

Figure IX.2.1 Existing Entities Involving in the Puno Bay's Environment, and Their Inter-relationships

(2) Strengthening of the Puno Province Municipality's institutional capacity

It is undoubted that the Puno Province Municipality is taking the most important role in the conservation of the Puno Bay's environment. There is no entity other than the Municipality who can take the role as the administrative manager of the urban development plans, the land use plans, the urban sanitary management, etc. in the Puno City, the biggest pollution source of the Puno Bay. Also, the Municipality is the sole entity who is responsible for the formulation of regulations and plans related to the sanitary services provided to the Puno City's residents, as well as the execution of these regulations and plans.

The Puno Province Municipality's organization is on the way to be reformed in order to adopt the decentralization undertaking in Peru since the beginning of the 1990s decade. It is foreseeable that the Municipality will continue to suffer such kind of unstableness for some more years in the future. At this present time, the Municipality has not been prepared enough to assume its competence and its functions. While it is facing a series of problems such as the rapid population growth, the rapid urbanization, the degradation of the environment, etc., it remains in lack of financial resources, skillful experts, appropriate and timely decision-making system, coordination between the administrative organs, cooperation from the residents and private organizations, etc.

However, the development of the Municipality's institutional capacity should be considered as an urgent need. The conservation of the Puno Bay's environment, the sustainable development of the Puno Province, the improvement of the Puno City's cleanliness, etc. can not be realized if the Municipality remains in lack of initiative in administrative management, and can not utilize its natural and human resources in an appropriate manner.

Due to the existing Peruvian regulatory system, and the policy of the central government, the strengthening of the Puno Province Municipality's institutional capacity is not an easy task. The number of the staff members that the Municipality can employ, as well as the maximum salary of these staff members are limited by the national law and the central government. Consequently, it is difficult for the Municipality to recruit more qualified staff members, especially in the planning sections, necessary for performing the administrative self-

management, and carrying out the development projects without depending heavily on the external supports.

However, the issue on the revision of the existing national regulatory system and the central government's policy is beyond the framework of this Study. Several measures aiming at the strengthening of the Puno Province Municipality's institutional capacity had been proposed in the "Plan of Institutional Strengthening of the Puno Province Municipality (November 1998)", a part of the Program of Rehabilitation and Urban Management for the Republic of Peru (Programa de Rehabilitacion y Gestion Urbana en la Republica del Peru, or "PRGU" in short) funded by the World Bank.

Apart from the measures discussed in the Plan mentioned above, the following measures are considered to be very important for the strengthening of the Puno Province Municipality's institutional capacity for successfully carrying out the projects proposed by this Study.

1) Improvement of the tax collection system and the public service tariff charge collection system

The lack of financial resource seems to be the most serious problem that the Municipality is facing.

Since the enactment of Decree 776 in December 1993, the main financial sources of municipal revenues are local taxes, including property tax, tax on the transfer of property, taxes on vehicles, and some minor taxes on gambling, raffles, and games. However, the use of these instruments is restricted by central government regulations.

And the Municipality lacks of independent revenue base, due to the fact that it cannot determine tax bases and tax rates. It results in an inadequate funds to finance its investment plans, and therefore, to fulfill its investment funds, the Municipality must depend deeply on the external financial sources, such as the central government transfer (mainly through the Municipal Compensation Fund), or the investment funds controlled by the central government, or the funds provided by the international donors.

To increase the revenue, at this present time, the Municipality has no other choice than the improvement of the system of collection of local taxes, and non-tax revenues (such as the solid waste collection fee).

The Municipality's tax collecting capacity is now being constrained by its weak institutional and administrative capacity. Under the present passive tax collection system, there is only a small part of residents paying property taxes and public service fees on the voluntary basis. (Throughout the year 1998, there were only 12,000 taxpayers among about 25,000 households in the Puno District). Furthermore, the method of determining this fee is not reasonable: it bases on the characteristic and the value of resident's existing properties, instead of on the quantity or quality of the service provided to each specified district of the City. And all resulted a low rate of tax and fee collection.

This existing system of collection taxes and fees should be revised. The organs in charge of collecting taxes and fees of the Municipality should be equipped with more skillful experts, and should be able to make and implement the plans aiming at the revision of the existing tax and fee collection system, in order to increase the Municipality's revenue, and to make the system more reasonable without partiality.

Besides, it is suggested that the application of a kind of *environmental fee* can be studied as a tool to motivate the participation of the tourists visited the Puno City and Puno Bay into the conservation of the Puno Bay's environment. The tourists are generally in favor of the environmental conservation, and it is expected that such kind of environmental fee will be acceptable to a major part of tourists who visit and admire the historic values and beautiful landscapes of the Puno Bay and the Titicaca Lake.

2) Improvement of public relation

Since January 1999, the newly selected Mayor of the Puno Province Municipality had shown the efforts to reinforce the organs in charge of improving the public relation. The Unit of Public Relation and Institutional Image, as well as the Directorate of Public Promotion and Participation had been established among few organs newly installed in the organization structure of the Municipality since January 1999.

However, the operational capacity of the Unit of Public Relation and Institutional Image mentioned above should be strengthened to enable the diffusion of information on the Municipality's services to the residents, and to motivate the participation of residents and other private entities to the tasks for the conservation of the Puno Bay's environment.

This Unit of Public Relation and Institutional Image can be assigned as the main organ in charge of carrying out the public education program recommended by this Study. Taking this responsibility, the Unit of Public Relation and Institutional Image should be appropriately equipped to be able to perform the tasks such as the followings:

- Conducting the educational campaigns, the public enlightenment campaigns, etc.;
- Staging the campaigns and the events, such as the Clean Day, the Puno Bay's Clean Day, etc.;
- Publishing the municipal newsletters, making up and managing the educational tools, such as the educational video, the educational booklet;
- Operating and maintaining the tools for the public enlightenment campaign, such as the video projection wagon cars, etc.;
- Maintaining and improving the cooperational relationship with the representatives of the barrios, the regional public agencies, the NGOs, and other private organizations.

(3) Strengthening of the Multisectorial Committee

As mentioned previously, the Multisectorial Committee is considered to be one of three main entities those are taking the most important roles in the conservation of the Puno Province Municipality. Beside the Municipality (as an administrator), and the PELT (as a technical adviser), the Multisectorial Committee should perform effectively the role of a coordinator between the Municipality, the PELT, the mass media, and other groups of residents.

However, at this present time, only with the meetings organized occasionally, the Multisectorial Committee's can not perform its role efficiently. The strengthening

of the Multisectorial Committee is considered to be an urgent necessity for the conservation of Puno Bay's environment. The Committee should be reformed to be able to work permanently, with at least a small office and an adequate number of permanently working staff members.

The central government, and the international cooperation agencies should give initial supports to the strengthening of the Multisectorial Committee. And then, the members of the Multisectorial Committee should give concrete contributions to the Committee in order to make it works effectively and sustainedly.

2.2 PUBLIC EDUCATION PROGRAM

The public education program proposed here aims at the heightening of Puno City residents' awareness, consciousness on environmental issues, as well as the promotion of these residents' participation in the tasks for the conservation of Puno Bay's environment.

(1) Objectives of the Public Education

The objectives of the public education are set as follows:

- Explain the magnitude and urgency of the issue on environment of the Puno Bay.
- Stress the benefits of an adequate behavior to conserve the environment, and to the contrary, the harm of an improper one on public health, welfare and the environment as related to the daily life of the general population.
- Point out that only through the active participation of the whole population can the problems related with the polluted Puno Bay be solved.
- Point out the main factors causing the degradation of environment of Puno Bay.
- Promote the use of on-site facilities for preventing the flush of untreated polluted water to the Puno Bay.
- Underline the costs involved in solid waste management as a public service, and the effects of the residents' improper waste management habits on SWM, i.e. illegal dumping increases the costs and reduces efficiency and so forth.

Also, explain the problems faced by the Municipality in extending services to non-collection areas.

- Promote adequate waste disposal habits and public participation in matters related to solid waste management, treatment of liquid waste water, as well as maintenance and use of relevant facilities.

(2) Methods of Public Education

Generally, public education methods are divided into (1) the campaigns targeting the general or large segments of the population; and (2) those trying to reach limited and confined target groups. The first method utilizes mainly the mass media or indiscriminate general campaigns, while the second concentrates on reaching specific groups through educational programs, enlightenment campaigns (such as events, lectures, meetings, etc.) and other costume designed campaigns.

Target of the education campaign	Available methods
General or large segment of population	- Mass media (advertisement, press release, etc. in TV, radio, newspapers, etc.) - Indiscriminate general campaigns (posters, street wall painting, etc.)
Specified group of resident	- Educational programs - Enlightenment campaigns - Other costume designed campaigns.

