14.3.3 Overall Site Development Plan

a. Fundamental Issues

The important issue during the planning of the site development is that no one in the world likes to have SWM facilities, especially a landfill, because of the NIMBY (Not In My Back Yard) syndrome. In the case of Mersin the situation is worse because the public's impression of a disposal site is that of "awful" open dumping, currently operating at the compost plant landfill. Although the Mersin City Development Master Plan (City M/P) designated the site as a final disposal site, the Mersin GM should pay careful attention to ease the surrounding people, i.e., giving a new image of a sanitary landfill, construction of a greenbelt along the site, etc.

Further, the overall site development plan should fully consider the other development projects, such as industrial complex development, etc., in the surrounding areas. In addition, this site is still in use as a quarry for raw materials of Cimsa cement factory. The topography of the site will have to be altered when the site development works begin.

b. Overall Site Development Plan

An overall site development plan is summarised as follows:

- A 30m wide buffer zone (trees, plants) will be constructed along the boundary of the proposed Cimsa site to isolate the disposal site from the surrounding residents, and thereby ease resident opposition to the operation of the site.
- Basically the landfill operation will be carried out in the cavity of the Cimsa quarry (15 ha). The compost and sorting plant will be constructed outside the cavity.
- Because the target site slopes from north to south and south-west to north-east, the leachate treatment facility will be constructed at the south-easternmost end.
- The sorting and compost plant will be constructed outside the south-eastern boundary of the quarry, in consideration of the plant space required and wastewater treatment.

14.3.4 Contents of the Project

The outline of the project which was proposed to materialise the targets is presented in the table below.

Table 14-2: Outline of the Feasibility Study

Project		Outline			
Separate Collection			2002 -2005		
		• Compactor Truck (16m^3)	21-33		
		• Tractor Trailer	0		
		• Lorry	0		
		• Collection Truck (Medical)	1		
		• Container (800 l)	286-346		
Sorting Plant		• Construction	: 2001		
		• Operation Commencement	: 2002		
		• Plant Capacity	: 100 ton/day		
		• Plant Type	: Manual sorting + Magnetic Separator		
		• Operation	: 350 day/year, 16 hour/day		
		• Raw Material	: Separated Non-compostable Waste		
		• Recovered Material	: Paper, Plastics, Glass, Ferrous metals, Non- ferrous Metals, Textile		
Compost Plant		• Construction	: 2001		
		• Operation Commencement	: 2002		
		• Plant Capacity	: 110 ton/day		
		• Plant type	: Aerated Static Pile		
		• Operation	: 350 day/year, 16 hour/day		
		• Raw material	: Separated Compostable Waste		
		• Compostable Content	: 20.3 % by dry weight		
		• Moisture Content	: 70 %		
		• Composting period	: 28 day		
		• Maturation period	: 60 day		
		• Compost Product Amount	: 16.2 ton/day		
Final Disposal	MSW		Phase 1	Phase 2	Phase 3
		• Construction	2001	2001	2005
		• Operation Commencement	2002	2004	2005
		• Area Total	: 24 ha		
		Landfill Area	5 ha	4 ha	4 ha
		Buffer zone	: 6 ha		
		Others	: 5 ha (Plant, Medical, etc.)		
		• Landfill Volume	463,000 m^3	397,000 m^3	297,000 m^3
		• Disposal Period	2002 - 2003	2004 -2004	2005 -2005
		• Leachate Treatment	: Phase 1 Waste Stabilisation pond		
			: Phase 2 Circulation + Evaporation		
	Medical	• Construction	: 2001		
		• Operation Commencement	: 2002		
		• Area	: 2 ha		
		• Landfill Volume	: 57,500 m^3		
		• Disposal Period	: 2002 - 2020		
		• Leachate Control Facility	: Circulation + Evaporation		

14.3.5 Project Cost Summary

The estimated project costs are summarised in the table below.

