)/CH(S)/2019/00603				

बहीं संख्या एवं दिनांक Register No & Date	:	00603/NTH(ER)/CH(S)/29/11/2019
परीक्षण सामग्री का विवरण Description of Test Item	:	Solid waste.
परीक्षण सामग्री का पहचान Identification of Test Item	:	Sample received in a packet marked as Baidyabati Municipality dated 19/11/2019.
नमूना का विशिष्टि (यदि हो) Product Specification (If any)	:	Nil.
नमूना प्राप्ति की तिथि Date of Receipt of the Test Item	:	27/11/2019
कार्य सम्पादन की तिथि Date(s) of Performance of Tests	:	From: 29/11/2019 To: 24/12/2019
व्यावहृत प्रणाली का पहचान Method(s) used for Test	:	On the lines of FCO 1985.
नमूना प्रक्रिया जहाँ प्रासंगिक हो Sampling Procedure where relevant	:	NA

Tested By	Checked By	Approved By
Sayantan Saha	Dr. Anath Bandhu Mondal	Dr. S. N. Bandyopadhyay
SA(Chemical)	Scientist- B (Chemical)	Scientist- C (Chemical)

FORM NO : NTH/SL/F/5

भारत सरकार
Government of India
राष्ट्रीय परीक्षण शाला (पूर्वी क्षेत्र)
National Test House (Eastern Region)
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Block-CP, Sector-V, Salt Lake City, Kolkata - 700 091

TEST CERTIFICATE

Test Certificate No.	Date of Issue	Code No.	Page	No. of Pages
NTH(ER)/CH(S)/2019/603	26/12/2019	1574857289786	1	1

ANNEXURE-1

Results of Chemical Analysis of Solid waste of Baidyabati Municipality :

Tested Parameters	Observed Value
1. Moisture , % by weight	: 10.98
2. Colour	: Black
3. Odour	: No Odour
4. Bulk density (gm/cm^3)	: 0.65
5. Total organic carbon, % by weight	: 17.85
6. Total Nitrogen (as N) , % by weight	: 2.49
7. Total phosphates (as P_2O_5), % by weight	: 1.33
8. Total potash (as K_2O), % by weight	: 2.45
9. C : N ratio	: 7.17
10. pH	: 7.55
11. Conductivity (as ds/m)	: 3.03
12. Arsenic (as As_2O_3), mg/kg	: Practically nil.
13. Cadmium (as Cd) , mg/kg	: 1.68
14. Copper (as Cu) , mg /kg	: 73.63
15. Chromium (as Cr) , mg/kg	: 29.11
16. Mercury (as Hg) , mg/kg	: 0.14
17. Nickel (as Ni) , mg/kg	: 17.96
18. Lead (as Pb) , mg/kg	: 27.23
19. Zinc (as Zn) , mg/kg	: 240

Tested by	Checked by	Approved by
Sayantan Saha	Dr. Anath Bandhu Mondal	Dr. S. N. Bandyopadhyay
SA (Chemical)	Scientist B (Chemical)	Scientist C (Chemical)

添付資料８

ADVANCED ANALYTICAL TESTING LABORATORY

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Ref.No. ADV/19-20/1028

Dated –02.07.2019

CERTIFICATE OF ANALYSIS
SAMPLE DRAWN BY US

This is to certify that a sample of **"Water"** Submitted on **07-06-2019** on account of **JOY AMBEY CONSTRUCTION & COMPANY, Baidybati (RWMCplant),** Hooghly-712222, has been analyzed with the following results:

Sample Mark : Water
Analysis Started On : 13.06.2019
Analysis Finished On : 28.06.2019

CHEMICAL TEST FINDINGS:

Sl.no	Parameters under test	sample designation		
		lagoon 1	lagoon 2	Sedimentation pond
1	ph	8.00	8.10	8.42
2	turbidity	9.00	11.00	27.00
3	TDS	1190.00	1180.00	1168.00
4	suspended solids	150.00	145.00	100.00
5	Ammonical nitrogen	25.00	18.00	15.00
6	BOD	125.00	115.00	95.00
7	COD	250.00	225.00	175.00
8	As	BDL	BDL	BDL
9	Hg	BDL	BDL	BDL
10	Pb	0.01	0.01	BDL
11	Cd	2.00	1.75	BDL
12	Cr	2.00	2.00	1.20
13	Cu	3.00	2.85	1.20
14	Zn	5.00	3.50	1.78
15	Ni	3.00	2.85	1.45
16	CN	0.20	0.15	BDL
17	F	2.00	1.92	1.15
18	Phenolic compounds	1.00	0.85	0.12
19	total kjeldahl nitrogen	100.00	85.00	65.00

Cert Checked By:

For Advanced Analytical Testing Laboratory

Advanced Analytical Testing Laboratories Kolkata

Authorized Signatory