The mass media can be used through paid advertising and through press releases and other forms of free coverage in television, radio, newspapers and magazines. In the long run this method is very effective because it reaches vast amounts of people at the same time, but because the message has to be very vague and general because of the diversity of the audience, its effectiveness is very difficult to evaluate in the short run. Also, this method is the most expensive and complicated, as large amounts of money and long periods of time are required to implement a campaign.

The techniques to reach limited target groups are endless and are generally divided between those targeting area groups, i.e. community centers, neighborhood associations, sports clubs and so forth, and those targeting social groups determined by such things as age, gender and religion, i.e. schools, women associations, churches, etc.

In targeting area groups, the goal is to focus on the issues having direct effects on the residents. The approach methods are such as appealing to the sense of community and brotherhood, creating a sense of awareness in which the residents of a certain area influence and control each other to change and/or modify inadequate habits. The problem with this method is finding a proper way to transmit the idea, because the educational level and the attention span of the average Puno's resident are limited.

In case of the Puno Province, the effective methods of public education seem to be: **(a) the educational program, and (b) the enlightenment campaign.**

Some specified educational tools, such as the educational video, educational booklet, etc. shall be prepared to improve the effectiveness of these education program and enlightenment campaign.

1) Educational Program

The educational programs have the target mainly at the students of elementary and secondary schools. Schools particularly present an effective audience because children are very impressionable, curious and idealistic, so that it is very easy to transmit the message. However, by the same principle, it is also very easy for them to forget the issue at stake. Therefore, the biggest challenge regarding to the public education at schools is how to design the programs in such a way that the students can remember the main points of the programs.

The possible measures are the followings:

- Expand the regular curriculum relevant to environmental conservation (to convey the basics of environmental conservation to the students);
- Train the teachers (on the most important facts on environmental conservation and provide them with educational materials to support their teachings);
- Develop extra-curricular activities (to organize the field trips for the students to learn the relevant issues through live experience);
- Develop an educational tool (to product the pamphlets, booklets, video tapes, etc. as materials for educational programs);

- Other measures.

The tools developed for these educational programs oriented to the students can however be also used to enhance the awareness of common residents, and the staff members of the agencies or organizations involved in the activities for environmental conservation.

2) Enlightenment Campaign

The enlightenment campaigns shall complement the educational programs, which aim at the specific target groups. The strategy for the enlightenment campaigns is the 'repeat and incite to crisis' method, wherein several tools are used for the same topic, and are then repeated many times. For general and common information, mass media (such as TV, radio) are effective tools. On the other hand, meetings and seminars, events and campaigns can be used for specific topics and areas.

- Meetings with the Community

These meetings should be carried out at all candidate communities. During these meetings, the issues such as the followings are discussed: (1) benefits to health, economic development and the environment of the relevant programs; (2) relationship between diseases and polluted water, solid waste; (3) common diseases in the community; (4) benefits of the regular sewerage system and the waste management system; (5) the solid waste generated by each individual should be his responsibility, while the environment should be everybody's; (6) need for changes in bad habits and attitudes; (7) need for cooperation by the community.

- Staging of Events and Campaigns

The staging of events and campaigns on environmental conservation can focus on the topics similar to the ones for the meetings with the community. The events and campaigns may be conducted by any organization, such as the Multisectorial Committee, the Municipality (the Unit of Public Relation and Institutional Image, or the Division of Public Cleaning), the Communities, the NGOs, etc. The Puno Province Municipality and the PELT should identify these efforts, try to coordinate and support them, as well as develop their own initiatives.

3) Educational tools

After determining the public education techniques, proper tools must be prepared. Beside the background study and the preparation of lecturers, the educational tools such as the educational videos and booklets should be prepared.

These educational tools can be used at the educational programs carried out by the organs in charge of public environmental education in all sectors. These organs should establish a program for utilize these educational tools.

The Municipality should be equipped with a '*video projection station wagon*' which can also be used as a campaign car for supporting the enlightenment campaigns. This wagon car can be equipped with the audio-visual instruments such as the video projector, the cassette desk, the speakers, the placard, etc. The Unit of Public Relation and Institutional Image may be assigned the responsibility for operating and maintaining this wagon car. A program should be made to utilize this wagon car at the schools, the parks, the markets, the commercial streets, etc. on a daily basic in order to carry out the environmental campaigns effectively.

The contents of the educational tools should be carefully studied in order to make them attractive and easy to transmit the specified messages to the residents.

Generally, the two typical educational tools may have the following characteristics.

(i) Educational Video

In a country with scarce economic, and technical resources such as Peru, any message transmitted in a high-tech medium, such as a video, is bound to gain automatic attention and credibility from the public. Moreover, a video can show very descriptive images of the present reality of the audience, so that they understand that it relates directly to them and not to some worldwide fashion trend.

However, since the target audiences of the video are socially diverse groups such as communities and schools, it is impossible to produce custom made videos for each target group. Therefore, the video must be aimed in a way that it can be effective with as wide a range of the population as possible without

losing its usefulness with specific target groups. The goal is to be as specific as possible without excluding a particular segment of the population.

Regarding the contents and structure of the video, it had to be short, simple, concise and direct, so that the audience's mind does not have time to wonder off.

The video has to be identified by a specified slogan to create a homogeneous and global campaign by defining a unified message.

(ii) Educational Booklet

The educational booklet must be designed to fit several purposes. It should complement the video so that they can be used jointly and it must be more general than the video so that its use is not confined to school education or community lectures. With this in mind, the booklet was designed as follows:

- Small, short and simple to avoid initial rejection by the public.
- Colorful and made with quality materials to encourage the people to keep it and study it.
- Layout with little text and many pictures and illustrations to avoid boredom.
- Impersonal text, with a general vocabulary not restricted to any particular age, gender, income, social, religious or interest group.
- Plot supportive of the video, i.e. present situation - harmful consequences - adequate measures to avoid such consequences - benefits of taking the measures.

The booklet has also to be identified by a specified slogan to create a homogeneous and global campaign by defining a unified message.

2.3 INSTALLATION OF THE CLEAN DAY

The questionnaire survey on the public consciousness related to environmental issue carried out by the Study Team in November 1998 indicated that the Puno City's residents have a relatively favorable custom of cleaning the roads and other public areas around their houses. A major part of interviewed residents had also expressed their willingness to cooperate with the municipal authority in the tasks for improving the Puno Bay's environment. And according to the relevant agencies, a significant number of residents had participated in the campaigns organized occasionally in the past for clean up the Puno Interior Bay.

Therefore, in order to improve the residents' consciousness on environmental conservation, the installation of the Clean Day as a fixed day on the Puno City's calendar was recommended. On this day, the Puno City's residents can bear their willingness to keep their district clean, by sweeping the roads, remove the littered wastes around their houses, etc.

However, to successfully conduct this Clean Day, the Municipality's capacity should be strengthened at first. The Municipality should be capable to mobilize a great part of its residents, by cooperating with the mass media, other public and private organizations to instruct and motivate the residents. The enterprises, shops, hotels, tourist agencies, and other commercial entities those can earn more benefits from the improvement of the City's cleanliness, should share a part of the cost required for carrying out this Day. The competition between the towns of districts can be applied, so as the ones which shown significant efforts can be awarded appropriately.

2.4 ENFORCEMENT OF ENVIRONMENTAL REGULATIONS

Regarding to the management of wastewater, a legal norm aiming at the control of wastewater quality applied to all areas of the country is now being prepared by the Ministry of Health with the cooperation of other relevant authorities. Apart from this, the Puno Province Municipality had approved the Municipality Ordinance on sanitation and public health in January 1994. So then, the legal framework on management of wastewater and solid waste in the Puno Province seems to be conformable to the region where the heavy industrial factory does not exist, and there is only a few number of medium scale factories.

However, these legal norm and ordinance should be enforced with detailed documents defining the violated individuals, their magnitude, the corresponding fines to be imposed, as well as the entities in charge of supervise these violations.

Besides, it is necessary to establish a proper and sound legislation for the control of poisonous wastes generated by the hospitals in the City.

In general, it is difficult to effectively control non-point pollution sources by structural measures. An appropriate land use should be encouraged to minimize the outflow of pollution loads. Municipal ordinance should also regulate land use from the viewpoint of pollution control. For example, development of the steep slope area or grazing in the inundation area should be restricted. Not only regulatory ways but also instructive ways should be adopted. For example, it must be useful for pollution load control to instruct livestock farmers how to treat and reuse waste/dung of livestock.

3. ESTIMATED COST FOR PUBLIC EDUCATION AND INSTITUTIONAL CONSOLIDATION PLAN

The cost for carrying out the public education program and institutional consolidation plan proposed for improvement of Puno Bay's environment is estimated as shown in *Table VIII.2.1*.