Table 14-3: Cost Schedule of the Project for Mersin GM

unit: US$ 1,000

MERSIN			2000	2001	2002	2003	2004	2005
Separate Collection System	Container	Invest.		5	1	1	1	1
	Compactor	Invest.		1,344	256	192	320	256
		O&M for Compactor			924	1,100	1,232	1,452
Plant	So ting Plant	Design & Supervision	142					
		Invest. for civil work		567				
		Invest. for machine		1,685				
		Invest. for V&E		377				
		O&M			378	378	378	378
	Compost Plant	Design & Supervision	263					
		Invest. for civil work		872				
		Invest. for machine		3,138				
		Invest. for V&E		867				
		O&M			440	440	440	440
Final Disposal	Municipal Waste	Design & Supervision	317			25	105	
		Invest. for civil work		5,185			1,805	7,548
		Invest. for V&E		1,257				
		O&M			375	375	375	341
	Medical Waste	Design & Supervision	91					
		Invest. for civil work		1,869				
		Invest. for V&E		341				
		O&M			34	34	34	34

Note V&E: Vehicles and Equipment

14.3.6 Project Evaluation

a. Technical Evaluation

The technical systems of the project comprise:

1. Introduction of a separate collection system
2. Construction of a sorting plant
3. Construction of a compost plant
4. Construction of Cimsa MSW disposal site
5. Construction of Cimsa medical waste disposal site

The technical evaluation assesses the feasibility of this priority project, with reference to the present technical capabilities of the target area.

a.1 Separate Collection System

The introduction of the separate collection system is expected to be difficult, for mixed collection is practised in the target areas. To overcome this difficulty, separate collection is going to be introduced gradually, first in areas where the system can be easily implemented. In the F/S, areas like GSHC - pilot project area in Mersin - are prioritised, and the aim is to disseminate the practice to 30% of the population by 2005.

Based on the pilot project in Mersin, it is concluded that properly explaining to the residents the objectives, the methods, and the degree of public co-operation required from them would ensure the feasibility of introducing the separate collection system.

The pilot project verified the feasibility as non-compostable waste in compostable waste is only less than 10%. By modifying the contents to suit the conditions in whole Mersin GM, the education book produced to promote the pilot project is also an indispensable tool in gaining very effective public participation.

In conclusion, the gradual introduction of the separate collection system would be very feasible by making full use of the experiences gained from the pilot project in Mersin.

a.2 Sorting and Compost Plant

Mersin is one of the municipalities in Turkey with some experience in the construction and operation of a compost plant. The plants, however, are not successfully operated. The sorting facilities that are constructed in some cities are very simple in structure and totally different from what this study proposes. In the planning, the design, the construction, and the operation of the sorting and compost plant, therefore, an experienced consultant and plant manufacturer from advanced nations should be contracted, on condition that they enter a joint venture with local firms. This would facilitate the transfer of the relevant techniques and know-how to local firms.

Excluding the plastic bag breaker for the sorting plant and the selective crushing separator (SCS) for the compost plant, all relevant equipment can be procured locally, and would therefore eliminate any problems when acquiring spare parts and for maintenance. The plastic bag breaker and the SCS will be imported, but since the structure of both equipment is simple, there should be no problems especially with the transfer of techniques required to operate and maintain these equipment. In terms of acquisition of spare parts and maintenance, the setting up of a local agency could overcome any problem.

a.3 MSW and Medical Waste Disposal Site

The local construction firms are fully capable of developing the MSW and medical waste disposal sites. The disposal sites in Turkey, however, do not carry out sanitary landfilling as stipulated by the SWM and Medical Waste Control Regulations of the MoE. A consultant from an advanced country that is fully experienced in the planning, the design, the construction, and the operation of a sanitary landfill will be contracted and made to work together with a local firm, also in consideration of technology transfer.

There should be no problems with the procurement of the equipment needed to operate the MSW and the medical waste disposal sites, as all the necessary resources are available locally.

b. Social Evaluation

The project would incur various social impacts, however, only the intangible social impacts were evaluated.

Negative Impacts:

- Opposition from the residents who live near the Cimsa site
- Loss of livelihood for scavengers.
- Rise in cleansing tax rates.

Positive Impacts:

- Improvements in sanitary conditions and public health of the Compost Plant dumpsite surrounding area
- Promotion of investment and tourism.
- Increase in land value.

b.1 Measures to Mitigate Negative Impacts

Opposition from the residents who live near the Cimsa site

Although the proposed Cimsa disposal site is located more than 1,000 metres from the nearest inhabitant, it has already received opposition from the residents who live near the site. In order to reduce opposition, a 30 metre buffer zone (tree, plants) will be constructed along the boundary of the proposed site. This will isolate the disposal site from the surrounding residents and thereby ease resident resistance.

Loss of Livelihood for Scavengers

The project proposes to prohibit the entry of unauthorised persons into the disposal site from 2002, so that the sanitary landfill can operate efficiently. If this is enforced, this will deprive the scavengers who work in the dump site of their livelihood. As a preventative measure, Mersin GM may request the operator of the sorting plant to hire scavengers as sorting workers.

