L.3.5.2 Recommendations to Mitigate the Damage

a. Recommendation for Short Term Improvement

The following table shows countermeasures for each inundation prone area to be improved in a short term. The priority order was proposed by the municipality.

Table L-174: Recommendation for Short Term Improvement

No.	Name of Area	Priority	Reason
1	Buenos Aires, 12 de Septiembre, Abraham Rugama	1	to reconstruct the wall to make the water flow on the watercourse along the east side of the area. However, it is needed to investigate the capacity of the watercourse. to expand the watercourse along the west side of the area. To solve the problem in this area, a consolidated river plan should be carried out, which is also including a land use plan, tree planting, etc.
2	Miriam Tinoco	4	The problem of the area was already solved.
3	Ana Virgen Roble	1	to improve the roads in the area. (pavement ,or at least to make the level of the roads lower than one of the houses.) to improve the existing watercourse along the west side of the area to discharge water to the Acome river.
4	David Andino	1	The same as above.
5	Pablo Sabala	3	to move the houses to prohibit the new settlement in the area.
6	Carlos Fonseca	1	to construct drains to prevent the area from the water coming from the upper area. to improve the roads in the area.
7	Florida	1	The same as above.
8	Augusto Cesar Sandino, Rubén Darío, Pedro Joaquín Chamorro	2	The same as above.
9	Resistencia	2	The same as above.
10	José Benito Centeno	3	The same as above.

Almost all the inundation prone area in Chinandega are underdeveloped areas classified as 2.2. In view of short term, to improve roads is a considerably effective countermeasure to mitigate damage by inundation.

However, in order to make these improving actions more effectively, first of all the following steps should be taken:

- to work out guidelines to control water storm,

  Guidelines should include following items:

  - responsibility sphere of each organization (See Section L.3.5.4 Institutional Requirement),
  - a technical guideline (ex. Capacity of the river should be calculated on the basis of once 10 year probable rainfall.),

- and adjustment of laws and regulation regarding storm water management.

- to conduct basic investigation on the inundation prone areas according to the guideline (conduct topographical survey, design rivers and watercourses, etc.),
- to raise necessary funds for making the plan and executing it.

b. Recommendation for Middle and Long Term Improvement

A flood defense plan is needed for middle and long term improvement. A planning process of the plan is shown in the following section L.3.5.3. In this section, items which should be taken into account when a flood defense plan is made are described.

1) The study area in Chinandega inclines towards the southwest basically, so that many inundation prone areas are located in the western or southern part of the city. This indicates that the water coming from the city center cause inundation. Therefore, the construction of drains to block the water going into the inundation areas is needed.

2) It is clear that the land use of upriver area much affects the feature of flow of the Acome river. Therefore, it is important to take the land use into account.

L.3.5.3 Planning Process for the Improvement

Figure L-56 shows a general flow of planning process of a flood defense plan.

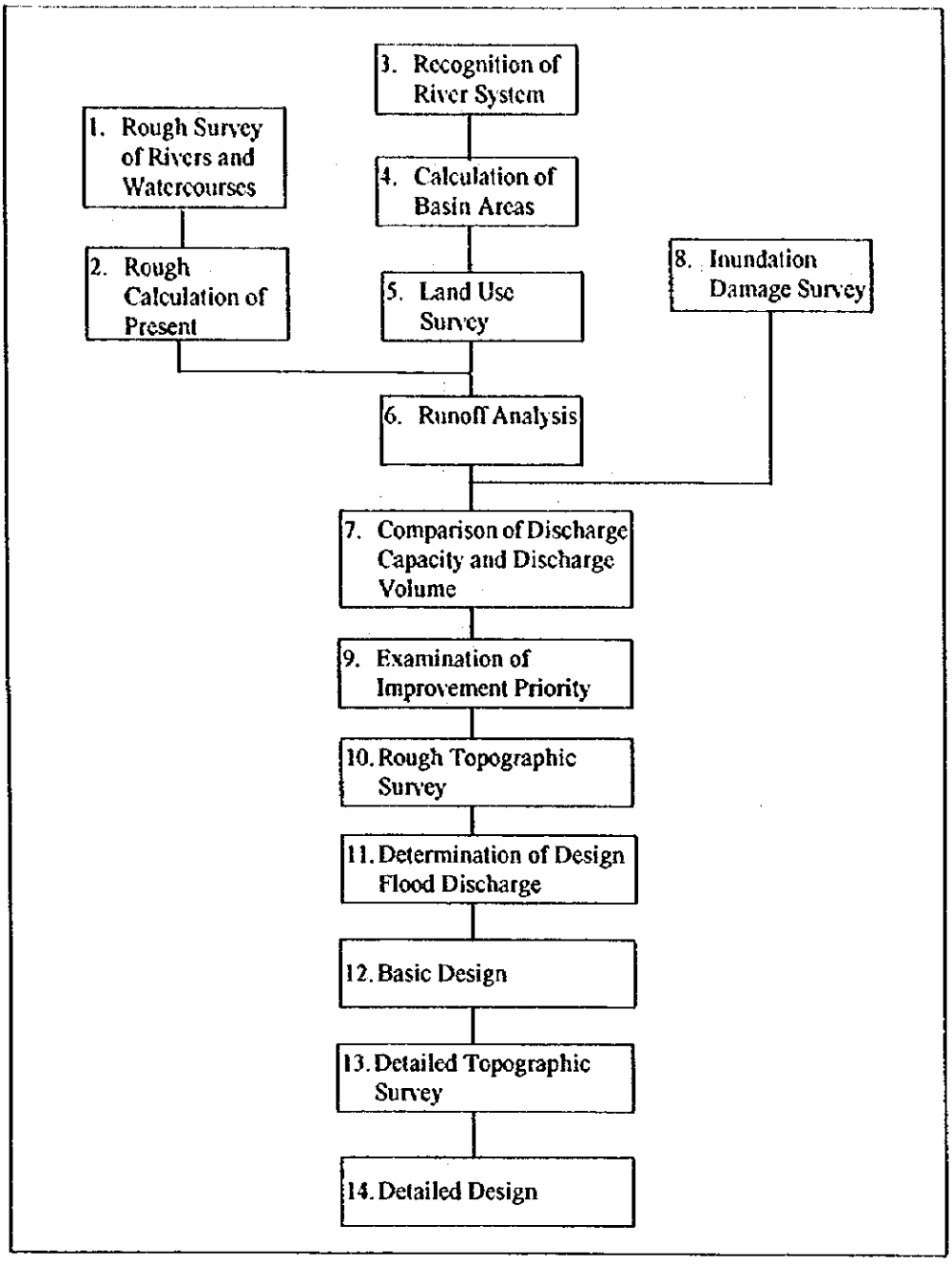

Figure L-56: Flow of Planning Process of Flood Defense Plan

1. Rough Survey of Rivers and Watercourses

To survey about three cross sections (a upstream point, a middle point, a downstream point) of rivers and watercourses.

2. Rough Calculation of Present Discharge Capacity

On the basis of the above survey result, present discharge capacity of rivers and watercourses are calculated by Manning's formula.

Manning's formula

$$V=1/n \times R^{2/3} \times I^{1/2}$$

V: flow velocity (m/s)
n: roughness coefficient
R: hydraulic radius (m)
I: gradient

$$Q=A \times V$$

Q: discharge capacity (m^3/s)
A: sectional area (m^2)

3. Recognition of River System

To recognize a relation ship of rivers (main rivers, tributaries).

4. Calculation of Basin Areas

According to the river system, to calculate the drainage areas which are divided by each tributary.

5. Land Use Survey

This survey is conducted in order to determine runoff coefficient, and the result of the survey is useful upon planning a river alignment.

6. Runoff Analysis

Although there are some runoff analysis methods, the rational formula method is recommendable for the rivers in the study area. Because the drainage areas of the rivers in the study area are comparatively small. In general, it can be said that the rational formula method is appropriate for a less than $200km^2$ drainage area and shorter than 2 hours time of concentration.

$$Q=1/3.6 \times f \times r \times A$$

Q: design flood discharge (m3/sec)
f: runoff coefficient
r: average rainfall intensity (mm/hr) with in the time of flood concentration
A: drainage area (km^2)

7. Comparison of Discharge Capacity and Discharge Volume

To recognize parts of rivers which are needed to be improved by comparing the result of 2 and 7.

8. Inundation Damage Survey

To investigate actual inundation damages which have occurred, in order to mainly give priority order of improvement.

9. Examination of Improvement Priority

Upon considering the above items synthetically, priority order of improvement is examined.

10. Rough Topographic Survey]

According to the priority order, to conduct a rough topographic survey on a river for a basic design. The survey may consist of horizontal plan and vertical alignment.

11. Determination of Design Flood Discharge

To decide a design flood discharge of a river.

12. Basic Design

On the basis of the design flood discharge decided in 11, a basic design is made, which consists of horizontal, vertical and cross section plan, and rough design of structures.

13. Detailed Topographic Survey

To conduct a detailed topographic survey in order to conduct a detailed design.

14. Detailed Design

The detailed design is made for construction, which consists of horizontal, vertical and cross section design, and other necessary designs for construction.

L.3.5.4 Institutional Requirements

The pluvial drainage is the municipal competence. Meanwhile it is not well defined who would be the responsible for the maintenance and protection of: permanent rivers and seasonal or temporal rivers inside and outside of municipal extension. Law No. 217-96 establishes the competence of MARENA taking water as "a natural resource". Whereas, MINSA should control its quality. Other entities are involved in the use and protection of water (e.g., the Agriculture Ministry and the National Commission of Water Resources).

It is recommended to carry out an ample and detailed evaluation study on the basin and the ditches that cross the municipality, especially in the urban area. The study should be in such a way as to identify:

- simply what is an urban drainage way (i.e., municipal competence); and
- what exceeds the above aspect and could cause effects to: groundwater and surface water (natural resources), to the public health, to the safety of persons and physical assets (floods, erosions, etc.).

Based on this study, it is recommended to classify ditches and other drainage ways in two systems:

- **micro-drainage** (municipal responsibility); and
- **macro-drainage** (responsibility shared by the Municipality and the Central Government (MCT as operating agent)).

Because of its natural competence MARENA should lead this intersectorial study and should promote solution of:

- a local nature, through an agreement or treaty with the municipality; or
- a wider nature, by means of the Law.

The Annex N presents the recommendations on regulations and intersectorial actions in this regard.

L.3.6 Municipal Solid Waste Management

L.3.6.1 Future Waste Amount and Composition

a. Waste Amount

As explained in section L.1.6.2 Future Waste Amount and Composition in Granada, the Study Team uses the same forecast model, percentage of average GDP, factors in waste amount increase including methodology for the forecast-model to forecast future waste amount of Chinandega. The difference factor between both cities which the Study Team considering is the percentage of garden wastes (such as grass, wood) and cleaning waste (soils, etc.) in Chinandega which share about 43% of MSW. The Study Team concluded, therefore, the increase in waste generation per capita per year in the planning period in Chinandega is :

Chinandega = 1.5% (2.7 % x 0.57 = 1.431 say 1.5%)

a.1 Forecast on Waste Amount

Table L-175 shows a temporary forecast on waste generation ratio in Chinandega which estimated based on the generation ratio in 1996.

Table L-175: Forecast on Waste Generation Ratio for Chinandega

Unit : g/unit/day

Year	Chinandega			
	1996	2000	2005	2010
1. MSW				
1.1 Household	675	716	772	831
1.2 Restaurant	15,109	16,036	17,275	18,611
1.3 Other Shop	1,676	1,779	1,916	2,064
1.4 Institution	98	104	112	121
1.5 Market	2,827	3,000	3,232	3,482
1.6 Street Swept	36,677	36,677	36,677	36,677
2. Other Waste (ton/day)	1.4	1.5	1.6	1.7

In addition, a temporary forecast on the increase of the number of generation source in the Study Area is also estimated based on that in 1996 and tabulated in Table L-176.

Table L-176: Forecast on the Number of Generation Sources in Chinandega

Year	Chinandega			
	1996	2000	2005	2010
1. MSW				
1.1 Household Waste	100,748	115,393	133,753	153,444
1.2 Restaurant	41	47	54	62
1.3 Other Shop Waste	465	533	617	708
1.4 Institutional Waste	1,577	1,806	2,094	2,402
1.5 Market Waste	1,732	1,984	2,299	2,638
1.6 Street Sweeping (km)	45	45	52	60

The Study Team forecasts waste amount generation in Leon and tabulated in Table L-177.