Table IX.2.1 Estimated Cost for Institutional Consolidation Plan

1. Institutional Consolidation					
1.1 Puno Provincial Municipality					
1) Improvement of tax/charge collection system					
Personnel expenses	assignment	Chief	Clerk	Assistant	total
	number of staff	1	2	10	13
	unit (soles/man/month)	1,000	800	400	2,200
	sub total (soles/year)	12,000	19,200	48,000	79,200
Training expenses	unit (soles/year)	1,000	2,000	0	3,000
Administration (1% for personnel expenses)		120	192	480	792
Total (soles/year)		13,120	21,392	48,480	82,992
2) Improvement of public relation (educational program, enlightenment campaign)					
Personnel expenses	assignment	Chief	Clerk	Assistant	total
	number of staff	1	3	6	10
	unit (soles/man/month)	1,000	800	400	2,200
	sub total (soles/year)	12,000	28,800	28,800	69,600
Training expenses	unit (soles/year)	1,000	3,000	0	4,000
Administration (1% for personnel expenses)		120	288	288	696
Total (soles/year)		13,120	32,088	29,088	74,296
1.2 Multisectorial Committee					
Personnel expenses	assignment	Chief	Clerk	Assistant	total
	number of staff	1	1	3	5
	unit (soles/man/month)	1,000	800	400	2,200
	sub total (soles/year)	12,000	9,600	14,400	36,000
Training expenses	unit (soles/year)	3,000	3,000	0	6,000
Administration (1% for personnel expenses)		120	96	144	360
Total (soles/year)		15,120	12,696	14,544	42,360
1.3 PELT (management of fund)					
Personnel expenses	assignment	Chief	Clerk	Assistant	total
	number of staff	1	4	0	5
	unit (soles/man/month)	1,000	800	400	2,200
	sub total (soles/year)	12,000	38,400	0	50,400
Training expenses	unit (soles/year)	6,000	12,000	0	18,000
Administration (1% for personnel expenses)		120	384	0	504
Total (soles/year)		18,120	50,784	0	68,904
4. Enforcement of Environmental Regulations (Ministry of Health)					
Personnel expenses	assignment	Chief	Clerk	Assistant	total
	number of staff	1	2	4	7
	unit (soles/man/month)	1,000	800	400	2,200
	sub total (soles/year)	12,000	19,200	19,200	50,400
Training expenses	unit (soles/year)	6,000	4,000	0	10,000
Administration (1% for personnel expenses)		120	192	192	504
Total (soles/year)		18,120	23,392	19,392	60,904

Table IX.2.2 Estimated Cost for Public Education Program (Unit: S/.)

Measures		Cost (S/.)	Remarks
Educational Program	Video projection station wagon		
	Procurement	289,800	The cost includes the cost for procurement of video deck, display monitor, cassette desk, amplifier, speakers, etc. (soles/13years)
	Operation cost	2,268	= gasoline cost = 2liters/day * 360 days/year * 1US\$/liter (soles/year)
	Maintenance cost	14,490	= 5% of procurement cost (soles/year)
	Making of educational videos	25,200	= 1 tape/year * 8,000US\$/tape (soles/year)
	Making of educational booklets	12,600	= 2 booklets/year * 5,000US\$/booklet (soles/year)
Enlightenment Campaign	Making of promotion posters	31,500	= 2 posters/year * 2,000US\$/poster (soles/year)
	Holding of events and campaign	63,000	= 2 events/year * 10,000US\$/event ; including "the Clean Day" (soles/year)
	Holding of meetings	37,800	= 12 meetings/year * 1,000US\$/meeting (soles/year)

Table IX.2.3 Implementation and Disbursement Schedule for Non-structural Measures

(thousand soles (S./1000))

Non-structural Measures	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1. Institutional Consolidation														
1.1 Puno Provincial Municipality	157	157	157	157	157	157	157	157	157	157	157	157	157	157
1) Improvement of tax/charge collection system	83	83	83	83	83	83	83	83	83	83	83	83	83	83
2) Improvement of public relation	74	74	74	74	74	74	74	74	74	74	74	74	74	74
1.2 Multisectorial Committee	42	42	42	42	42	42	42	42	42	42	42	42	42	42
1.3 PELT (management of fund)	69	69	69	69	69	69	69	69	69	69	69	69	69	69
sub total	269	269	269	269	269	269	269	269	269	269	269	269	269	269
2. Public Education Program														
2.1 Video projection station wagon	307	17	17	17	17	17	17	17	17	17	17	17	17	307
1) Procurement	290													290
2) Operation cost	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3) Maintenance cost	14	14	14	14	14	14	14	14	14	14	14	14	14	14
2.2 Making of educational videos	25	25	25	25	25	25	25	25	25	25	25	25	25	25
2.3 Making of educational booklets	13	13	13	13	13	13	13	13	13	13	13	13	13	13
sub total	344	55	55	55	55	55	55	55	55	55	55	55	55	344
3. Enlightenment Campaign														
3.1 Making of promotion posters	32	32	32	32	32	32	32	32	32	32	32	32	32	32
3.2 Holding of events and campaigns	63	63	63	63	63	63	63	63	63	63	63	63	63	63
3.3 Holding of meetings	38	38	38	38	38	38	38	38	38	38	38	38	38	38
sub total	132	132	132	132	132	132	132	132	132	132	132	132	132	132
4. Enforcement of Environmental Regulation	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Total	806	516	516	516	516	516	516	516	516	516	516	516	516	806
IGV [18% for Item 2.1.1), 2.1.3), 2.2, 2.3 and 3.1]	67	15	15	15	15	15	15	15	15	15	15	15	15	67
Grand Total (including IGV)	873	531	531	531	531	531	531	531	531	531	531	531	531	873

Non-structural Measures	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
1. Institutional Consolidation													
1.1 Puno Provincial Municipality	157	157	157	157	157	157	157	157	157	157	157	157	4,089
1) Improvement of tax/charge collection system	83	83	83	83	83	83	83	83	83	83	83	83	2,158
2) Improvement of public relation	74	74	74	74	74	74	74	74	74	74	74	74	1,932
1.2 Multisectorial Committee	42	42	42	42	42	42	42	42	42	42	42	42	1,101
1.3 PELT (management of fund)	69	69	69	69	69	69	69	69	69	69	69	69	1,792
sub total	269	269	269	269	269	269	269	269	269	269	269	269	6,982
2. Public Education Program													
2.1 Video projection station wagon	17	17	17	17	17	17	17	17	17	17	17	17	1,015
1) Procurement													580
2) Operation cost	2	2	2	2	2	2	2	2	2	2	2	2	59
3) Maintenance cost	14	14	14	14	14	14	14	14	14	14	14	14	377
2.2 Making of educational videos	25	25	25	25	25	25	25	25	25	25	25	25	655
2.3 Making of educational booklets	13	13	13	13	13	13	13	13	13	13	13	13	328
sub total	55	55	55	55	55	55	55	55	55	55	55	55	1,998
3. Enlightenment Campaign													
3.1 Making of promotion posters	32	32	32	32	32	32	32	32	32	32	32	32	819
3.2 Holding of events and campaigns	63	63	63	63	63	63	63	63	63	63	63	63	1,638
3.3 Holding of meetings	38	38	38	38	38	38	38	38	38	38	38	38	983
sub total	132	132	132	132	132	132	132	132	132	132	132	132	3,440
4. Enforcement of Environmental Regulation	61	61	61	61	61	61	61	61	61	61	61	61	1,584
Total	516	516	516	516	516	516	516	516	516	516	516	516	14,004
IGV [18% for Item 2.1.1), 2.1.3), 2.2, 2.3 and 3.1]	15	15	15	15	15	15	15	15	15	15	15	15	496
Grand Total (including IGV)	531	531	531	531	531	531	531	531	531	531	531	531	14,500