Rise in Cleansing Tax Rates

The project proposes to raise the present cleansing tax rate, which will increase the revenue of SWM services. A higher revenue is required to implement the proposed projects. Although this would increase the financial burden of the citizens, the following considerations are taken into account to minimise the negative impacts.

a) To introduce a cross-subsidy mechanism (i.e., the affluent pays for the less well off).

b) To maintain the cleansing tax rate in 2005 at less than four times the residents' current willingness to pay.

c) To keep the proposed rate below 1.0% of the resident's income.

The table below compares these amounts.

Table 14-4: Ratio of Cleansing Tax to Income

	2002	2003	2004	2005
Average annual household income (US$/year)*1	6,000	6,100	6,210	6,320
Cleansing tax per household (US$/year)	12.7*2	23.0	23.1	46.5
Ratio of cleansing tax (%) to income	0.21	0.38	0.37	0.74

Note: *1: Calculated assuming that the increase is in proportion to the per capita GRDP.
*2: Amount of willingness to pay from the POS

The WTP is below 1 % of the average income, and assuming that residents can afford to pay more, the project proposes a cleansing tax rate higher than the amount they are willing to pay (US$ 12.7 /year).

b.2 Positive Impacts

Improvements in sanitary conditions and public health of the areas surrounding the Compost Plant dumpsite

The project will bring various benefits; the current open dumping operation adversely affects Compost Plant dumpsite and its surrounding area to a significant degree. Consequently, residents from adjacent areas frequently complain about these unfavourable conditions and therefore strongly oppose use of the site. These adverse impacts will considerably be mitigated by the rehabilitation of the Compost Plant dumpsite. The implementation of the project, therefore, will improve the sanitary and public health conditions of the areas surrounding the Compost Plant dumpsite , and terminate resident opposition to the operation of the disposal site. In particular fire outbreaks, which affects not only the surroundings, but also the city centre, will be eliminated completely.

Promotion of Investment and Tourism

In addition to the health effects, separate collection, promotion of government related recycling by constructing sorting and compost plants, and the proper disposal of wastes will provide Mersin GM with a favourable environment that would eventually promote investment and tourism. Since Mersin GM is the centre of economic and social activities in the Icel Province, the improvement of its environment will enhance its image and eventually contribute to attracting more investors and tourists to the area.

Increase in Land Value

A well-managed waste disposal operation will improve the living environment, which in turn will increase the value of the land in the area. A study on the relationship between the living environment and land value suggests that, other factors held constant, housing values with distance from a landfill rise at an average rate of 6.2 % a mile within a two-mile radius of the landfill, presumably because the environmental and aesthetic problems associated with living near a landfill diminish as distance from it increases. Thus, the implementation of projects, sanitary landfill operation, etc., increases the land value around the present Compost Plant disposal site.

c. Financial Evaluation

c.1 Financial Evaluation Method

Financial evaluation is carried out to determine whether both the cleansing service management and the financial plan can be realised within the financial capacity of the agency in charge. Several agencies are involved with the cleansing services, but the evaluation of the financial state of each agency would be difficult. Here, an overall financial evaluation of the cleansing service in the target area, consisting of Mersin GM, Akdeniz DM, Troslar DM, and Yenisehir DM, is carried out in accordance with the conditions shown in the table below.

Table 14-5: Conditions for Financial Evaluation

Executing Body	**Waste collection and public area cleansing services:** • Planning and monitoring by the GM and the DMs • Operation by private contractors **Sorting plant, compost plant, and disposal site:** • Planning and monitoring by the GM • Operation by private contractors
Evaluation Period	17 year period, from 2000 to 2016
Revenue	**Revenues**: • cleansing tax • budget allocation from general finances of the DMs and the GM • sale of Recoverables and compost • tipping fee for direct haulage and for medical waste The revenue in 2005 will be adopted for the period from 2006 to 2016.
Investment Cost	The following investment costs until 2005 is considered: • introduction of a separate collection system • construction of a sorting plant • construction of a compost plant • development of an MSW disposal site • construction of a medical waste disposal site The renewal investment costs are also considered until 2016 according to the life span.
Operation Cost	The estimated cost is adopted until 2005. The expenditures adopted for 2006 to 2016 are as in 2005.
Salvage Value	The salvage value of vehicles, machinery and equipment in 2017 was taken into account.
Cut-off Rate	The standard discount rate (8%) used by the European Development Bank and World Bank is applied.
Price Increase	The prices for 1998 is adopted in the financial evaluation; price increase is not considered.

c.2 Case Studies

Case studies are conducted using the following parameters. There are 25 case studies in total.