Table L-177: Forecast on Waste Amount Generation in Chinandega

Unit : ton/day

Year	Chinandega			
	1996	2000	2005	2010
1. MSW				
1.1 Household Waste	68.0	81.7	102.1	125.8
1.2 Restaurant	0.6	0.8	0.9	1.2
1.3 Other Shop Waste	0.8	0.9	1.2	1.5
1.4 Institutional Waste	0.2	0.2	0.2	0.3
1.5 Market Waste	4.9	6.0	7.4	9.2
1.6 Street Sweeping	1.7	1.7	1.9	2.2
1.7 Bulky Waste*	0.0	0.0	1.2	1.7
Sub-total	76.2	92.2	114.9	141.9
2. Other Waste	1.4	1.5	1.6	1.7
Total	77.6	93.7	116.3	143.1

Note: * assumed 2% of the household waste.

b. Waste Composition

b.1 Forecast on Waste Composition

As same as forecast on future waste composition in Granada and Leon, the Study Team set the frame of the waste composition for Chinandega in 2010 as follows:

- The ratio of combustible contents will decrease gradually. On the other hand, the ratio of incombustible contents will increase.
- The ratio of kitchen waste will decrease from 85% at present to 83% in year 2010 while the ratio of paper and plastic will increase from 2% and 3% to 5% and 6% respectively in year 2010.
- The ratio of grass and wood will decrease greatly from 37% at the time being to 33% in year 2010. Meanwhile, metal and glass ratios will increase from 1% to 3% in year 2010.

- For textile and others, the percent of these contents are rather stabilized.

Table L-178 shows the forecast on waste composition of MSW in the Study Area.

Table L-178: Forecast on Composition of MSW in Chinandega

Unit : %

Composition	1996	2000	2005	2010
1. Combustible Contents	**85.21**	**85**	**84**	**83**
Kitchen Waste	39.34	38	37	36
Paper	2.77	3	4	5
Textile	1.45	2	2	2
Plastic	3.15	4	5	6
Grass and Wood	37.88	37	35	33
Leather and Rubber	0.62	1	1	1
2. Incombustible Contents	**14.79**	**15**	**16**	**17**
Metal	1.42	2	2	3
Glass	0.95	2	3	3
Ceramic and Stone	6.59	5	5	5
Others (soils, etc.)	5.83	6	6	6
Total	**100.00**	**100**	**100**	**100**

c. Waste Stream

The future waste stream is forecasted on the basis of the same conditions as one of Granada. The amount of each component in future waste stream as shown in Table L-179 and illustrated in Figure L-57 and Figure L-58.

Table L-179: Future Waste Stream of Chinandega in Year 2005 and 2010

Unit : ton/day

Items	1996	2000	2005	2010
Waste Generation	76.2	92.2	114.7	141.4
Recycling at Generation Source	8.5	10.3	12.8	15.8
Waste Discharge	48.4	60.4	78.0	99.7
Self-Disposal at Generation	19.3	21.5	23.9	25.9
Collection	39.5	49.3	70.2	99.7
Illegal Dumping	8.9	11.1	7.8	0.0
Recycling at Disposal Site	0.4	0.5	0.0	0.0
Other Wastes	1.4	1.5	1.6	1.7
Final Disposal	40.5	50.3	71.8	101.4

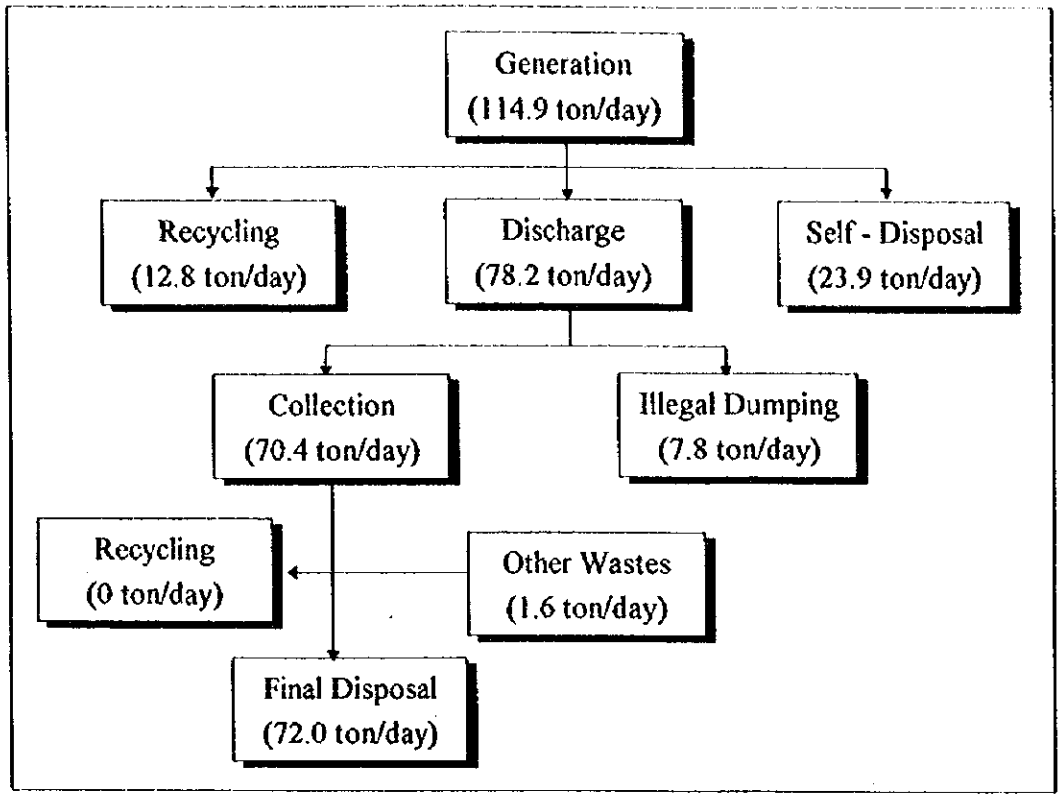

Figure L-57: Future Waste Stream of Chinandega in 2005

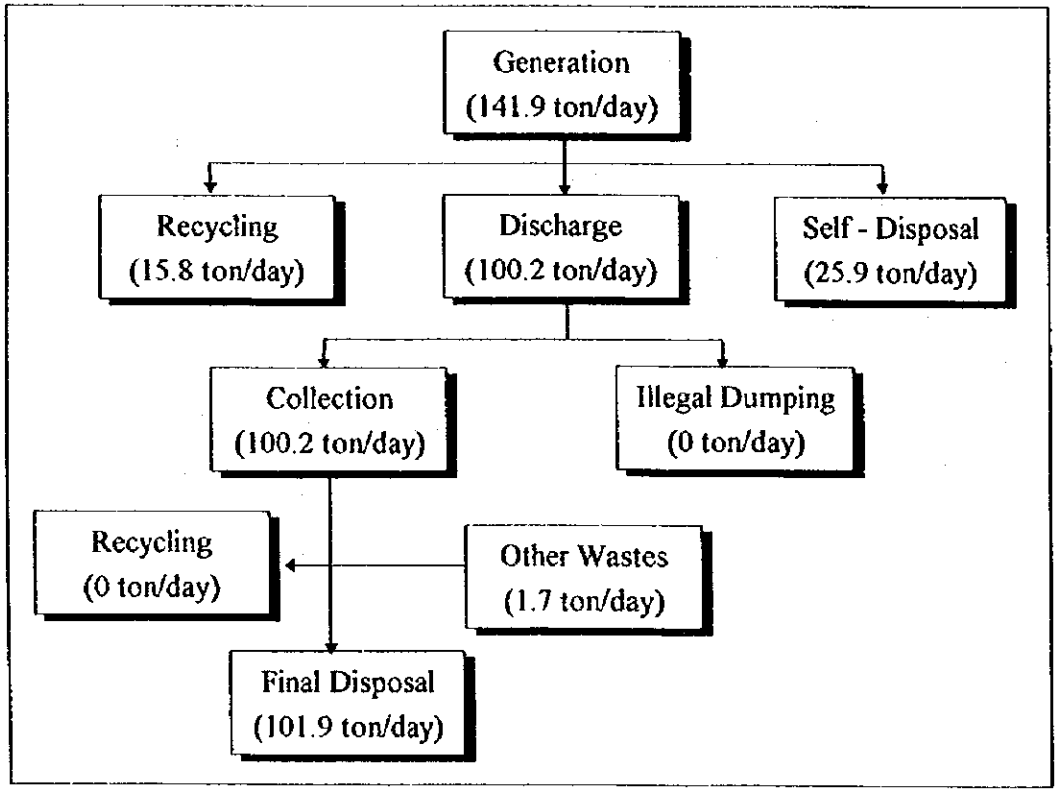

Figure L-58: Future Waste Stream of Chinandega in 2010

L.3.6.2 Selection of and Optimum Technical System

The procedures for examining SWM's technical systems for Chinandega are almost all the same as one for Granada. Therefore, only specific matters on Chinandega are discussed in this section.

L.3.6.2.1 Policy for Selection of an Optimum Technical System

a. Criteria for Selection

Taking the current situation and background of SWM in Chinandega city into account, the policies for the selection of a technical system are as follows:

1) Systems and technologies to be adopted should be as simple as possible so that operation and maintenance would be easy and inexpensive.
2) The foreign currency requirements for the purchase, operation and maintenance of systems should be minimized. The use of locally available materials and services should be maximized.
3) The use of labor intensive rather than capital intensive techniques should be used where technically feasible and economically viable.
4) Technical system proposals have to be consistent with the institutional requirements should be maxim to ensure their efficiency.

b. Selection Procedure of an Optimum Technical System

An SWM technical system consists of various technical subsystems such as discharge and storage system, collection and transportation system, street sweeping system, intermediate treatment system, final disposal system, etc. A number of alternatives can be formed from the combination of these various subsystems. Hence, selection of the optimum technical system will be carried out according to the following procedure:

1. Preconditions for selection of subsystems
2. Identification of potential subsystem technologies for Chinandega city
3. Screening potential subsystem technologies
4. Candidate technical systems

L.3.6.2.2 Preconditions for Selection of Subsystems

a. Location of Landfill and Workshop

The municipality has a plan to close the existing landfill and has five candidate sites for landfill in each direction the city, i.e. one in the east, one in the west, one in the north and two in the south which are shown to the study team.

The workshop for the waste collection vehicles is 'Municipal Workshop' which is located in the northwestern part of the city.

b. Road Conditions

The road conditions of Chinandega are similar to ones of Granada and Leon, i.e. in the areas located in the periphery of the city and along rivers the road conditions are very bad.

L.3.6.2.3 Identification of Potential Subsystem for Chinandega

The screened potential subsystems for Chinandega are listed in the following table.

Table L-180: Potential Subsystems of SWM for Chinandega

Technical Systems	Technical Sub-systems	Sub-system Components
Discharge and Storage	• Source Separation	• Mixed discharge • Separate discharge
	• Type of Storage Equipment	• Nylon sacks • Plastic bags • Dustbins • On-site storage • Large containers
Primary Collection	• Type of Collection System	• Handcart • Animal cart
Secondary Collection and Transportation	• Collection Frequency • Collection Method	• Mixed collection • Separate collection
	• Type of Collection Service	• Curb collection • Door-to-door collection • Bell collection • Point collection • Public container collection
	• Collection Schedule	• Day collection • Night collection
	• Type of Collection Vehicle	• Compactor truck • Tractor and trailer • Tipper truck • Skip truck
	• Transportation System • Transfer Station	• Motor vehicle
Street Sweeping	• Cleaning Method	• Manual street sweeping • Mechanical cleaning
Intermediate treatment	• Composting	• Centralized composting plant • On-site/community based composting
Recycling	• Government Related • Private Sector Centered	
Final Disposal	Method of Sanitary Landfill	
Maintenance of Vehicles and Equipment	• Preventive Service Workshop • Full Service Workshop	

4.6.2.4 Screening of Potential Subsystems

a. Discharge and Storage System

With the same reason as Granada, the recommendable receptacles are as follows:

- plastic bags and nylon sacks for household waste,
- plastic bags and dustbins for commercial waste,
- plastic bag, dustbins and containers for institutional waste,
- on-site storage and containers for market waste.

b. Primary Collection

Similarly to Granada, the usage of handcarts and animal drawn carts is considered inappropriate in a long term improvement. But in a short term, it should be taken into account.

c. Collection and Transportation

c.1 Collection Frequency

A twice or thrice a week collection is recommendable. A daily collection is inappropriate due to its high costs.

c.2 Mixed or Separation Collection

A mixed collection should be implemented because no intermediate treatment technologies are employed. However, the separation of recyclable and non-recyclable waste at generation sources are encouraged.

c.3 Collection System

A curb collection is recommendable for the central part of the city, and a point collection for the periphery area (bad road conditions' areas).

c.4 Collection Schedule

A daytime collection is recommendable for the most areas, and an early morning or a nighttime collection should be examined in the city center.

c.5 Collection Vehicle

Compactor trucks are recommendable for the city center, i.e., the well paved area, and tipper trucks for the periphery area. For market waste, the introduction of container trucks or tipper trucks are candidates.