CHAPTER - X FEASIBILITY STUDY

CHAPTER - X

FEASIBILITY STUDY

1. INTRODUCTION

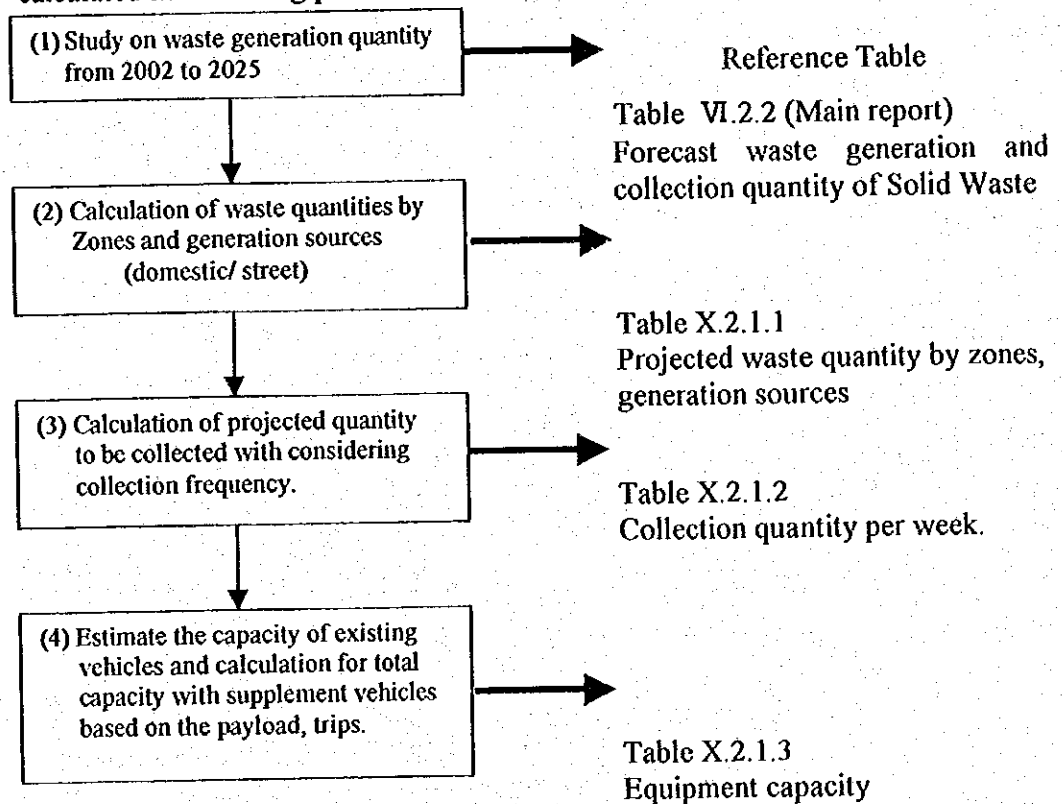
This supporting report of the feasible study aims at compensation of the main report.

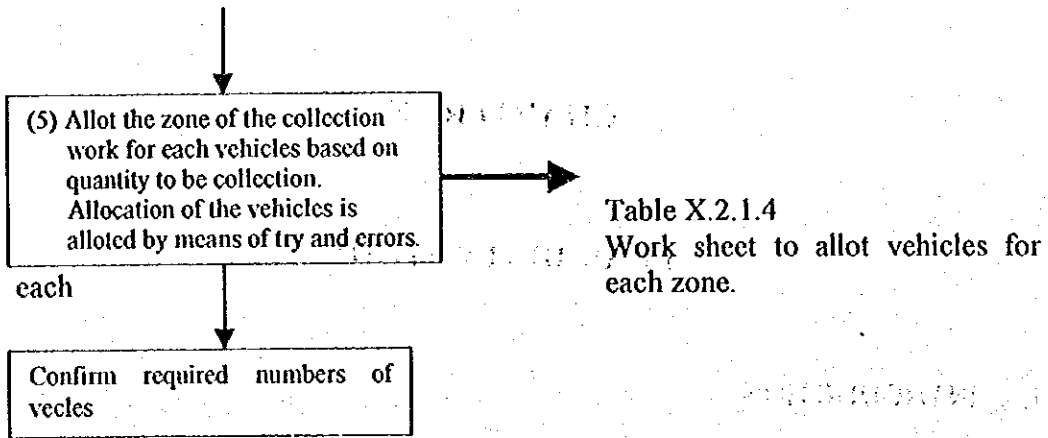
2. DESIGNING

2.1 WASTE COLLECTION

(1) Necessary number of collection vehicles.

Calculation of required numbers and it's work allocation of the vehicles are calculated in following process.





The following tables show the necessary number of collection vehicles.

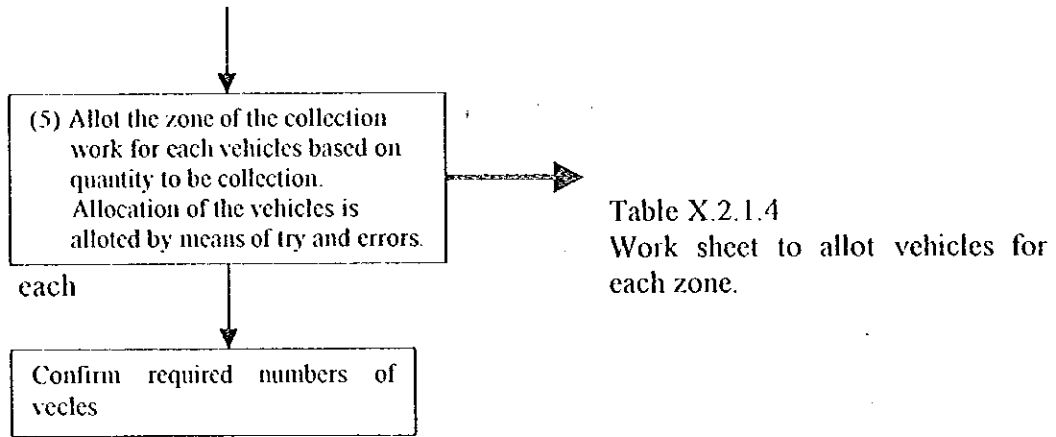
1) Table I.2.1 Projected Solid Waste quantity by collection zone.

Table X.2.1 Project SW Quantity by Collection Zone, Generation Source.

2022-100%

Supporting to Chapter X.2.1 Waste Collection
 Table X.2.1.1 Projected SW Quantity by Collection Zone, Generation Source

Collection Zone	2022-100%																											
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
(1) A-Zone	3.50	3.79	4.07	4.64	4.91	5.19	5.19	5.19	5.06	6.50	6.64	6.58	7.16	7.83	8.00	8.36	8.74	9.12	9.31	9.92	10.32	10.74	11.15	11.60	12.08	12.51	12.98	13.45
(2) B-Zone	1.52	1.63	1.75	1.83	1.93	2.03	2.13	2.23	2.42	2.52	2.62	2.72	2.81	2.90	2.90	3.00	3.09	3.18	3.27	3.37	3.46	3.55	3.64	3.74	3.84	3.94	4.03	4.13
(3) C-Zone	6.53	7.19	7.85	8.62	9.38	10.18	11.01	11.88	12.79	13.75	14.74	15.78	16.21	17.98	19.16	20.33	21.64	22.95	24.31	25.71	27.16	28.66	30.20	31.76	33.37	35.02	36.72	38.47
(4) D-Zone	1.38	1.85	2.14	2.47	2.82	3.19	3.59	4.01	4.49	4.99	5.52	6.08	6.41	7.34	8.06	8.80	9.57	10.25	11.04	11.84	12.83	13.76	14.72	15.69	16.68	17.71	18.77	19.86
(5) E-Zone	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.15	0.16	0.18	0.19	0.21	0.23	0.25	0.27	0.29	0.31	0.33	0.35	0.37	0.40	0.42
(6) F-Zone	0.62	0.75	0.89	1.06	1.24	1.48	1.64	1.86	2.11	2.38	2.66	2.96	3.15	3.62	4.00	4.39	4.79	5.21	5.67	6.14	6.63	7.14	7.65	8.19	8.74	9.30	9.89	10.49
(7) G-Zone	0.22	0.29	0.36	0.43	0.50	0.57	0.64	0.72	0.81	0.91	1.01	1.11	1.21	1.32	1.43	1.54	1.66	1.82	1.98	2.15	2.32	2.50	2.68	2.87	3.06	3.25	3.45	3.65
Total	14.01	15.53	17.0	18.9	20.6	22.4	24.0	26.0	28.2	30.4	32.6	35.0	36.2	40.1	42.8	45.7	48.6	51.5	54.7	58.0	61.4	64.9	68.5	72.1	75.9	79.7	83.7	87.8
(8) A-Zone	4.79	4.83	4.89	4.93	4.42	4.24	4.10	4.00	3.90	3.83	3.76	3.71	3.63	3.57	3.52	3.47	3.43	3.38	3.37	3.35	3.33	3.34	3.33	3.30	3.28	3.28	3.27	3.25
(9) B-Zone	2.67	2.71	2.75	2.78	2.82	2.88	2.92	2.98	3.02	3.06	3.02	3.06	3.09	3.12	3.16	3.19	3.23	3.26	3.29	3.33	3.36	3.40	3.43	3.46	3.50	3.53	3.57	3.60
(10) C-Zone	7.88	8.48	9.08	9.68	10.28	10.88	11.48	12.08	12.68	13.28	13.88	14.48	15.08	15.68	16.28	16.88	17.48	18.08	18.68	19.28	19.88	20.48	21.08	21.68	22.28	22.88	23.48	24.08
(11) D-Zone	5.63	5.17	4.72	5.13	5.51	5.87	6.22	6.60	6.74	6.89	7.06	7.22	7.34	7.52	7.69	7.87	8.05	8.19	8.38	8.58	8.79	9.00	9.17	9.39	9.62	9.86	10.10	10.27
(12) E-Zone	3.68	4.17	4.68	4.87	5.07	5.26	5.44	5.63	5.93	6.20	6.48	6.74	6.96	7.26	7.55	7.84	8.12	8.36	8.64	8.98	9.23	9.51	9.76	10.06	10.41	10.74	11.07	11.33
(13) F-Zone	0.92	1.70	2.47	2.66	2.83	2.99	3.14	3.31	3.53	3.74	3.95	4.15	4.32	4.54	4.75	4.96	5.16	5.34	5.54	5.74	5.95	6.16	6.33	6.57	6.81	7.04	7.28	7.47
(14) G-Zone	2.31	1.93	1.55	1.53	1.51	1.50	1.49	1.59	1.40	1.41	1.43	1.45	1.61	1.63	1.65	1.67	1.69	1.88	1.91	1.93	1.96	1.99	2.16	2.18	2.20	2.23	2.25	2.45
Total	28.00	28.60	29.20	29.80	30.40	31.00	31.60	32.20	32.80	33.40	34.00	34.60	35.20	35.80	36.40	37.00	37.60	38.20	38.80	39.40	40.00	40.60	41.20	41.80	42.40	43.00	43.60	44.20



The following tables show the necessary number of collection vehicles.