- Cleansing tax: Tax rate (tariff) and year to increase the rate.
- SWM budget allocation from general financial sources (municipal budget) other than cleansing tax: Rate
- Central government subsidy: Rate
- Reduction in expenditure: Rate

In order to implement these case studies the following conditions were established:

Cleansing tax

The following assumptions were made to examine the cleansing tax rate and the year to increase the rate:

- The tax collection rate will be increased to 90 % in 2002.
- Number of cleansing tax payers for waste generated by households will increase in proportion to the population, and for enterprises the increase will be proportional to the GRDP.

SWM budget allocation from general financial sources

The present SWM budget allocation rates from general financial sources of municipalities were estimated by the team as follows:

Mersin GM: 4 %

Akdeniz, Troslar, and Yenisehir DMs: 11 %

The general financial source growth rate in real terms by 2005 is also estimated at 1.3 times the 1998 figure.

Central government subsidy

In Turkey, investment comes from either foreign loans or central government subsidies. Municipalities repay foreign loans with interest. Since SWM service is not profitable, a soft loan is favourable. The team advocates an OECF loan, as a foreign loan, for investments required in 2000 and 2001, that is repayable in 25 years, has a 7 year grace period, and has an interest rate of 2.2%

Reductions in expenditure

In order to achieve a sound financial state, expenditure shall be reduced by:

- reviewing the construction cost estimated by the team at the detailed design stage of the design of the landfill's slope liner, the need for a liner, etc.
- reducing operation cost by contracting out the plant operation and properly managing the administration cost.

c.3 Overall SWM Costs

The overall SWM cost needed for the implementation of the project (target year: 2005) are summarised in the following table.

Table 14-6: Cost Summary for Financial Evaluation of Project

unit: US$1,000

Items		2000	2001	2002	2003	2004	2005	Total
Investment	Separate Collection	0	1,349	257	193	321	257	2,377
	Sorting Plant	142	2,629	0	0	0	0	2,771
	Compost Plant	263	4,877	0	0	0	0	5,140
	Final Disposal Site	317	6,442	0	25	1,891	6,189*6	14,864
	Medical WDS	91	2,210	0	0	0	0	2,301
	Sub-total	813	17,507	257	218	2,212	6,446	27,453
O & M Costs	Separate Collection	0	0	924	1,100	1,232	1,452	4,708
	Sorting Plant	0	0	378	378	378	378	1,512
	Compost Plant	467*2	467*2	440	440	440	440	2,694
	Final Disposal Site	1,650*3	1,763*3	375	375	375	341	4,879
	Medical WDS	0	0	34	34	34	34	136
	Administration*1	402	423	524	538	549	577	3,013
	Sub-total	2,519	2,653	2,675	2,865	3,008	3,222	16,942

Items		2000	2001	2002	2003	2004	2005	Total
Existing System	Collection & Haulage*4	4,029	4,291	3,468	3,468	3,468	3,468	22,192
	Public Area Cleansing*5	1,888	1,947	2,008	2,072	2,138	2,206	12,259
	Sub-total	5,917	6,238	5,476	5,540	5,606	5,674	34,451
Overall SWM expenses		9,249	26,398	8,408	8,623	10,826	15,342	78,846
Overall SWM costs		8,436	8,891	11,011	11,288	11,522	12,121	63,269

Note: *1: 5% of the overall SWM expenses (inclusive of depreciation cost)
*2: Calculated based on US$32/ton (US$19/ton of the current O&M cost of the compost plant + US$13/ton of depreciation cost)
*3: Calculated based on US$10/ton
*4: Calculated based on US$25/ton
*5: Calculated based on US$221/ton
*6: Modified the investment cost according to the disposal volume after 2006 assumed to be equivalent to the volume of 2005 for the financial evaluation.

The overall SWM cost for 2005, calculated by converting the project investment cost into the depreciation cost, is US$ 12.1 million – 2.5 times the overall SWM expenses (US$4.8 million) at present.

c.4 Conclusion of the Financial Evaluation

Of the 25 case studies the financial evaluation concludes the case consisting of the following parameters as recommendable.