At present, 6 containers are placed at markets and on the streets, and there is one container truck for them. Accordingly, to expand the system or stop it in the future should be well examined on the basis of the experience.

However, various kinds of trucks should not be introduced, because it cause high maintenance cost and difficult operation. The type of vehicle should be determined in view of a integrated system.

d. Street Sweeping

Manual sweeping is recommendable for street sweeping.

e. Intermediate Treatment

No intermediate treatment technology is recommended. However, On-site/community composting is currently operated at the sewage treatment plant by the cooperation with Holland. This plant is a test stage with the cooperation from the nearby community which provides source segregation (organic waste and non-organic waste) work. This work should be encouraged. Meanwhile, on-site composting for private use should be promoted in view of waste reduction.

f. Recycling

The following table shows the surveyed waste composition of Chinandega, the standard waste composition of industrialized countries and the United States. This comparison clearly shows that the present composition of recyclable waste in Chinandega is far less than that of industrialized countries: 9 % in Chinandega, 27-80 % in industrialized countries, and 67.5 % for the United States.

Table L-181: Comparison of Waste Composition

	Chinandega in 1996	Industrialized Countries	United States in 1990[b]
Kitchen	39.86 %	20-50 %	9.0 %
Paper	1.91 %	15-50 %	40.0 %
Textile	1.43 %	2-10 %	2.0 %
Plastic	2.82 %	2-10 %	7.0 %
Grass/Wood	38.21 %	-	20.5 %
Leather/Rubber	0.64 %	-	1.0 %
Metal	1.43 %	3-13 %	9.5 %
Glass	0.96 %	4-12 %	8.0 %
Ceramic/Stone	6.77 %	1-20 % (including others)	3.0 % (including others)
Others	5.97 %	-	-
Total	100.00 %	100.0 %	100.0 %

Note: Screened items are recyclable wastes.

As shown in the above table, there are little recyclable fraction in the waste generated in Chinandega. So that, to introduce a government related recycling system is unfeasible.

However, recycling should be encouraged in view of waste reduction and resource conservation.

g. Final Disposal

To mitigate having an adverse effect on environment, at least level 2 sanitary landfill should be introduced.

h. Maintenance of Vehicles and Equipment

To strengthen the ability of the workshop, 'Municipal Workshop', more machinery especially for preventive work should be equipped.

This workshop is not only for the waste collection vehicles, but also for vehicles belonging to the municipality, e.g., construction machinery and trucks. Consequently, this work should expand its ability to respond not only the demand of the SWM field, but also other fields dealt with in there.

L.3.6.2.4 Candidate Technical Systems

According to the procedure (1.Preconditions for selection of subsystems, 2.Identification of potential subsystem technologies, 3.Screening potential subsystem technologies) taken above, candidate technical systems are shown in the following table.

Table L-182: Candidate SWM's Technical Systems

System	Proposal
Discharge and Storage	Source separation: Separates recyclable and non recyclable wastes Type of storage: household waste Nylon sack, Plastic bag, Container commercial waste Plastic bag, Dustbin, Container institutional waste Plastic bag, Dustbin, Container market waste On-site storage, Container
Primary Collection	No primary collection
Collection and Transportation system	Collection frequency: More than twice a week Collection method: Mixed collection for non-recyclable wastes Type of collection: Curb collection, Point collection, Public container collection Collection time: Day collection for most areas, and night and early morning collection for the city center Type of collection vehicle: City center Compactor truck, Container truck Other area Tipper truck, Container truck Market Container truck, Tipper truck Transportation system: Direct transport by motor vehicle
Street sweeping	Manual sweeping method
Intermediate treatment	The existing on-site/community based composting is promoted. On-site composting for private use is encouraged.
Recycling	Recycling activities are encouraged through institutional and educational programs.
Final Disposal	Sanitary landfill Level 2 or more.
Maintenance of Vehicle and Equipment	for Preventive work mainly.

L.3.6.3 Institutional Requirements

Urban cleaning is essentially a municipal duty, given that it is the result of the citizens' livelihood and the Law No. 40-88 defines those services as municipal obligation. It lacks a **Regulation of Urban Cleaning**, which would establish the rights and duties of the citizen and the municipality regarding the urban cleaning, including the municipal competence to penalize transgressors. Today, MINSA has the prerogative (Decree No. 432-89) regarding sanitary aspects.

The Regulation is an executive document. Only when at the same time better municipal services are introduced and the community is motivated to comply with the burden, the use of the regulation becomes viable, and as a result, there will be an improvement in the environment and citizens will increase their trust for the municipality. At that moment, the citizens accept to pay for the services, and a tax plan to pay for the services could be

introduced. Urban cleaning will not be derived from separated actions and investments, but from the integration of them. Therefore, in order to organize this integrity, trained persons and an adequate organization are needed. Meanwhile in order to introduce and develop the trained persons and adequate organization, a control system based on a prior planning is indispensable.

In short, the **institutional training** by the municipality will comprise at least:

- An Operational Plan with resources and costs dimensioned or estimated;
- An Urban Cleaning Regulation coherent with the Operational Plan;
- A Tax Plan coherent with the costs and economic capacity of the citizens. It should be considered that **everybody** should receive services and **pay** for the services according to the "viable quality" of the services and the economic capability of the citizens. The Tax Plan should consider averages for the social-economic segments;
- The organizational improvement and human resource training for the departments of Waste Collection, Public Cleaning, and Vehicles and Equipment will provide indispensable support to achieve the regularity of the services; and
- Community involvement should be implemented in proportion to the "improved and regular" services in order to attain the burden sharing by citizens. Meanwhile, the areas subject to the community participatory projects should be gradually expanded, but the contents of the participation should be full and complete in respective community.

Before it is decided whether to **"privatize"** those services partially or totally, it is considered that the waste collection services, street cleaning and landfill disposal should be being operated by the municipality until when the operation department and its staff are trained to be able to plan and control the operation results and costs.

Annex N presents shows recommendations on "Instructions and/or Regulations (as well as Tables with Strategies and Intersectorial Integration)".

The Main Report for F/S of Volume III includes (item 4.3.2) the proposed Regulation on SWM for Granada, that might be the same for the other municipalities.

L.3.7 Industrial Solid Waste Management

L.3.7.1 Major Findings of the Industrial Waste Survey

Industrial solid waste (ISW) generated amount in Chinandega is estimated about 6,400 ton/year, which is in the middle level of ISW generation among the 3 cities (Leon the largest and Granada the smallest). The industries in CIIU3116 (processing dry seeds from leguminous and the likes) is the main source of ISW generation in Chinandega, which counts for about 80% of ISW generation in Chinandega. The ISW of these industries (i.e., CIIU3116) mainly consists of organic compounds, and therefore it is less possible that hazardous ISW be included therein. Meanwhile the industries with high potentiality of generating hazardous waste in Chinandega is CIIU3512 (fertilizers, insecticides and the like), whose ISW counts for about 2% of the total ISW generation in Chinandega.

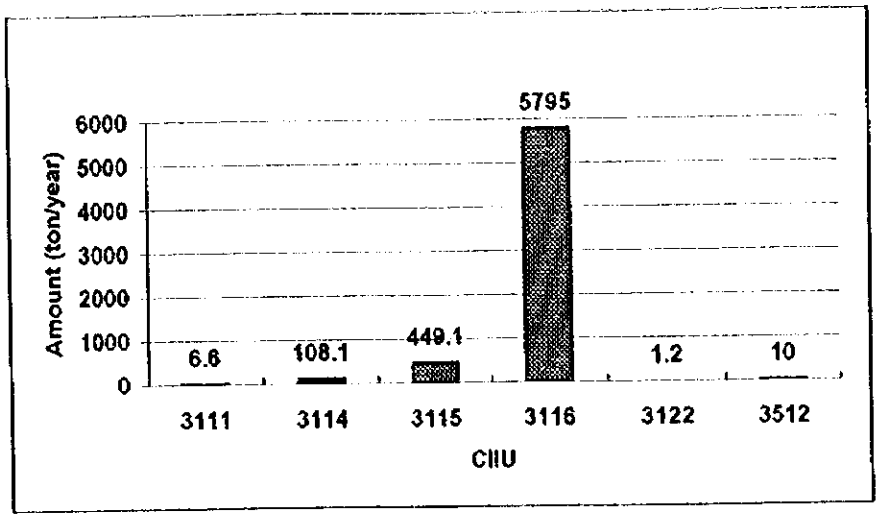

Figure L-59: Solid Waste Generation Amount

The great majority of the ISW generated from industries in Chinandega are disposed of at the municipal SW dumping site without control and in a disordered manner.

However, under such circumstances, legislation for treatment and/or disposal of ISW is not established at this moment, which is urgently needed and awaited.

L.3.7.2 General Recommendations for the Industrial Solid Waste Management

L.3.7.2.1 General Recommendations

a. Technical System

a.1 General Aspect

In the same principle for the IWWM, cost of safe treatment/disposal of ISW should be born by the industries by all means based on the "polluter pays principle (PPP)", since the ISW is generated and disposed of as a result of industrial production activities.

On the other hand, from a technological management viewpoint, the following will be listed as the key solutions for the problems:

- Reduction of ISW generation amount and reduction of its generated pollution load by means of production processes (including raw/auxiliary materials) conversions; and
- Establishment of appropriate treatment/disposal technologies.

In practice among others, the disorderly mixed dumping of ISW and domestic SW in the present landfill should be immediately prohibited.

In this context, legislation on appropriate management of ISW should be established in order for authorities to take administrative measures (e.g., manifest system) and be empowered in doing so. On the other hand, an integrated system to bind both industries and authorities in facilitating the appropriate ISW management should be sought and established.

a.2 Industrial Waste Management System

The treatment/disposal of ISW generated by the company's activities should be undertaken and its cost covered by the company which profits from its activities. On the other hand, the authorities should arrange necessary administrative measures including legislation/rules in order for ISW to be properly treated, and carry out necessary monitoring/supervision as well as instruct the companies to make sure that they observe these legislation and rules. The following items are recommended to be put into practice urgently for the effective monitoring and guidance.

- Introduction of a manifest system
- Classification of industrial solid waste
- Hazardous solid waste management
- Treatment and disposal system of industrial solid waste.

a.2.1 Manifest System

A manifest system needs to be introduced so that the authorities know where the ISW are generated and the routes which the ISW are transported from the generation sources and where and how it is finally disposed of according to the type of IW.

By introducing the following manifest system (see Figure L-30), the process of solid waste from its generation to final disposal can be understood by waste generators and competent authorities. Moreover, whether or not the ISW is properly treated/disposed of in accordance with its characteristics can be monitored.

- The generator of ISW issues the manifest sheet comprising 6 carbon copies((A) to (F)) which indicates type of solid waste, its volume, and the date of discharge, etc.
- The generator keeps one copy (A) of the manifest sheet and submit one copy (B) to the competent authorities.
- Four copies from (C) to (F) should be handed to the ISW transporter together with the ISW and the transporter should keep one (C) of these copies.
- Copies from (D) to (F) should be handed to the agent of the ISW final disposal site together with the ISW.
- The agent of the ISW final disposal site should keep one (D) of these copies and return (E) of the manifest sheet to the waste generator and (F) to the competent authorities.
- Competent authorities and the waste generator shall collate the manifest sheet they received from the agent of the ISW final disposal site with the manifest sheet they have been keeping and confirm whether the ISW was treated/disposed of properly or not.