1) Table X.2.1 Projected Solid Waste quantity by collection zone.

Table X.2.1 Project SW Quantity by Collection Zone, Generation Source.

2025-100%

Supporting to Chapter X.2.1 Waste Collection
Table X.2.1.1 Projected SW Quantities by Collection Zones, Generation Source

Collection Frequency	Projected Collection Quantity of Domestic Waste (kg)																											
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
(1) A Zone	3.50	3.79	4.07	4.34	4.61	4.88	5.15	5.42	5.69	5.96	6.23	6.50	6.77	7.04	7.31	7.58	7.85	8.12	8.39	8.66	8.93	9.20	9.47	9.74	10.01	10.28	10.55	
(2) B Zone	1.52	1.71	1.90	2.09	2.28	2.47	2.66	2.85	3.04	3.23	3.42	3.61	3.80	3.99	4.18	4.37	4.56	4.75	4.94	5.13	5.32	5.51	5.70	5.89	6.08	6.27	6.46	
(3) C Zone	6.53	7.19	7.85	8.51	9.17	9.83	10.49	11.15	11.81	12.47	13.13	13.79	14.45	15.11	15.77	16.43	17.09	17.75	18.41	19.07	19.73	20.39	21.05	21.71	22.37	23.03	23.69	
(4) C-North	1.58	1.85	2.14	2.47	2.85	3.19	3.59	4.01	4.49	4.99	5.52	6.08	6.61	7.14	7.64	8.16	8.65	9.15	9.62	10.10	10.56	11.04	11.52	12.00	12.48	12.96	13.44	
(5) C-South	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.26	0.27	
(6) C-South	1.67	2.38	3.18	3.97	4.75	5.53	6.31	7.09	7.87	8.65	9.43	10.21	10.99	11.77	12.55	13.33	14.11	14.89	15.67	16.45	17.23	18.01	18.79	19.57	20.35	21.13	21.91	
(7) D	0.62	0.75	0.89	1.06	1.24	1.43	1.64	1.86	2.11	2.38	2.66	2.96	3.26	3.56	3.86	4.16	4.46	4.76	5.06	5.36	5.66	5.96	6.26	6.56	6.86	7.16	7.46	
Total 2(1-7)	14.0	15.5	17.0	18.5	20.0	21.5	23.0	24.5	26.0	27.5	29.0	30.5	32.0	33.5	35.0	36.5	38.0	39.5	41.0	42.5	44.0	45.5	47.0	48.5	50.0	51.5	53.0	
(8) A-road	4.79	4.83	4.87	4.91	4.95	4.99	5.03	5.07	5.11	5.15	5.19	5.23	5.27	5.31	5.35	5.39	5.43	5.47	5.51	5.55	5.59	5.63	5.67	5.71	5.75	5.79	5.83	
(9) Market	2.67	2.71	2.75	2.79	2.83	2.87	2.91	2.95	2.99	3.03	3.07	3.11	3.15	3.19	3.23	3.27	3.31	3.35	3.39	3.43	3.47	3.51	3.55	3.59	3.63	3.67	3.71	
(10) B-road	5.63	5.17	4.72	5.13	5.51	5.87	6.23	6.59	6.95	7.31	7.67	8.03	8.39	8.75	9.11	9.47	9.83	10.19	10.55	10.91	11.27	11.63	11.99	12.35	12.71	13.07	13.43	
(11) C-North	3.68	4.17	4.66	4.87	5.07	5.26	5.44	5.63	5.82	6.01	6.20	6.39	6.58	6.77	6.96	7.15	7.34	7.53	7.72	7.91	8.10	8.29	8.48	8.67	8.86	9.05	9.24	
(12) C-South	0.92	1.70	2.47	2.66	2.83	2.99	3.14	3.31	3.53	3.74	3.95	4.15	4.35	4.54	4.73	4.93	5.12	5.31	5.50	5.69	5.88	6.07	6.26	6.45	6.64	6.83	7.02	
(13) C-South	2.31	1.93	1.55	1.53	1.51	1.50	1.49	1.48	1.47	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.37	1.36	1.35	1.34	1.33	1.32	1.31	1.30	1.29	
(14) B-South	28.65	19.66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total 2(8-14)	20.00	20.93	21.86	22.79	23.71	24.64	25.56	26.49	27.42	28.34	29.27	30.19	31.11	32.03	32.95	33.87	34.79	35.71	36.63	37.55	38.47	39.39	40.31	41.23	42.15	43.07	43.99	

4) Table X.2.4 Work sheet of allot the zone for each vehicle

Table X.2.1.4 Work Sheet of allot the zone for each vehicle

(1) Work Sheet(1) of Vehicle Allocation(Check Sheet)

● Sum-up of allocated capacity (Domestic waste)

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Domestic Waste	78	86	94	102	110	118	126	134	142	150	158	166	174	182	190	198	206	214	222	230	238	246	254	262	270	278	286
A Zone	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
B Zone	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
C-North	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
C-South	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
D Zone	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Capax. Total	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Required equipment capacity	135	145	155	165	175	185	195	205	215	225	235	245	255	265	275	285	295	305	315	325	335	345	355	365	375	385	395
Available capacity	19.6	21.4	23.4	25.6	27.6	29.6	31.2	33.5	35.8	38.2	40.6	43.1	44.4	48.3	53.9	56.9	59.9	63.1	66.3	69.6	73.0	76.5	80.1	83.7	87.5	91.3	95.3

● Sum-up of allocated capacity (Street waste)

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Street Waste	5.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
A Zone	3.0	5.0	5.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
B Zone	3.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
C-North	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
C-South	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D Zone	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capax. Total	13.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4
Required A Zone capacity	5.6	5.2	4.7	5.1	5.5	5.9	6.2	6.6	6.7	6.9	7.1	7.2	7.3	7.5	7.7	7.9	8.0	8.2	8.4	8.6	8.8	9.0	9.2	9.4	9.6	9.9	10.1	10.3
Required B Zone capacity	4.6	5.9	7.1	7.5	7.9	8.2	8.6	9.0	9.5	9.9	10.4	10.9	11.3	11.8	12.3	12.8	13.3	13.7	14.2	14.7	15.2	15.7	16.1	16.7	17.2	17.8	18.3	18.8
Required C-North capacity	2.3	1.9	1.6	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.6	1.6	1.7	1.7	1.9	1.9	1.9	2.0	2.0	2.0	2.2	2.2	2.3	2.5	2.5
Required C-South capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Required D Zone capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Available capacity	28.8	20.5	21.1	21.6	22.1	22.7	23.3	23.9	24.4	25.1	25.7	26.3	27.0	27.6	28.3	29.0	29.7	30.4	31.1	31.9	32.6	33.4	34.2	35.0	35.8	36.7	37.5	38.4

(2) Work Sheet(2) of Vehicle Allocation(Export fleet)

In Case of Monday, Wednesday, Friday

Note: Marked (shaded) columns shows the collection quantity of full collection.

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
New 12 cum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/ trip	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No. equip	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New 4 cum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C-North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C-South	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Available capacity	28.8	20.5	21.1	21.6	22.1	22.7	23.3	23.9	24.4	25.1	25.7	26.3	27.0	27.6	28.3	29.0	29.7	30.4	31.1	31.9	32.6	33.4	34.2	35.0	35.8	36.7	37.5	38.4

1) Table X.2.4 Work sheet of allot the zone for each vehicle

Table X.2.4 Work sheet allots the zone for each vehicle.

Table X.2.1.4 Work Sheet of allot the zone for each vehicles

(1) Work Sheet(1) of Vehicle Allocation (Check Sheet)

(2) Sum-up of allocated capacity (Domestic, waste).