Cleansing Tax

- Raise the cleansing tax fee in real terms to 1.8 times the 1998 rate in 2003.
- Further raise the cleansing tax rate in 2005, aiming to provide 67 % of the SWM cost, including depreciation costs, i.e., double the above rate, or 3.6 times the 1998 rate.

SWM Budget Allocation

- Raise the SWM budget allocation from general financial sources (excluding cleansing tax) to 1.4 times the 1998 rate in 2003.

Central government subsidy

- Acquire a central government subsidy equivalent to 20 % of the investment for 2000 and 2001.

If the above requirements are satisfied, the implementation of the project will be financially feasible because the FIRR is slightly over the cut off rate at 8.1 %.

The cash flow of the recommended case is shown in the figure below.

Although this case would incur a financial deficit until 2004, covering all the cleansing service expenses (including depreciation costs) in 2005 would be possible.

By 2005 there will be a reserve of US$ 3 million that can be allocated to replacement costs for vehicles and equipment from 2006.

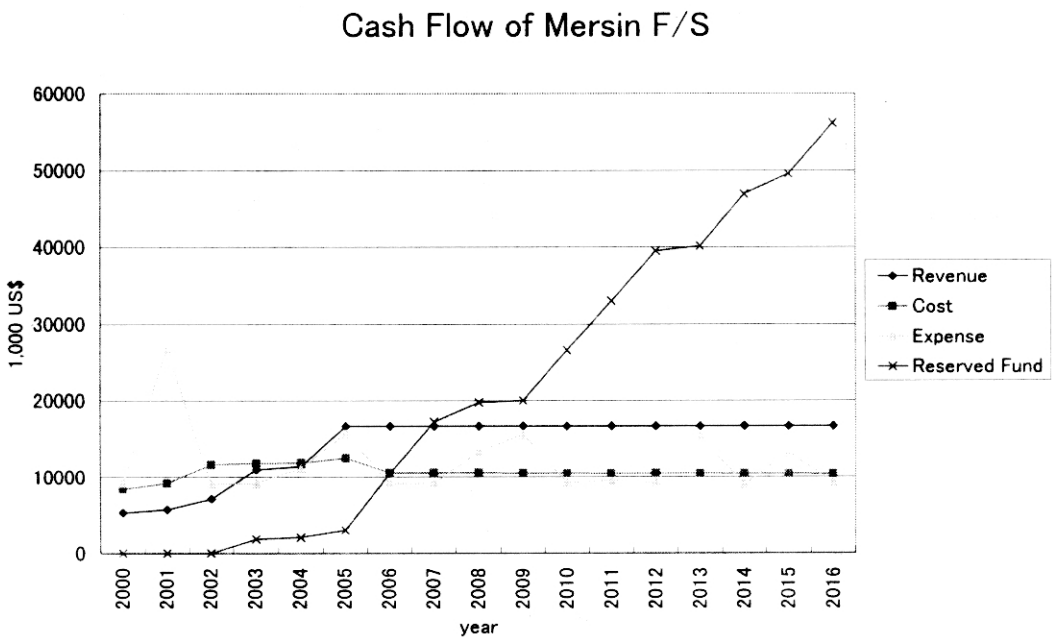

Figure 14-4: Cash Flow Diagram for Recommended Case

d. Economic Evaluation

d.1 Economic Evaluation Method

Economic evaluation is carried out to determine the necessity of the project in view of the present national economic conditions. Because environmental benefits are difficult to quantify, economic evaluation is mostly limited to cost minimisation methods and qualitative evaluation. With resource-recovery and disposal site cost reduction as the benefits that can be expected from the introduction of an intermediate treatment facility, a comparison is made between costs and benefits of a project that has (*with the project*) and does not have (*without the project*) the introduction of such facility.

In this study, the proposed project objectives are as follows:

- Promote resource recovery and reduction of disposal amount through the construction of a sorting plant and compost plant.
- Introduce separate collection to improve compost quality.

Taking the above into consideration, the evaluation of the project is carried out as follows.

Table 14-7: Economic Evaluation Method

	Collection & Public Area Cleansing	Intermediate Treatment	Final Disposal
Evaluation Method	Qualitative Evaluation	Quantitative Evaluation (Cost-benefit Analysis) Qualitative Evaluation	Qualitative Evaluation
Evaluation Period		17 years (2000-2016)	

The benefits and costs for quantitative evaluation are as shown in the table below.