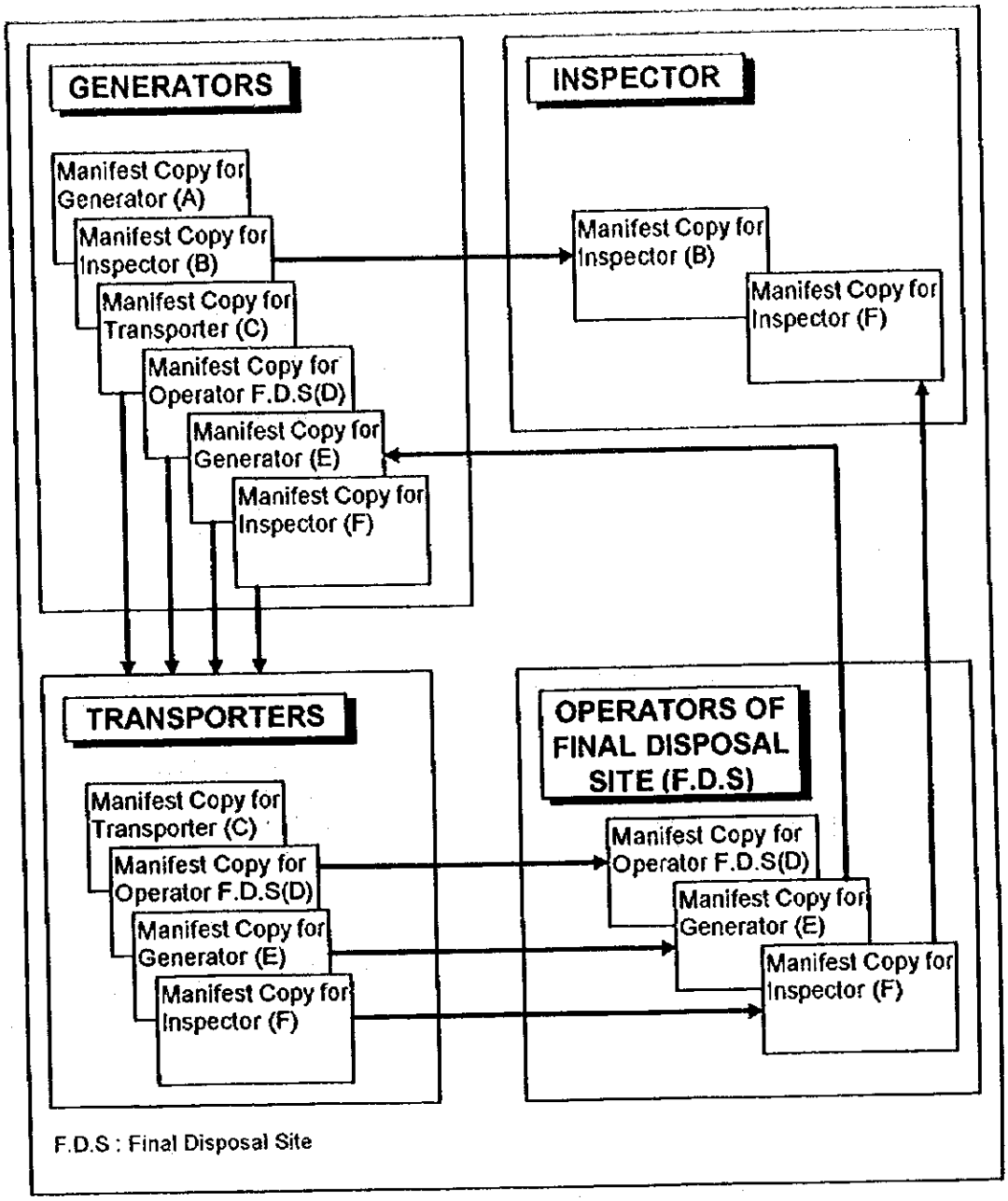

Figure L-60: Concept of Manifest System

a.2.2 Definition of the Waste

ISW types are diverse and its characteristics, such as its hazardousness, also differ. In order to manage various ISWs, it is indispensable to define the types and characteristics of the solid wastes and manage them based on the definition.

The definition of ISW is basically classified into either hazardous or non-hazardous waste which is then divided into liquid, solid, and semisolid.

The following are the definitions determining the kind of solid wastes that are hazardous.

- Definition given in the Basel Convention

- Definition given by the European Union (EU)
- Definition given in the domestic laws in developed countries such as RCRA (Resource Conservation and Recovery Act) of the U.S.

However, expensive analysis facilities and high analytical skills are indispensable in order to identify and manage hazardous and non-hazardous solid wastes based on the definition used in these developed countries. In view of the present conditions in Nicaragua from the technological and economic perspectives, it is judged that it is unrealistic to manage ISW using these definitions because it lacks prevalence in adequate analyses facilities and skills.

Therefore, the following method is recommended to classify and manage ISW until technological base is established and administrative measures are economically arranged.

- Roughly judge whether solid waste is hazardous or non-hazardous from the outward appearance (liquid, solid, or semisolid) and its generation process (type of business of waste generators)

To put it more concretely,

- Make a list of industrial classification according to high, middle, and low potential of generating hazardous waste referring to cases from developed countries.
- Make a list of ISW classification according to either high or low potential of being hazardous wastes from the outward appearance referring to cases from developed countries.

The possibility of wastes being hazardous or non-hazardous is judged from the ISW classification and industrial classification of waste generators referring these lists. Secondly, ISW, which is judged as a highly potential hazardous waste, is treated and managed as hazardous wastes unless the waste generator (polluter) proves that the wastes they generated to be non-hazardous at their own cost of laboratory analysis.

a.2.3 List of Potential Hazardous Waste

The study team classified ISW into 24 categories and carried out a survey on the amount of waste generation etc. for the factory survey referring to the present condition in Nicaragua and some cases of other countries.

The characteristics of hazardous solid waste are defined as follows here.

- Ignitable
- Corrosive
- Reactive
- Toxic (Acute, Non-acute)

Table L-183 shows the assumption made on the respective characteristic of hazardousness for each of 24 ISW categories referring to the past cases, which was employed in the Team's factory survey.

It is necessary to note that this hazardousness assumption (i.e., Table L-183) was made referring to past cases. This judgment chart shall be used for the ISW management for the time being and if some inconvenience emerges, the respective hazardousness assumption should be re-examined in order to meet the actual condition in Nicaragua.

Table L-183: Relations of 24 Industrial Waste Classification and Hazardous Waste

No.	Type of Waste	Liquid or Not	Hazardous Waste					Non-hazardous Waste	
			Ignitable	Corrosive	Reactive	Toxic		Non-inert	Inert
						Acute	Non-acute		
1	Ash, combustion residue	No	No	Possible	Possible	Possible	Possible	Possible	Possible
2	Dust	No	Possible	Possible	Possible	Possible	Possible	Possible	Possible
3	Slag from melting	No	No	Possible	Possible	Possible	Possible	Possible	Possible
4	Sludge	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible
5	Asbestos	No	No	No	No	No	Possible	No	No *2
6	Acid	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible
7	Alkalis	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible
8	Oily waste	Possible	Possible	No	Possible	Possible	Possible	Possible	No
9	Chemical residue	Possible	Possible	Possible	Possible	Possible	Possible	Possible	No
10	Waste from food production	Possible	No	No	No	No	No	Possible	No
11	Waste similar to domestic waste	No	No	No	No	No	No	Possible	No
12	Animal manure	No	No	No	No	No	No	Possible	No
13	Carcasses	No	No	No	No	No	No	Possible	No
14	Glass and ceramics	No	No	No	No	No	No	Possible *1	Possible
15	Metal and scrap	No	No	No	No	No	No	Possible *1	Possible
16	Paper and cardboard	No	No	No	No	No	No	Possible *1	No
17	Plastic	No	No	No	No	No	No	Possible	Possible
18	Rubber	No	No	No	No	No	No	Possible	Possible
19	Textile	No	No	No	No	No	No	Possible	Possible
20	Leather	No	No	No	No	No	No	Possible	Possible
21	Wood	No	No	No	No	No	No	Possible	No
22	Construction and demolition waste	No	No	No	No	No	No	Possible	Possible
23	Water	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible
24	Others	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible

*1: Considering a possibility used as containers contaminated with non-inert

*2: Asbestos without treatment is considered as hazardous waste

a.2.4 Industrial Category of Potentially Hazardous Waste Generators

Table L-184 shows industrial category (using the CIIU code) of potentially hazardous waste generators, based on past cases.

This table also needs to be reexamined in the future, in order to meet the actual condition in Nicaragua.

Table L-184: Potentiality of Hazardous Waste Generation Industrial Category

Potentiality	CIIU Code	Industrial Category
Highly potential Industries	351	Manufacture of industrial chemical products
	352	Manufacture of other chemical products
	354	Oil and coal products
	356	Other non-classified plastic products
	371	Iron and steel industries
	372	Basic metal industries
	381	Manufacture of metal products except machinery & equipment
Potential Industries	3211	Textile processing and materials manufacturing
	3231	Leather tanning and finishing
	3232	Fur dressing, dyeing and other fur and skin articles
	3319	Other non-classified wooden products
	341	Paper, printing and publishing industries
	3420	Printing, photoengraving, publishing and the likes
	355	Manufacture of rubber products
	362	Glass and glass products
	3699	Other non-metallic mineral products
	382	Manufacture of machinery except electrical
	383	Manufacture of electrical machinery
	384	Manufacture of transport equipment
	385	Manufacture of science, measuring, controlling equipment (inc. lens)
	390	Other manufacturing industries
	625	Gasoline filling stand
	952	Laundries and dry cleaners
Less Potential Industries	311	Food manufacturing
	312	Other food manufacturing
	313	Beverage industries
	314	Cigarettes, cigars and tobacco
	3212-3219	Textile industries
	322	Garment industries
	3233	Leather products (exe. footwear)
	324	Leather footwear
	3311-3315	Wood and cork industry
	332	Furniture, fixture and the likes
	361	Potters and ceramic products
	3691-3696	Manufacture of non-metallic mineral products

Regarding the authorities' management of ISW, hazardous wastes generating industries should be mainly monitored and supervised, referring to Table L-68 for the time being, and at the same time, whether or not the proper treatment and disposal is done for respective ISW category should be monitored by utilizing Table L-67.

a.3 Industrial Waste Reduction

Most of the ISW are the scraps and residues of raw materials incorporated in the manufacturing process and if it is treated or disposed of at the "end-of-pipe", the cost of treatment/disposal becomes very large.

Therefore, as the first step of ISW management by industries, it is rational to use up raw materials as much as possible in the manufacturing process than treating or disposing of ISW at the "end-of-pipe". In other words, Cleaner Production Technology (CP Technology) should be introduced, which keeps the generation amount of waste to a minimum through: improvement and/or conversion of the manufacturing process; raw materials conversion to what improves material efficiency in products.

The introduction of CP Technology brings about the following beneficial impacts to the industries.

- Increase profits by improving material efficiency in products.
- Reduce ISW treatment/disposal cost by reducing the ISW amount generated.

It can be concluded that the introduction of CP Technology is not only a great advantage but also reduces environmental impact by ISW.

Therefore, the reduction of ISW amount by rationalization of manufacturing process should be carried out before the "end-of-pipe" treatment is implemented.

Figure L-31 illustrates the example of the reduction of COD discharge amount when CP Technology was applied to pulp and paper industry in Japan.

Moreover, as significant amount of ISW consists of left-over of raw materials from manufacturing products, it is necessary to set up a mechanism which facilitates the exchange of information on solid waste among companies so that the wastes generated from company A can be used as a raw materials by company B if this mechanism functions.