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Domestic A Zone	78	90	90	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
B Zone	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
C-North																											
C-South																											
D Zone																											
Capacity	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Required A Zone	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
Required B Zone	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Required C-North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Required C-South	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Required D Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Required Total	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200

(2) Sum-up of allocated capacity (Street, waste)

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Street A Zone	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
B Zone	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
C-North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C-South	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Required A Zone	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
Required B Zone	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Required C-North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Required C-South	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Required D Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Required Total	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200

In Case of Monday, Wednesday, & Friday

(2) Work Sheet(2) of Vehicle Allocation (Sheet)

Note: Marked (shaded) columns shows the collection quantity of bell collection.

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
New 12 cum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C-North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C-South	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New 4 cum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C-North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C-South	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capacity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

		1998	1999	2000	2001	Y2002	Y2003	Y2004	Y2005	Y2006	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012	Y2013	Y2014	Y2015	Y2016	Y2017	Y2018	Y2019	Y2020	Y2021	Y2022	Y2023	Y2024	Y2025	Check										
New	6.8 cum	0	0	0	0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	186										
	A Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									
	B Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
	C-North					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
	C-South					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
D Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
Total					4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0						
Existing	5.0 cum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
	A Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
	B Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	C-North					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	C-South					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
D Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Total					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Existing	12 cum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	A Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	B Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	C-North					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	C-South					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
D Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Total					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Existing	4 cum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	A Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	B Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	C-North					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	C-South					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Existing	6 cum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	A Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	B Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	C-North					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C-South					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

(ten/dec)	1998	1999	2000	2001	Y2002 (Y2003)	Y2004	Y2005	Y2006	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012	Y2013	Y2014	Y2015	Y2016	Y2017	Y2018	Y2019	Y2020	Y2021	Y2022	Y2023	Y2024	Y2025	Σ New
New																												
0.8 cum Compactor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.0 B Zone					4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	180
2.0 C-North					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.0 C-South					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D Zone					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total					4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	180
Existing																												
0.8 cum Compactor	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
3.2 B Zone	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	0
2.0 C-North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.4 C-South	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	0
Σ New					4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	180
Σ Existing					3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	0
Σ Total					7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	180
Σ New					4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	180
Σ Existing					3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	0
Σ Total					7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	180

2.2 FINAL DISPOSAL

(1) Necessary Capacity of Sanitary Landfill Site.

Necessary landfill site volume is proportional to hauled waste into the site but generally, quantity of the waste is estimates in weight. Then the volume of wastes is decided by its specific gravity of the solid waste. Specific gravity of solid waste differs on a situation such that at the time when the waste unloaded from the collection vehicles, at the time when after compaction by heavy machine or when sufficient long time has passed after the waste dumping. Then, in this study, following conditions of waste are considered.

- 1) Specific gravity of waste at the moment when the waste is unloaded is assumed 0.3 Kg/m^3 . This specific gravity is necessary to obtain work load for the bulldozer.
- 2) Specific gravity of waste after compaction by heavy machine is assumed as 0.7 Kg/m^3 for the reason that the waste will be compacted by heavy machine with covering soil. This way of covering has to be done according to the DEGESA Standard. This figure is necessary to estimate of workload for heavy machine. *Table X.2.5* shows the volume of necessary landfill site and covering soil in each year based on the projected waste collection volume by 2008.

(2) Pit for covering soil.

In *Table X.2.5* shows that the necessary covering soil by 2008 is approx. $47,300 \text{ m}^3$ for two sites. This quantity of soil can be excavated and transported at the City Owned Site. This site has approximately 10 ha, of which approx. 5 ha is used as the Sanitary Landfill Site. Remained area that is 5 ha can be used as a borrow pit for taking covering soil.

According to the Technical Standard, characteristics of the final covering soil shall be decided depending upon rainfall per year. In Cancharani, rainfall is 720 mm / year in average, then covering soil shall be clay according the standard. However the result of the definitive study for establishment of sewage pond at the skirt of Cancharani, clay which can be used as impermeable core of the Dams to store up the sewage is found at the place 1 Km apart from the project sanitary

Table X.2.5 Necessary sanitary landfill site volume and covering soil by 2008.

Year	(1)*1 Waste generation including direct ton/day	(2)*2 Waste can be hauled ton/day	(3)*3 Waste to be compacted m ³ /day	(4)*4 Necessary volume for waste at the site m ³ /day	(5)*5 Covering soil to be compacted ton/day	(6)*6 Covering soil to be compacted m ³ /day	(7)*7 Necessary volume for waste+soil at the site m ³ /day	(8)*8 Dumping waste at the site ton/year	(9)*9 Necessary volume for waste at the site m ³ /year	(10)*10 Necessary covering soil in weight ton/year	(11)*11 Necessary covering soil in volume m ³ /year	(12)*12 Covering soil+Dumping waste ton/year	(13)*13 Accumulation of waste ton	(14)*14 Covering soil + Dumping waste m ³ /year	(15)*15 Accumulation of waste + covering soil m ³
2002	75.6	44.1	147.0	63.0	25.2	15.7	78.7	16,093.0	22,990	9,194	5,747	25,287	25,287	28,737	28,737
2003	77.4	46.5	154.9	66.4	26.5	16.6	83.0	16,958.0	24,226	9,689	6,056	26,647	51,934	30,282	59,019
2004	79.2	48.9	162.9	69.8	27.9	17.5	87.3	17,841.0	25,487	10,193	6,372	28,034	79,969	31,859	90,878
2005	81.3	51.6	171.8	73.6	29.5	18.4	92.1	18,816.0	26,880	10,750	6,720	29,566	109,535	33,600	124,478
2006	83.4	54.3	181.0	77.6	31	19.4	97.0	19,820.0	28,314	11,324	7,078	31,144	140,678	35,392	159,870
2007	85.5	57.1	190.4	81.6	32.6	20.4	102.0	20,852.0	29,789	11,914	7,447	32,766	173,444	37,237	197,107
2008	87.6	80.1	200.2	85.8	34.3	21.5	107.3	21,926.0	31,322	12,527	7,831	34,453	207,897	39,153	256,259

*1 This figure means whole generation of waste from the city and waste transported directly.
 *2 This figure means that waste can be carried to the site. The figure is decided at the capacity of collection equipments.
 *3 The volume of this column can be obtained by deviding hauled waste to the site in weight by density of the waste. In this case, the density is assumed as the density just after unloaded waste density from collection vehicles at the site, that is 0.3 ton/m³.
 *4 This figure means volume occupied with waste volume compacted by heavy machine. At this stage, the density of waste can be assumed 0.7ton / m³.
 *5 According to the Standard issued by the DIGESA, thickness of daily or intermediate covering soil is 0.15 m. In accordance with this Standard, necessary covering soil to be compacted in weight is 57 % of compacted waste of which density is 0.7 ton / m³.
 *6 The density of covering soil is assumed as 1.6 ton / m³.
 *7 This column = (5) / 1.6 = (4) X 0.25
 *8 This column = (4) + (6)
 *9 This column = (2) X 365
 *10 This column = (7) X 365
 *11 This column = (5) X 365
 *12 This column = (6) X 365
 *13 This column = (8) + (10)
 *14 This column = (9) + (11)
 Necessary covering soil by 2008 (m³) = 47,251.9

landfill site. The quarry has approx. 80,000 m³ of clay but this quantity will be consumed as seepage control layers on the bottom and slope of the proposed sanitary landfill site, or carry out final covering, other quarry has to be studied. For this reason, in this study, excavated soil will be used as the final covering soil.

In addition, if a quarry were found other than the quarry studied in the definitive study mentioned above, covering with the clay on the surface of compacted soil waste will make the site good situation for the reason that leachate quantity will drastically decrease. Detailed data on the clay is shown in the definitive study of the PELT.

(3) Leachate generation quantity at the site.

Leachate quantity is calculated following equation.

$$Q = I/1000 \times (C1 \times A1 + C2 \times A2)$$

Here: Q is the leachate discharge: m³/day.

I is daily rainfall ; mm/day

C1 is the Sink coefficient of the site under use.

C2 is the Sink coefficient of the closed site.

A is the area of each site : m²

C is a function of climate conditions but, C is changeable coefficient from the covering conditions of the surface of compacted waste.

Generally, rainfall intensity of " I " takes the maximum daily rainfall for past 20 years in Japan.

By means of this equation, example of calculation is shown in the Final Report. If the sanitary landfill site has a leachate treatment facility, daily discharge of leachate can be treated by the facility. Then the volume of leachate adjustment pond (or the sedimentation tank) is decided that the discharge of daily leachate minus the facility treatment capacity. In this study, instead of the leachate treatment capacity, evaporation capacity is considered as mentioned in the main report. In this case, pan

evaporation takes 4.7 mm/day (= 1,716 mm/year) which is lowest value as the pan evaporation in past.

As the result of calculation, in the case of average rainfall, no necessary of adjustment pond is clarified.