Table 14-8: Benefits and Costs

	Intermediate Treatment
Benefits (B)	• Resource recovery (Recoverables and compost) • Reduced disposal cost • Reduced haulage cost*[1] • Effective land use
Costs (C)	The following were converted into economic cost: • Investment cost and O&M cost of separate collection • Investment cost and O&M cost of sorting plant • Investment cost and O&M cost of compost plant
Evaluation Standard	EIRR > 8 %

Note: Since Cimsa site and other candidate sites locate almost the same distance from the centre of the city (about 20 km), the benefit of reduced haulage cost is not expected.

The benefits and O&M costs in 2005 will be used for the benefits of O&M costs in 2006 - 2016. As in the financial evaluation, the investment required for vehicle and equipment renewal is considered for investment cost. In addition, the salvage value in 2016 is calculated as negative costs in 2017.

d.2 EIRR Calculation Results

Based on the above costs and benefits, even at a 0% discount rate the benefit–cost ratio is no more than 0.75. The benefits of resource recovery include environmental benefits, such as reduced environmental CO_2 loads, therefore there may be some disputes when the project benefit is evaluated using market prices. If the benefit of resource recovery is taken as double the market price, the EIRR is 11%, and therefore above the cut off rate.

d.3 Qualitative Evaluation

Intermediate Treatment

Although some of the benefits can be quantified, this alone is insufficient to present an overall benefit required to fulfil the established evaluation criteria for the project's feasibility.

As the world's awareness of the importance of global environmental preservation intensifies, the effects of resource recovery through the construction of a sorting plant and a compost plant would widely surpass the benefits measured quantitatively.

The following are also some of the effects that is considered to result from resource recovery:

- Soil conditioning by compost use
- Creation of jobs from the operation of the sorting plant
- Improvements in resource recovery activities
- CO_2 reduction due to energy conservation

In view of these impacts, therefore, the need to implement the proposed project is fully justified.

Final Disposal

The adequate final disposal of hauled waste prevents adverse environmental impacts.

The construction of the Cimsa disposal site may have the following impacts:

- Improvements in public health and in the environment around the existing compost site.
- Prevention of leachate runoff to outer areas by adopting a circulation process for the rehabilitation/closure of the compost plant site.

To counteract any risk that may result from the handling or unexpected contact with contagious materials, the development of a medical waste disposal site is of extreme importance. This undertaking will not meet any opposition as this would actually contribute to eliminating the fears and worries of the surrounding residents.

Based on the above qualitative evaluation the project is deemed feasible.

14.4 Environmental Characteristics of the Project Site

14.4.1 The Area Influenced by the Project

14.4.1.1 The Land Use

Among the area within 1.5 km radius of the proposed site, it is supposed that the area within 1 km radius is probable zone of impact and the rest is buffer zone.

There are 8 different specified land use types in the probable zone (Table 14-9, Figure 14-5). Cultivated land is about 385 ha (54 % of the total area) and is the widest of all the other types of usages. Vineyard is the most popular agricultural land use type in the area. Vineyards cover about 343 ha in the site where it covers 151 ha within 1 km radius and 192 ha in the buffer zone. The cultivated land in the probable zone consists of 13.6 ha of non irrigated field and 28.9 ha of fallow fields.

Table 14-9: The Distribution of Existing Land Use

ZONE	DISTRRIBUTION OF LAND USE BY ZONES (Ha)								
	Vine-yards	Non-irrigated fields	Fallow Fields	Forest	Maquis	Grazing	Housing	Excavation site	Total Area
1. Probable Zone	151.1 (%48)	-	23.1 (%7)	-	26.8 (%9)	57.7 (%18)	-	45.3 (%18)	314.0 (%44)
2. Buffer Zone	191.6 (%48)	13.6 (%3)	5.8 (%2)	3.7 (%1)	81.1 (%21)	85.8 (%22)	10.9 (%3)	-	392.5 (%56)
TOTAL	342.7 (%48)	13.6 (%2)	28.9 (%4)	3.7 (%1)	107.9 (%15)	143.5 (%20)	10.9 (%2)	63.9 (%8)	706.5

Note: the terms in the parenthesis is the percentage of the zone use respect to where it is located.

The cultivated lands are in the form of small parcels because of the rough topographic structure. As the parcels are located on the small and medium steep slopes, the priority has been given to plants which have the minimum need of water consumption (Figure 14-6).