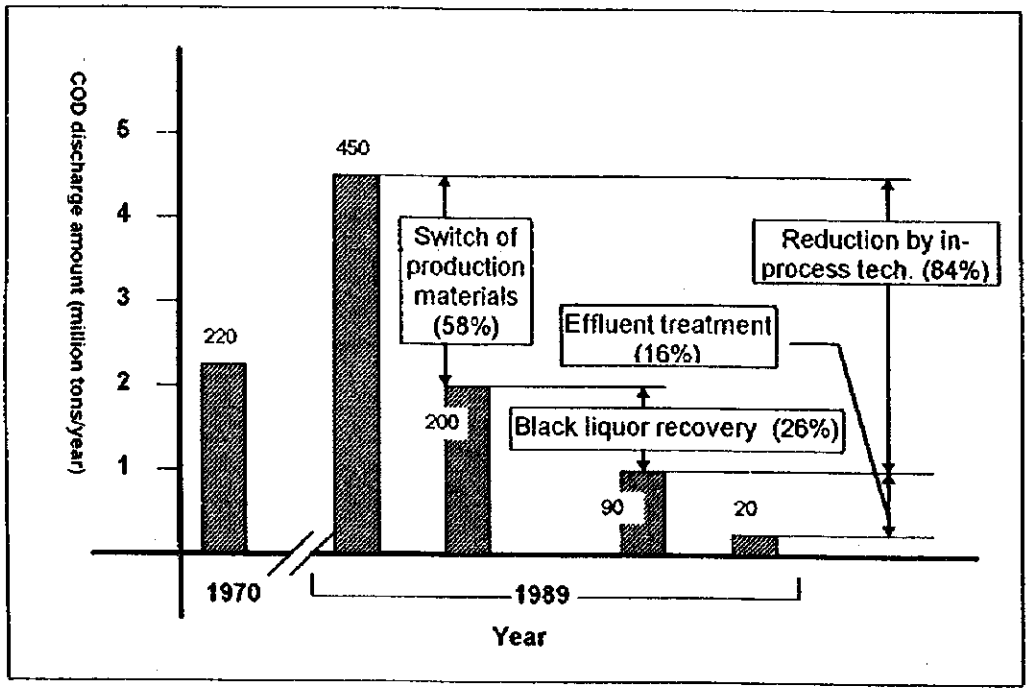

Figure L-61: Reduction of COD Discharge from Pulp and Paper Industry in Japan [10]

[10] Source : J. Nakanishi, "Technological Measures to Eliminate Pollution in the Last Tow decade in Japan"

a.4 Industrial Waste Treatment/Disposal by Third Party

The demand for the treatment/disposal of ISW is predicted to increase in the future. This is attributed to the increase of ISW generation amount in correlation to the economic growth in Nicaragua, and strengthening legislation which restricts discharge of ISW, and international trend of environmental protection such as ISO14000.

Therefore, the authorities needs to encourage creation of safe and reliable ISW treatment/disposal sectors in Nicaragua based on the market principle, in parallel with the economic growth and strengthening of legislation on ISW.

a.5 Outline of Industrial Waste Treatment / Disposal Method

a.5.1 Industrial Waste Treatment/Disposal Flow

In order for ISW to be properly treated/disposed of, it is vital to understand the characteristics of ISW, and select the most appropriate treatment/disposal method which best suits its characteristics. Figure L-32 shows the process of implementing appropriate treatment/disposal for ISW in general.

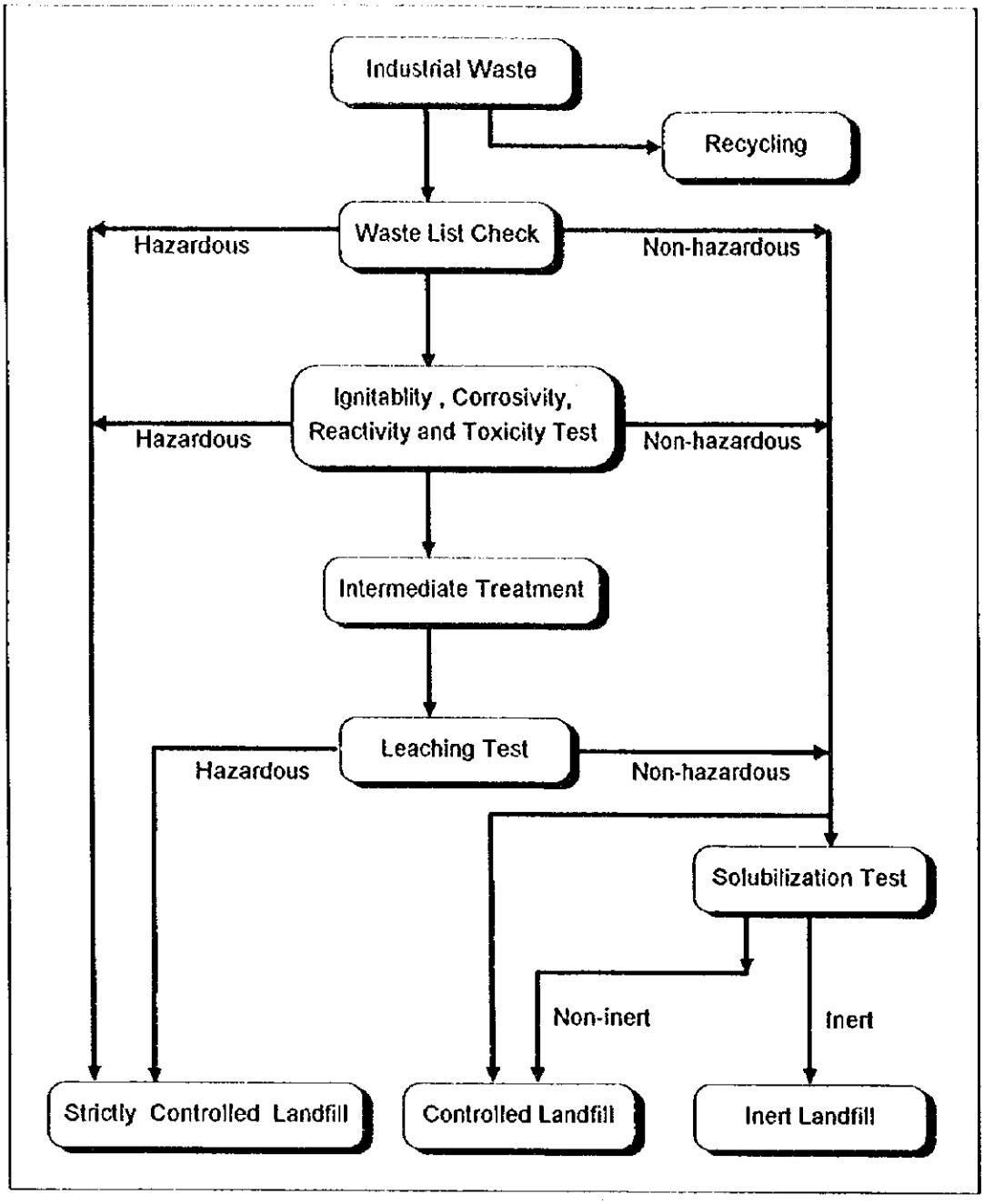

Figure L-62: Industrial Waste Treatment/Disposal Flow

a.5.2 Industrial Waste Treatment / Disposal Method

The industrial waste treatment/disposal method is diversified as the types and characteristics of ISW are diverse. It is, therefore, indispensable to understand the characteristics of the solid waste and select treatment/disposal method most suitable for its characteristics.

However, as the intermediate treatment facility requires considerable expenses in its construction, maintenance & operation, the following treatment should be practiced for the time being considering the present economic condition in Nicaragua.

- Simple intermediate treatment (such as neutralization), and

- Treatment/disposal by utilizing existing production facility. (As a concrete example, a large amount of fossil fuel is used in the calcination process of cement. In this process, if hazardous wastes such as waste oils, solvents and tires etc. are incinerated with fuel in a small appropriate ratio, it works not only as cement production but also as ISW disposal.)

Therefore, landfill disposal shall be adopted as a main ISW treatment/disposal method for the time being. In this case, it is essential that ISW should be disposed of at a landfill appropriately structured depending upon the characteristics of the solid wastes to be disposed.

To put it concretely, the following three types of final disposal sites need to be established.

- Strictly Controlled Landfill (SCL) where substances which are hazardous and difficult to handle are disposed of.
- Controlled Landfill (CL) where wastes which are not hazardous but require leachate control (mainly organic wastes) are disposed of.
- Inert Landfill (IL) where non-hazardous inert wastes such as earth and sand etc. which do not require leachate control are disposed of.