3 IMPLEMENTATION PROGRAM

Period of the site construction is limited if the landfill starts in 2002. As described the implementation program in the main report, including detailed survey such as the geological, topographical, and EIA, it can take only one year for preparation study. According to the DIGESA instruction that a project concerned with the establishment of the sanitary landfill site can be assisted, than this project should be assisted by the DIGESA as possible as it can.

The most effective items to give an influence to the implementation program are the work volume of the site construction. Then the owner of this project should select the appropriate Construction Company in accordance with the work volume.

4. PROJECT COST

The feasibility study period, as a first step of the work, is until 2008. Within this period, the Solid Waste processing business which have to be carried out is to supply the new collection vehicle and establishment of the new sanitary landfill site.

As for the procurement of the collection vehicles, there are two aspects that connect with the increase of waste collection quantity for the aim of improvement of collection rate and the increase of collection quantity associated with increase in population.

On the other hand, the new final disposal site, which is the sanitary landfill site becomes needed, to increase even landfill quantity along with the increase of collection quantity.

In the present Republic of Peru, as for a future final disposal site plan, the plan, design, construction must be established in accordance with a new standard. Therefore, it can not get the permission for the owner of the landfill site to construct the conventional type of landfill site. The facilities shall be hilevelization

that means the construction cost is an increase trend more.

Accompanying to this increase of the construction cost, other elements of cost increase such as increase of the waste collection quantity, increase of the maintenance control expense, personnel expenses, administrative expense can be easily assumed.

The project cost up to 2008 is 22,533,000. Soles.

5. FINACIAL PLAN

1) Conditions for Finance Analysis

In order to analyze the financial aspect of the proposed plan, there are some conditions as follows,

- (a) Inflation estimation is omitted
- (b) Profit tax of solid waste project is not counted
- (c) Revenue of solid waste project will grow with
 - i) the increase of Puno household
 - ii) the increase of solid waste charge with economic growth
(=1.5%/yr. This figure reflects the economic growth rate in Puno department)
 - iii) the increase of collection rate of waste handling charge
(=1.46%/yr. The goal of the collection rate in 2025 is set as 70%. The present rate is 48%)
 - iv) the implementation of environment fee, so to speak environment fee for "save Lake Titicaca" for tourists
(When solid waste management in Puno is neatly organized, tourists are able to enjoy esthetic enjoyment of environment as benefit, therefore tourists should share the cost of this project by paying environment fee.)
 - v) the contribution by PRONAA
 - vi) the contribution of S/. 550,000 every year by Puno municipality
 - vii) the contribution by the state government
- (d) The part of construction cost will be financed by local loan with 7% interest rate. Repayment period of the loan is 20 years and grace period is 5

years. The loan will cover the contingency of construction work, but not IGV of construction work.

- (e) Equipment cost, engineering service, vehicles, and manpower will be financed by local fund without interest.
- (f) Vehicles are depreciated with 10 years. After 10 years, the vehicles will be purchased again at same price.
- (g) Contingency (15%) is considered on the cost of construction work and engineering service.
- (h) IGV (18%) is considered on the cost of construction work, equipment cost, engineering service and vehicles.
- (i) Civil work and equipment will be bought out at the remaining value in 2008F/Y

2) Financial Viability of Proposed Project

(i) Results of Financial Viability

In Chapter VI of master plan, the following three cases were recommended to increase the revenue for solid waste management in Puno.

Case6: Waste handling charge is 48soles/household/yr and environment fee is 1.4\$/day/person under the condition that the expenditure for engineering service is covered by a contribution of Peru government.

Case7: Waste handling charge is 64soles/household/yr and environment fee is 1.1\$/day/person under the condition that the expenditure for engineering service is covered by a contribution of Peru government.

Case8: Waste handling charge is 48soles/household/yr and environment fee is 1.2\$/day/person under the condition that the expenditures for engineering service, heavy machines, and vehicles are covered by a contribution of Peru government.

The viabilities of these cases were analyzed for the term by 2025yr that is a target year of master plan. Therefore, these viabilities should be estimated again for the term by 2008yr that is a target year of feasibility study.

In the *Table X.5.1*, the results of financial viability analyses on the three cases are shown.

Table X.5.1 Results of Financial Viability

	Waste Handling Charge	Environment Fee	FIRR
	soles/household/yr	\$/day/person	%
Case 6	48	1.4	0.7
Case 7	64	1.1	1.3
Case 8	48	1.2	15.4

From the results of financial viability, the following facts can be said.

- Environment fee of Case 6 should be raised to make FIRR (0.7%) surpass 7% at F/S stage.
- Environment fee of Case 7 should be raised to make FIRR (0.7%) surpass 7% at F/S stage.
- Environment fee of Case 8 seems suitable, because FIRR (15.4%) exceeds 7% of interest rate of soft loan. However, P/L of Case 8 is negative, environment fee must be therefore raised to make P/L positive at F/S stage.

3) Financial Plan

(i) Calculation for Acceptable Financial Plan

Table X.5.2 Recommendable Combinations

	Waste Handling Charge	Environment Fee	FIRR	P/L	Revenue Balance
	soles/household/yr	\$/day/person	%	1,000 soles	1,000 soles
Case 9	48	2.1	13.6	9	1,466
Case 10	64	1.8	14.2	214	1,670
Case 11	48	1.4	21.1	140	1,596

*1: Engineering service of Case9,10 are covered by a contribution of Peru government.

*2: Engineering service, heavy machines, and vehicles of Case11 are covered by a contribution of Peru government.

*3: P/L stands for Profit – Loss.

Based on the results of analyses shown in the *Table X.6.3*, Case9,10,and 11 are recommendable for the target year of 2008yr. Reasons in detail to choose Case9,10,and 11 are described as follows:

Reason1: FIRR's are over 7% of discount rate.

Reason2: P/Ls are positive.

Reason3: Compared with accommodation charge in Puno, 1.4-2.1 \$/day/person for an environment fee seems acceptable.

(ii) Implementation of Financial Plan

In the *Table X.5.3*, advantages of each case are described.

TableX.5.3 Advantage of Each Case

	Waste Handling Charge	Environment. Fee	Advantage
	soles/household/yr	\$/day/person	
Case 9	48	2.1	If the priority of citizens is higher than the one of tourist, and if heavy machines and vehicles are not covered by a contribution Case9 is most suitable.
Case 10	64	1.8	If the priority of tourist is higher than the one of citizens, and if heavy machines and vehicles are not covered by a contribution, Case10 is most suitable.
Case 11	48	1.4	If the expenditure of engineering service, heavy machines, and vehicle is covered by a contribution of Peru government, Case11 is most suitable.

There are some crucial points to execute Case9,10,11 as follows:

- Point1: The present collection rate of the waste handling charge must be increased by 1.46% annually. This method can be executed without a fundamental change of solid waste management in Puno.
- Point2: The raise of the present waste handling charge must be regulated.
- Point3: The raise of the present waste handling charge must be informed well to Puno citizens from the preparation stage of the project.
- Point4: In order to mitigate the impact of the raise on the lower-income households, a certain type of mean could be considered. For example, Puno should be divided into higher income areas and lower income areas. Then, a higher increasing rate of waste handling charge should be applied at higher income areas.
- Point5: Introduction of environment fee must be regulated and informed well to the hotels in Puno.
- Point6: The state government should recognize that the value and benefit generated by the tourism at Lake Titicaca are worthy to provide a subsidy for an environmental improvement.

6. MANAGEMENT OF THE PROJECT

As for the collection and transportation, the correspondence to the increase of collection vehicles associated the increase of the solid waste is important.

Preventive maintenance is indispensable items in order to get sustainable good condition for the collection vehicles.

As for the sanitary landfilling, as Puno City has no experience of sanitary landfilling. The city should give opportunities to Staffs who are in charge of sanitary landfilling to study.

7. PROJECT EVALUATION

Generally, most effective items to surrounding the site as environmental situation, is leachate. As good management of the facilities keeps in good conditions for the site, environmental affection is quite low. One of the most important items is management of clay. Generally, clay has easily cracks in case no water supply. In order to avoid this situation, clay installation shall be waited until just before to reclaim the waste. One of the preventive way for avoiding, divided reclaimed way is effective.

These maintenance of the facilities will give the good condition for environmental and Lake Titicaca.