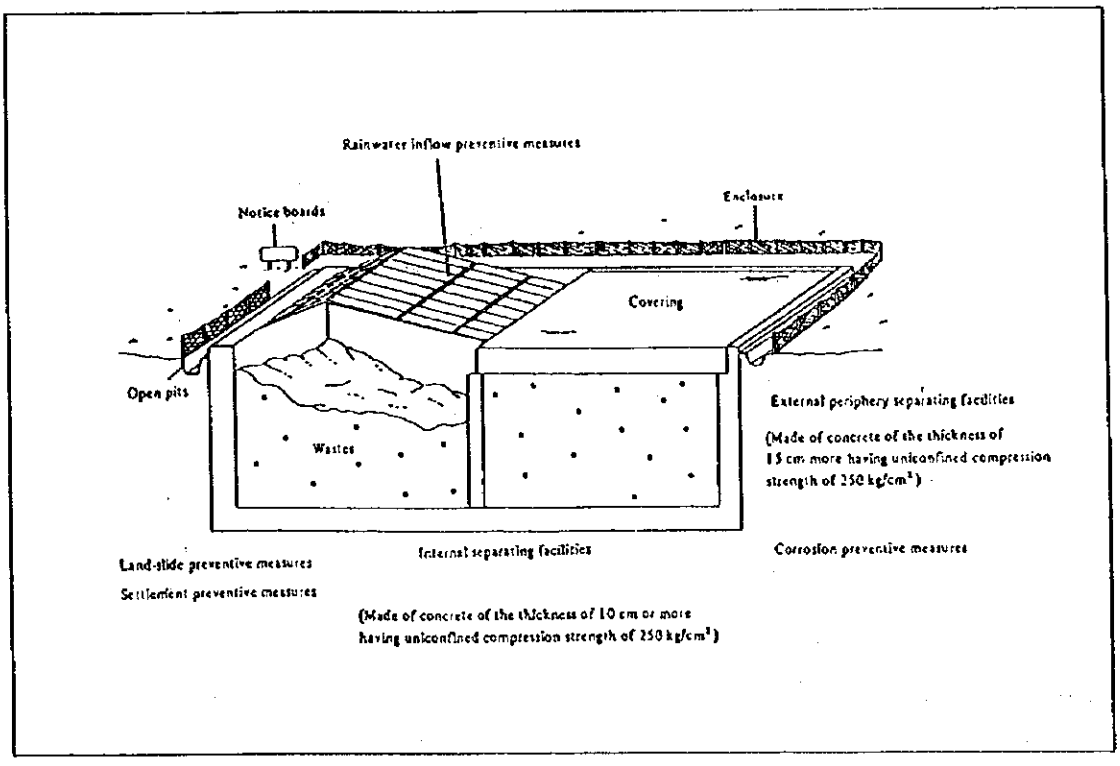

Figure L-63: Structure of Strictly Controlled Landfill

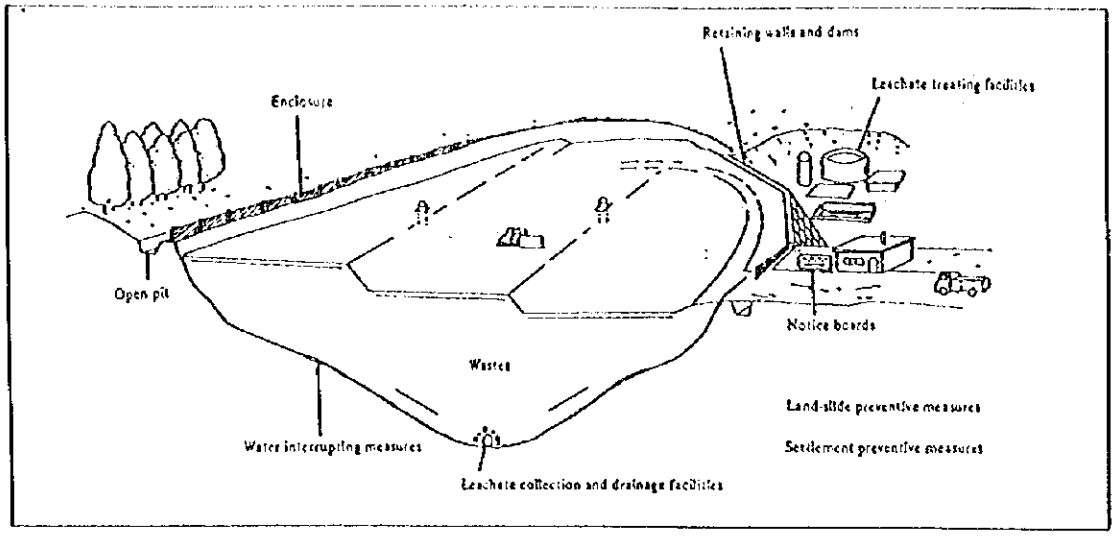

Figure L-64: Structure of Controlled Landfill

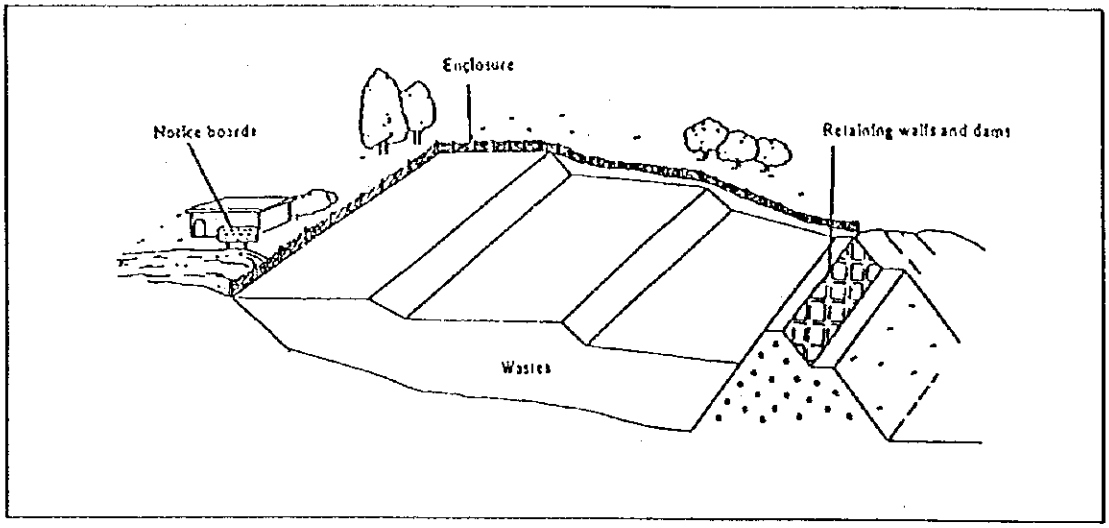

Figure L-65: Structure of Inert Landfill

b. Institutional System

b.1 Roles of Public Sector

MARENA is the competent authority for the management of industrial solid waste (ISW) and industrial wastewater (IWW) by the Law No. 217-96 and Decree 33-95. MARENA should establish the regulations related to ISW and IWW, as well as restrictions for its disposal and the operational limits of the municipality. It should also expedite easily understandable instructions to facilitate technical information to the IW generators, professionals, university students, and those interested in about IW and the IW management services that can be provided for industries in Nicaragua. On the other hand, MARENA should help and encourage industries in finding accessible financial resources or grants to support their projects of IW treatment/disposal and/or "cleaner production".

The competence to inspect and penalize the IW management belongs to MARENA and MINSA. INAA is also competent whenever they receive wastewater. The municipality can establish legal and technical norms restricted to the municipality which can not be more tolerant than the national norms (see Annex N).

The Annex N shows "Instructions and/or Regulations (as well as Tables with Strategies and Intersectorial Integration)" which is recommended for MARENA, and complementarily for MCT, MINSA and the municipality. Furthermore, the Regulation on agro-toxic materials, in its final phase, will be very important to the municipality.

b.2 Polluter Pays Principle (PPP) and Authorities' Management

The IW are qualitative and quantitative dependent of the type of industry, industrial process, of the raw materials, source of energy, and the management of the generator establishments, especially the training and discipline of the personnel, also the equipment maintenance and the working environment.

The IW is strictly industries' responsibility. Since the costs of IW management are included in the products price, the company that generates non-hazardous IW and/or less IW, they could achieve lower production cost. In addition, the "environmentally friendly products" are commonly an important marketing element with respect to customers consciousness.

It is an premise universally accepted premise: **"The generator is responsible for the waste generated by him or her"**, i.e., he or she is responsible for the management of the waste and its effects on the environment and public health, with all the costs to be born therewith. These costs constitute an incentive to minimize waste, in other words, it encourages a "clean production" which is the objective of a competitive and environmentally-conscious industries.

In general, the largest part of ISW results from the industrial effluents, therefore, the management on ISW and IWW should consider all the IW in total.

The consulting and operational services related to IWM constitute an attractive economic activity, once the market has reached certain level. In this context, the public authorities could create the situation that makes such economic activity (ISWM by private sectors) viable, which solves the problems involved with industrial contamination and pollution when the regulations for the IW management is established and its requirements are enforced obviously in a stepwise manner in a feasible time frame. The municipal/national government should not invest more than necessary for the studies, cadastres, regulation, technical information, inspection, monitoring and sanction to the transgressor when it is related to IW.

L.3.8 Medical Waste Management

L.3.8.1 Future Medical Solid Waste/Wastewater Amount

a. Forecast for Major Medical Institutions

The future medical solid waste generation in the major institutions with inpatient beds (hospital class) is estimated as shown in Table L-185. The growth rate of medical solid waste generation is assumed to be the same as the population growth rate in Chinandega (i.e., medical solid waste generation ratio per capita remain the same for future.). The

values in 1996 are based on the questionnaire survey to the 6 medical institutions carried out in February 1997. On the other hand, the future medical wastewater generation is estimated as shown in Table L-186 with the same assumption that it will increase in proportion to the population growth rate of the city. The water consumption of the medical institutions in 1996 are obtained from the record of INAA. Wastewater generation is estimated to be 80% of water consumption in the forecast.

Table L-185: Future Demand on Medical Solid Waste Management in the 6 Typical Medical Institutions in Chinandega

		1996	2000	2005	2010
Growth Rate of Inpatient Beds		1.000	1.143	1.324	1.519
Population		100,988	115,393	133,753	153,444
Risky Waste *1 (kg/day)	Risk *2	9.5	10.9	12.6	14.4
	Hazardous *3	3.0	3.4	4.0	4.6
	Special *4	0.03	0.03	0.04	0.05
	Subtotal *5	12.5	14.3	16.6	19.1
Common Waste		53.5	61.1	70.8	81.3
Grand Total		66.0	75.4	87.4	100.4

Note : *1 Study team's prepared category
*2 Waste with infection (sharps, blood, blood sustained and etc.), infected waste from laboratories, waste from infectious disease patients and wastewater etc.
*3 Chemical waste (medicines, drugs, etc.), radioactive waste etc.
*4 Ash from incinerator, sludge etc.
*5 Office waste, kitchen waste, packing waste, bulky waste, garden waste, domestic wastewater and etc.

Table L-186: Forecast of Medical Wastewater Generation Amount in the Medical Institutions

Item	1996	2000	2005	2010
Population	100,988	115,393	133,753	153,444
Population Growth Rate	1.000	1.143	1.324	1.519
Supply by INAA (ton/day)	163.3	186.6	216.2	248.1
Wastewater (ton/day)	130.6	149.2	173.0	198.5

b. Forecast for Minor Medical Institutions

n the medical institutions without beds for inpatients(C/S, P/M,), medical solid waste is estimated assuming that it will increase in proportion to the growth rate of population as shown in Table L-187.

Medical wastewater is assumed to increase in proportion to the growth rate of the population in the city as shown in Table L-188.

Table L-187: Forecast of Generation ratio of Medical Solid Waste Management in the Medical Institutions without Beds for Inpatients(C/S, P/M and Laboratory Class) in Chinandega

		1996				2000				2005				2010			
Medical Institution		C/S[1]	P/M[2]	Lab[3]	Total	C/S[1]	P/M[2]	Lab[3]	Total	C/S[1]	P/M[2]	Lab[3]	Total	C/S[1]	P/M[2]	Lab[3]	Total
Population					100,988				115,393				133,753				153,444
Outpatient Growth Rate					1.000				1.143				1.324				1.519
Outpatients/day/Institution		39	104	0	143	46	123	0	169	52	138	0	190	59	158	0	217
Outpatients/day		195	624	0	819	223	713	0	936	260	828	0	1,088	295	948	0	1,243
Risky Waste	Risk	27.0	0.4	0	27.4	30.9	0.5	0	31.4	35.7	0.5	0	36.2	41.0	.0.6	0	41.6
	Hazardous	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Special	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	27.0	0.4	0		30.9	0.5	0	31.4	35.7	0.5	0	36.2	41.0	0.6	0	41.6
Common Waste		2.7	0	0	2.7	3.1	0	0	3.1	3.6	0	0	3.6	4.1	0	0	4.1
Grand Total		29.7	0.4	0	30.1	34.0	0.5	0	34.5	39.3	0.5	0	39.8	45.1	0.6	0	45.7

Note: [1] C/S : Centro de Salud(Health Center) [2] P/M : Puesto de Salud or Puesto de Medico

Table L-188: Forecast of Generation of Medical Wastewater Management in the Medical Institutions without inpatient beds(C/S, P/M, Laboratory class) in Chinandega

Unit : kg/day

Item		1996				2000				2005				2010			
Basic Data	Population Growth Rate				1.000				1.143				1.324				1.519
	Population				97,387				115,393				133,753				153,444
	Institution Type	C/S	P/M	Lab	total	C/S	P/M	Lab	total	C/S	P/M	Lab	Total	C/S	P/M	Lab	Total
	Outpatient/day	195	624	0	819	223	713	0	936	258	826	0	1,084	295	948	0	1,243
Water (ton/day)	Water Supply by INAA	30.5	13.8	0	44.3	34.9	15.8	0	50.7	40.4	18.3	0	58.7	46.3	21.0	0	67.3
	Wastewater Generation	24.4	11.0	0	35.4	27.9	12.6	0	40.5	32.3	14.6	0	47.0	37.0	16.8	0	53.8

L.3.8.2 Major Findings of the Medical Waste Survey

a. Present Situation of Medical Institutions

a.1.1 Distribution of Medical Institutions in Chinandega

There are 14 medical institutions in Chinandega, among which 3 institutions provide beds for inpatients.

Table L-189: Distribution of Medical Institutions in Chinandega

Item			Ownership		Total
Category	Inpatient Beds	Type	Public	Private	
Major	With	Hospital	2(2)	1(1)	3(3)
Minor	Without	C/S	5(2)	0	5(2)
Minor	Without	P/S, P/M	6(1)	0	6(1)
Minor	Without	Laboratory	0	0	0
Total			13(5)	1(1)	14(6)

Note: Values in ( ) show the institutions conducted questionnaire survey.

a.2 Questionnaire Survey to the Typical Medical Institutions in Chinandega

In order to understand the medical waste conditions in Chinandega, questionnaire surveys were conducted to the 6 typical medical institutions shown in Table L-190 in September 1996 and February 1997 as follows:

(1) Questionnaire Survey in September 1996

focusing on the general information on medical waste management

(2) Questionnaire Survey in February 1997

focusing on the amount of medical waste amount and medical wastewater

b. Medical Solid Waste

b.1 Separation at Generation Source and Internal Collection and Haulage

Table L-190 shows condition of waste separation at generation source. 100 % of the institutions separate syringe needles although the separation of medical waste is not complete.

During internal collection and haulage, syringe needles are still separated in all the medical institutions.

Table L-190: Waste separation at generation source of and Internal Collection and Haulage at 6 typical medical Institutions in Chinandega

Institution Type		Separation at Generation Source	Internal Collection and Haulage		Total
			Separated	Mixed	
Public	Hospital	2*1*2	1*1*2	0	2
	C/S	2*1	1	1*3	2
	P/M,P/S	1*1	1	0	1
Private	Hospital etc.	1*1*2	1	0	1
Total		6	5	1	6
Share (%)		100.0	83.3	16.7	100.0

Note *1 : syringe needle only
*2 : pathological waste
*3 : all infectious waste incinerated inside premise

b.2 Internal Treatment

Internal treatment is conducted for reuse of gloves in an institution and glass in another institution.

b.3 Storage Place Before External Collection Service

1 public hospital(hospital Espana which was donated by Spanish Government provide a storage place with fence and lock. However, other 4 institutions provide storage places without fence and lock except 1 institution as shown in Table L-191.

Table L-191: Security of Storage Place before collection at 6 Typical Medical Institutions in Chinandega

Institution Type		Answer				No Answer	Total
		With Fence with Lock		With Fence	Without Fence		
		for Contaminated Waste Only	Entire Storage	Without Lock	Without Lock		
Public	Hospital	0	0	0	1	1	2
	C/S	0	0	0	1	0	1
	Others	0	0	0	2	0	2
Private	Hospital	1	0	0	0	0	1
Total		1	0	0	4	1	6
Share(%)		16.7	0	0	66.7	16.7	100

b.4 External Collection Service

Municipal public collection service is extended to medical institutions.

b.5 Final Disposal Site

Municipal final disposal site is used for medical waste disposal in Chinandega. Separated syringe needles are incinerated at a pit in the municipal final disposal site under a guidance of JOCV.

b.6 Recycling

Recycling is conducted in 1 institution for reuse of needle in a institution and culture plate in another different institution..

b.7 Incineration

In the 2 hospitals and 1 C/S, they incinerate medical waste using mechanical incinerator or furnace. On the other hand, remaining 3 institutions do not.