Table X.5.4 Analysis on FIRR for Case9, Case10 and Case11

(unit:1000Soles)

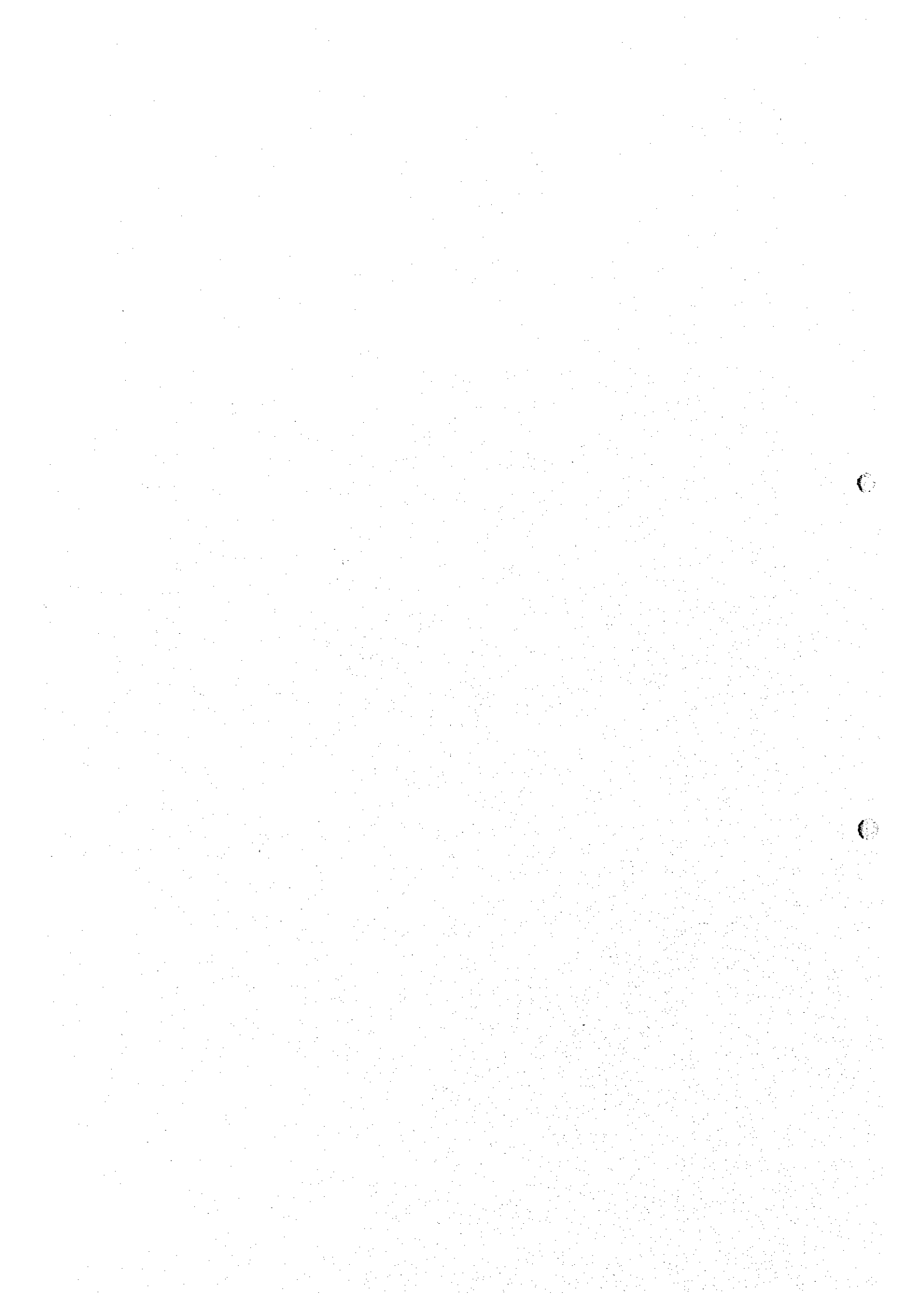
Serial No.	Year	Case 9			Case10			Case11		
		Cash In	Cash Out	Balance	Cash In	Cash Out	Balance	Cash In	Cash Out	Balance
1	1999		0	0		0	0		0	0
2	2000		14	-14		14	-14		14	-14
3	2001	167	3,494	-3,327	167	3,494	-3,327	167	3,494	-3,327
4	2002	2,730	4,676	-1,946	2,752	4,676	-1,924	5,970	4,676	1,294
5	2003	2,832	1,546	1,287	2,857	1,546	1,312	2,931	1,546	1,385
6	2004	3,072	4,203	-1,130	3,100	4,203	-1,102	2,908	4,203	-1,295
7	2005	3,054	1,593	1,461	3,085	1,593	1,492	3,135	1,593	1,542
8	2006	3,380	6,284	-2,904	3,412	6,284	-2,871	3,453	6,284	-2,831
9	2007	3,285	1,375	1,910	3,318	1,375	1,943	3,094	1,375	1,719
10	2008	6,564	1,656	4,908	6,597	1,656	4,941	6,615	1,656	4,959

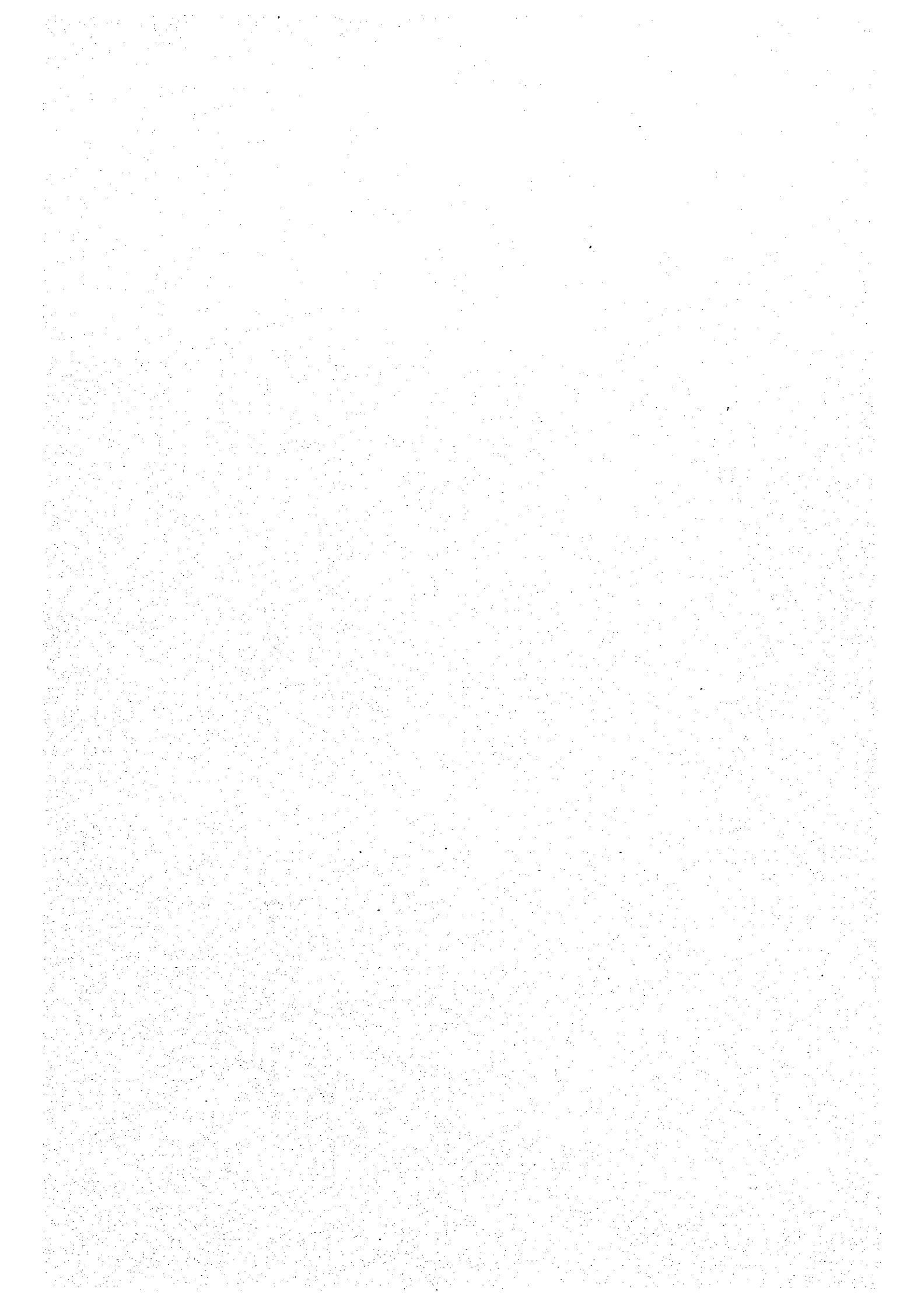
FIRR : 13.6%

FIRR : 14.2%

FIRR : 21.1%

- *1) Case 9: Waste handling charge is 48soles/house/yr, Environment fee is 2.1\$/day/person
- *2) Case10: Waste handling charge is 64soles/house/yr, Environment fee is 1.8\$/day/person
- *3) Case11: Waste handling charge is 48soles/house/yr, Environment fee is 1.4\$/d/p
- *4) Cash in: Revenue + Fixed asset sold
- *5) Cash out: Project expenditure





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