Table L-192: Conditions of Incineration in Chinandega

Category		Mechanical Incinerator with Thermometer	Primitive Incineration		Without Incineration	Total
			furnace	Open Air at Final Disposal Site for Syringe Needles		
Public	Hospital	1	1	2	0	2
	C/S	0	1	2	1	2
	P/S,P/M	0	0	1	1	1
Private	Hospital	0	0	1	1	1
Total		1	2	6	3	6
Share (%)		16.7	33.3	100.0	50.0	100

c. Medical Wastewater

c.1 Present Conditions

There is only 1 medical institution (17%) with treatment by septic tank in Chinandega. In the other 5 institutions (83%), medical wastewater is disposed of by either discharge into sewer or discharge into soak pit without treatment as shown in Table L-193.

Table L-193: Present medical Wastewater Management in Chinandega

Unit : number

Treatment		Without			With	Total
		Discharge into Sewer	Partial Discharge into Sewer and Partial Soak Pit	Discharge into Soak Pit	Septic Tank to River	
Public	Hospital	1	0	0	1	2
	C/S	1	0	1	0	2
	Others	1	0	0	0	1
Private		1	0	0	0	1
Total		4	0	1	1	6
Share (%)		66.7	0	16.7	16.7	100

b.2 Inspection by Medical Institutions

Decree No.33-95 provides that medical institution have an obligation to inspect the quality of wastewater. However, no institutions have been carrying out the designated inspections.

L.3.8.3 General Recommendations for the Improvement of Medical Waste Management

a. Technical System

a.1 Comprehensive View Points

a.1.1 Examination on Marketability of Participation of Private Sectors for Medical Waste Management

MINSA should examine the marketability of participation of private sector on the medical waste management.

a.1.2 Examination of Regional Treatment

Since the volume of medical waste generated from the institutions is not so large, possibility of regional treatment should be examined as one of alternatives.

a.2 Medical Solid Waste

Medical waste management should be focused mainly on prevention of the secondary infection caused by the medical waste. From this point of view, the followings are recommended.

a.2.1 Separation of Infectious Waste

Segregation of infectious waste at generation source intensified. Importance of infectious waste separation should be educated to cleansing workers, otherwise medical workers' effort will be in vain to segregate the waste at generation source, which has been carried out at present.

a.2.2 Internal Treatment

In principle, medical waste is to be treated in the institutions, however, taking into account the small quantity of generation of medical waste in each institution, regional treatment plan should be included as one of alternatives.

a.3 Medical Wastewater

a.3.1 Segregation of Infectious Wastewater at Generation Source

In order to reduce the volume of infectious wastewater, it should be segregated at generation source.

a.3.2 Pretreatment before Discharge

Infectious wastewater should be pretreated at generation source for the prevention of water pollution.

b. Institutional System

MINSA is the regulating authority (Decree No. 393-88). It is recommended to establish immediate instructions, which should be improved to "Code of Practice" for Medical Waste in the near future.

These norms should emphasize the management inside the generator establishments where waste will be classified and separated for a safe collection and disposal. Medical workers and cleaning workers must be oriented and trained for this purpose.

Hazardous medical waste should be defined and regulated by MARENA (Law No. 217-96). Meanwhile, MINSA should establish temporary instructions as the superior Ministry dealing with medical activities, mainly with regard to infectious waste.

The Municipality will operate, without monopolize them and at a reasonable price, the collection services and disposal of non-hazardous waste, proved in accordance with competent instructions.

The Annex N presents recommendations for the regulating acts and intersectorial actions.

The Main Report for F/S of Volume III includes (item 4.3.2) the proposed Regulation on SWM for Granada, that might be the same for the other municipalities.

ANNEX M

Public Education Program

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M Public Education Program

M.1 USE and Education in Development

M.1.1 Past Development and Lessons

The end of the WW II offered great opportunities for newly born countries to start nation building and to establish national economy. These nations, mostly known as developing countries today, have been inherited negative impact of the past colonial history.

The majorities were not able to escape from serious bottle-necks in their path of development in spheres of politics, society and economy. Common characteristic were perceived among these countries. For examples:

Weak government and ineffective bureaucracy; ill-unified nation and society sometimes split along the ethnic boundary; fragile economic structure; shortage of revenue and budgetal constraints; rapid population growth; shortage of food supply; endemic diseases as malaria, dengue, cholera and etc; insufficient water supply; high infant death ratio; and so on.

This complicated phenomenal layer has made it difficult for developing nations to breakthrough "vicious circle of poverty" by themselves. Namely, the circle is understood as follows:

1. **Capital shortage** → Low productivity → Low income → Low saving ratio → **Capital shortage** (Figure M-1)

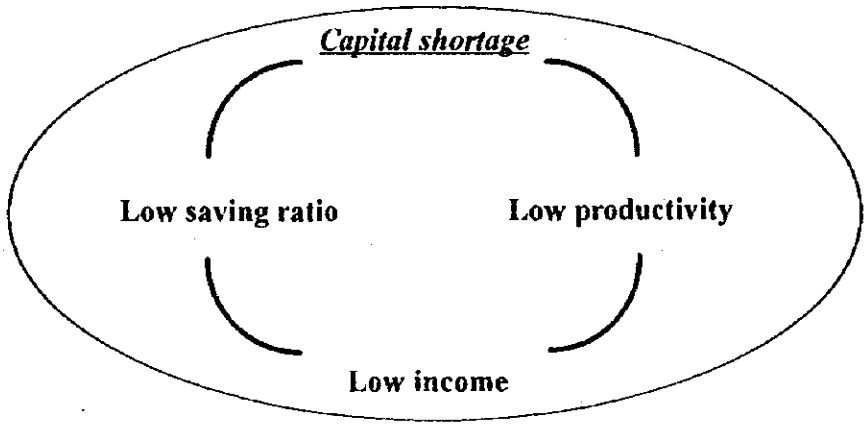

Figure M-1: Vicious Circle of Poverty

2. **Low income** → Low purchasing power → Less demand → Weak investment incentive → Lack of investment → **Low income**

3. **Poverty** → Malnutrition & Un-healthiness → Low Productivity → **Poverty**

4. **Poverty** → Less access for Education → Skilled labors shortage → Low productivity → **Poverty**

In contrast, the end of the war introduced a new type of competition at the same time that both socialist and democratic alliances struggled to occupy the seats of majority in the international political arena.

Under this circumstance, foreign assistance has became a trump in international politics. Therefore, it may be easily understood that foreign aid competition heated up between the two camps, that is, planned economies and market economies. Namely, this trend had last until the end of the Cold War.

The recipient sides had their own intention and the donor sides also had their own, however, the interests of the recipients were basically in harmony with those of the donors.

Development strategy introduced was based on western economic growth theories. Economists and economic planners, mostly under influence of the neo-classical school, equally pointed out that capital accumulation was the most urgent and priority target.

In their idea, development meant simply economic growth or achievement. Therefore, none of them doubt that if they could complete this mission, *vicious circle of poverty* would automatically be disappeared and then development be achieved.

For this purpose, a series of schemes for increasing domestic saving, intaking foreign loans and grant, and also quick and huge amount of capital investment so called "big push" were introduced.

In spite of this world wide sincere contribution, only intangible success was achieved through this combat against poverty in the early stage. Important findings, however, were observed to innovate development strategy. We may summarize the lesson as below:

- *Level of achievement in development is not in direct proportion to the volume of capital input. Capital Accumulation and Investment is not a sufficient condition but a sine qua non for economic development, and will never be able to take off developing economies without another socio-economic development.*
- *Therefore, more attention on non-economic factors should be required simultaneously, for example: infrastructure; technology transfer;* ***education****; management know-how and skill; ethos of profession and job; primary health care and nutrition; hygiene; safe drinking water; family planning; culture, custom, way of life; and so on.*
- *In other words, total approach toward development should include administrative, institutional and social reforms. We may note that no success can be achieved in* development without any attention onto social spheres.

M.1.2 Sanitation & Environmental Problems in Developing Countries

Unfortunately, the health and sanitation status of the developing countries have been worsen since the 1980's. It is understandable if we recognize the situation that the

countries have been facing: increasing of debt service ratio; serious economic regression; environmental pollution and destruction caused by exportation of dirty-industry by industrialized countries and in the path of deepening industrializing strategy; socio- economic uncomfortableness; natural disasters; and so on.

The countries have and now are confronting two-staged epidemiological challenge:

- *Historically-long active infective diseases like ARI and diarrhea still causing total 30% death of population;*
- *Especially, child and infant death caused by the diseases are serious, and more than 15 million children lose their life annually (only ARI and diarrhea diseases can erase 70% of these children's life)*

New-type diseases mostly observed in the developed countries as heart trouble, apoplexy, cancer, respiratory tract diseases have been increasing.

In addition, increasing external contact and urbanization has followed social transformation and changes in life style; and this has created social illness like drug-abuse and street-children.

And this has made and makes the governments impossible to maintain the health and sanitation management scheme effectively.

In the BHN aspect, however, we may have a simple but effective solution for the problem, that is; reasonable access for 'safe water' and 'basic sanitation' will be expected to decrease water related diseases defined by WHO in six types as below:

- *Water borne micro-biological diseases:*
- *Water borne chemical diseases:*
- *Water hygiene diseases:*
- *Water contact diseases:*
- *Water vector habitat diseases:*
- *Extra disposal di*seases:

And this aim has been expected to lessen the child death ratio rapidly and drastically.

In reality, however, more than one billion people are now not enjoying and living out of sound safe water and basic sanitation services.

M.1.3 Education in Development

As we noted above in M.1.1, among bottle-necks developing nations have faced and been facing, it goes without saying that both improving quality and increase quantity of human resource are the crucial factors to spur national development in total. Especially in the social aspects in development, it is without doubt stressing on the critical role of education.

Widely understood its importance of education in development, both physical and human capitals have been invested into the educational sector in developing countries. For example, share of aid on education in total ODA was 17.3% in 1975.

Namely, it is worth to note that large part of budget for education including foreign aid clearly flow not into the primary education sector but into the higher and professional education sector.

No DAC member countries has denied its importance of primary education, and has shown willingness to aid recurrent cost in primary education. The sector has, however, left behind for long time.

We may point out some major reasons why primary education was not the first consideration in both donors and recipients perspectives. At first, in the donors views:

(1) Investment in primary education has been suspected as "a bottomless pit".

(2) Empowerment of higher and vocational education has been an urgent issue to create highly skilled human resource.

Because of governmental budgetal constraint and donors' shrink from assistance on primary education, the sector has been remained under development and this has provided society less access for USE management skills and knowledege.

Before we start further discussion on the issues in the next chapters, for prevention of misunderstanding on ideas on education in development, we may note a simple definition on education and public education as below:

In general, education may be categorized into three levels as (1) Formal education, (2) Informal education, and (3) Non-formal education.

(1) This is a hierarchically structured and chronologically graded system that covers from primary school through the university curriculum. This may include general academic studies, kinds of specialized programs and institutions for full-time technical and vocational training.

(2) In contrast to formal education, this lifelong process is expected to explore the universe and expand individual view of life with daily experience. Family and neighbors, the market place, the library, the mass media, work and play, conversation with friends, and so on, these may be imagined schools that will offer values, skills, knowledge, attitudes etc.

(3) This may be defined as any types of organized educational activity that exists outside the established formal education system. This is intended to serve identifiable learning clienteles and special learning objectives.

In our concern, 'public education' may be define as a feedback-able organic integration of two streams of 'formal' and 'informal' education that is expected to create mutual understanding on and cooperative tackle against USE improvement.

M.2 Education and USE Improvement in Nicaraguan Development

M.2.1 Formal Education in Nicaragua

If we take a short glance at educational history in Nicaragua, it has also not been able to be an exception. The majorities have not enjoyed adequate access for basic education in the last dicades. Despite the governmental efforts in the Sandinistas and Chamoro eras, the country remained as an undereducated society even in the mid 1990s.

The educational system was forced beyond acceptable limits to maintain the rapidly growing school-age population. The number of adolescents (5 to 14 years old) had expanded by 35% between 1980 to 1990. However, a substancial minority of the primary school-aged and about 60% of the secondary school-aged had still no access for schooling. The number of students who could complete their 6 years primary education was about 14% that of the 1979 level.

This inherited inadequate educational system has lead shortage of active human resource as skilled labors, medical doctors, all kinds of engineers, teachers, official stuffs, communities, and so on to maintain the sound national social system.

M.2.2 USE Education in Nicaragua

M.2.2.1 Background and Issues in Nicaragua

At the beginning of the 1990's, it has became clear that health and sanitation gains have not been as enough as nation, especially the poorest and most vulnerable members of the population, might have expected. For example:

- *Access to safe water and sanitation has not reached ideal revel, and therefore;*
- *Infant mortal rate (per 1,000 live birth) still stays at above 50, and diarrhea diseases is the main factor for losing of their life.*

This has happened notwithstanding Nicaraguan major effort to improve the health status of its population for over a decade. However, it is reasonable to seek the major causes of the problems, in addition to its national budgetal constraint, within its administrative and institutional disorder as follows: an excessive centralization of decision-making process, complicated procedures, and luck of ideal communications between departments within the Ministry of Health (MOH).

Under this circumstance, the Government has introduced a new scheme for attacking these national constraints on health and environmental sanitation including: developing social participating, strengthening the decentralization process, human resources, information systems, and so on.

To encourage the economic development process, social conditions need to be improved and, at the same time, efficiency of social program also should be increased. Therefore, we may emphasize again here the importance of the proposed urban environmental sanitation project for the Government's overall development strategy.

M.2.2.2 USE Education Needed

No improvement on USE management in broad term, can be achieved without *sustainable mutual cooperative works* among the three types of entities, that is:

(1) The municipality and relevant government institutions (Public Actors);

(2) Communities and residents, etc., (Communal Actors), and;

(3) Grass roots oriented actors as NGOs and other social promotion organizations (Moderate Actors).

Here, we may seek the most significant reason why *public education* should be introduced and why *cooperation scheme* is required.

Such a educational system will be expected to establish public cooperation and also create a harmonious cooperative circumstance in the social programs. Only under this social environment, USE improvement and management system will be maintained in a sound manner.

Each modules in cooperation have their own obligation and responsibility in the USE improvement program and education:

- The municipality acts as a coordination board among the all entities and actors, provide innovated USE service using its financial and human resources, and takes actions on public education on USE.
- Relevant governmental organizations also provide services on USE and support public education program in all kinds of manner.
- Communal actors will be well-organized and put their voluntary efforts into USE management actions in cooperation with other relevant entities.
- Moderate actors, with applying their expertise, fill the niches in public service on USE, and transmit sustainable USE management scheme via communal education.

M.3 Main Actors in USE Improvement and Education

The relevant actors aiming USE management system improvement in the program are shown as below:

Public Actors: Administrative entities concerning USE improvement in general.

- MGG : Municipal Government of Granada
- MINSA-SILAIS : Ministry of Health-Local Systems of Integral Attention and Health
- INAA : Nicaraguan Institute of Waterworks and Sewerage
- MARENA : Ministry of Environment and Natural Resources
- MED : Ministry of Education
- Schools, Medical Institutes, etc.

Communal Actors: Power potential entities confronting negative SWM phenomena.

- Communities, Households, Mothers, Juvenile, etc.

Moderate Actors: Both public and private entities covering niches of SWM services.

- SPD (the Social Promotion Department) of the municipality in Granada
- DC (*the Development Committee*) in Granada and Community leaders
- NGOs
- Voluntary Workers, etc.

These actors should create a triad cooperation unit aiming its common targets on USE.

This cooperative figure, triad cooperation in USE may be illustrated in a Figure M-2atteched below.

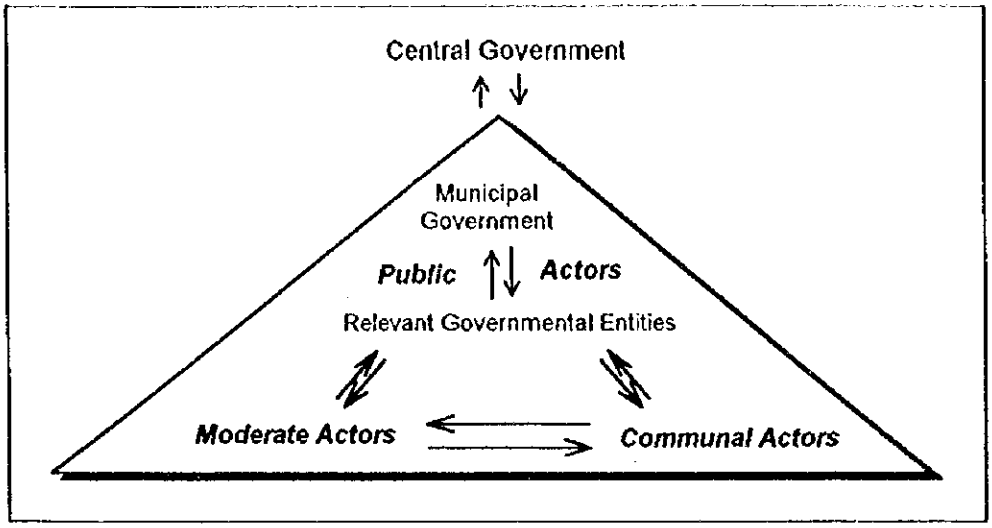

Figure M-2: Triad Cooperation in USE

Now we describe of each roles in detail.

M.3.1 Public Organizations and Actors

M.3.1.1 Municipal Government (Alcaldia)

This local level public unit has greatly contributed in municipal development as the main administrative-judicial-legislative actor, and a coordination entity between the central governmental and local organizations in Granada.

It is obvious that its tremendous efforts on USE management is observed, however, more contribution should be emphasized on coordination actions among the public entities and also on community oriented works.

Therefore, it should take a series of actions continuously towards long range goals in USE improvement, for example:

(1) Organizing and coordinating *cooperative meetings, workshops and seminars* for other governmental entities: each of these has mainly two purposes like (a) sharing and generalization/commonization of each experiences and knowledge on USE and communal services; and (b) creating new partnerships among the actors in ad hoc and/or permanent bases.

(2) Organizing communal sanitary education *workshops* especially in cooperation with all actors concerned in the urban fringe areas: the workshops mainly target to notify and orient communities and residents about the importance of cooperative work on USE. The workshops use round pictures, audio visual stuffs, etc.

(3) Providing communal *educational stuffs* as booklets and posters with simple-and-attractive design purposed to be welcomed by the communities. For

example, colorful and rich illustrated materials with little; impersonal text with easy and community oriented language.

(4) *Public campaigns* to maintain good public relations and community cooperation: they should be concerned on SWM and communal education activities. All kinds of mediums, for example, noticing boards, posters, flyers, radio, TV and the newspapers, educational activities in schools, etc., are suitable vehicles for the mission.

M.3.1.2 Non-Municipal Public Entities:

We may face difficulty if we try to seek good examples and traces that exhibit public education programs done by institutional cooperative works. However, some notable examples are able to quoted:

M.3.1.2.1 Experiences

Case 1: MINSA-SILAIS and INAA

Under the jurisdiction of MINSA-SILAIS, a local branch of the Health Ministry of Nicaragua, public health education has been placed in Granada. The most active governmental entity in sanitary education has organized and organizes sanitary educational '*workshops*' in different sectors of the region, especially in urban fringe and rural areas.

The main purpose of the workshops is to notify and orient communities and residents about the causes and effects of water related diseases (cholera, dengue, malaria, etc.) and how to prevent and terminate them. Round pictures, videos and projectors are utilized in the workshops. Namely, in isolated rural and/or ill-facility accessed areas, '*Mobile Workshop*', vans loaded electric facilities and audio visual equipment are available for the mission.

For example, when INAA plans to install pipe line for drinking water, MINSA will offer supportive community educational workshops. There will be explained how to manage the drinking water to prevent a series of water related diseases.

In Granada, four sanitary education manuals/brochures have been prepared for the inhabitants since the middle of October 1995 stressing on: (1) Control and/or disposal of domestic wastewater, (2) Construction, use and maintenance of latrines, (3) Adequate garbage disposal, (4) Protection of drinking water.

This effective educational program with the sophisticated manuals, however, was placed only in the limited and specific areas in Granada. Mainly because budgetal and coordinational constraints, this unique experience in community education could not expand and spread into the national stage.

Case 2: MINSA-SILAIS and MED

It may be worth to note that an new public effort on sanitary education introduced for both primary and secondary education by MINSA-SILAIS in 1996.

In the program, 30 teachers were trained to enhance their knowledge on USE and to transmit the knowledge to the adolescents in January 1996 in cooperation with the MED.

Both governmental entities have maintain good relations in joint works together, however, this remarkable program was unable to expand into the next year in 1997. We may seek its reasons mainly on financial and coordination constraints.

They are now intend to re-start the sanitation education program in 1997, since both of them have recognize that such a program on USE improvement is critical and needed to place urgently.

Case 3: MINSA and Army

It is worth to be noted that the army has participated in cleansing and mosquitoes fighting journey, as their intervention on epidemic emergencies.

Case 4: MINSA and Alcaldia

There is a participation through the town council for health care, where hey are directed by this institution. The entity works and contributes in all levels of health care activities.

M.3.1.2.2 Lesson from Experience

These experiences described above have projected and indicated interesting lessons and suggestions. These will help us to establish a grand strategy in the program:

(1) Public joint programs have proved their effectiveness on USE improvement. Each expertness also has shown great contribution in the mission of USE improvement, however, this complicated target may not be attacked by isolated non-cooperative actions.

(2) Therefore, new series of USE education programs are needed to be introduced. The programs should pay more attention on mutual communication and support among the actors.

(3) In the communal level, authoritarian scheme and tools should be transformed into grass roots oriented as possible. Since this modified easily initiated package will enhance communities' knowledge and awareness on USE smoothly; and will trickle down quickly deep into grass roots to build ideal community cooperation.

M.3.2 Communal Organizations and Actors

M.3.2.1 Urban Fringe Communities

In our concern, the Granada Municipality is unable to expand its muscle on USE management covering the whole parts of the city; and especially, the urban fringe area is left behind. This is mainly because the municipal budgetal and human resource limitation as another developing countries.

Under the circumstance, a sustainable USE management system should require:

(1) More efforts and contributions on cooperative works by/among the governmental entities;

(2) Mutual understanding and harmonious works between the government and private sectors, and also;

(3) Cooperation among the communities.

These are most confronting inadequate USE management and suffering from it in Granada. An stereo-typed image on the grass roots are usually as poor, undereducated, powerless and unorganized '*floating mass*'.

We may point out lots of examples that express doubt on trustworthy and potential of communal entities as a collaborator on USE improvement.

However, 15 years history of community participation in health care activities indicates us a good example in this concern. Its major apogee was observed in the years between 1982 to 1991. This outstanding participation was done in a wide and integrated manner with institutional support and coordination.

We may not neglect their potential power in USE improvement. Well-organized communal actors can play great roles in cooperative works targeting USE improvement.

Therefore, a series of actions should be taken to educate and unite the communal entities with introducing specified scheme and tools for the entity.

M.3.2.2 Individual Actors: Women and Mothers

It is noteworthy that role of women in family life has been very strong. For example, it may be supposed that about 30% or more of families are headed by women. Therefore, it is understandable that mothers also play important role in families and communities.

Mothers have played and will play a significant role in the community level health and sanitary action. Since their understanding on its importance through basic education and sharing information on health and sanitation, health and sanitation service will reach into communities.

However, there is a problem of illiteracy originated from its low schooling complete ratio of 20% at the primary level because of mainly economic reason. Therefor, it is important to select and supply adequate education materials for them.

Under supervision of field officers and volunteers, mothers will be transmitted fundamental knowledge on water related diseases prevention; and on health and sanitation: .

- Washing hands with clean water before meal (soaping is desirable);
- How to protect the drinking water.
- How to control and/or disposal of domestic wastewater;
- Placing adequate and simple garbage disposal

M.3.3 Moderate Organizations and Actors

Moderate actors are positioned and active as a media or intersection agent in between the administrative and communal entities. These grass roots oriented are expected to fill niches where the official services are not covered with their sophisticated communal expertise.

M.3.3.1 SPD

An official moderator called the SPD has organized each community by training all of the leaders and integrating them as '*the Development Committee*', the former *JUVED* (Neighborhood Development Board), and formulate social projects needed with communities.

The objectives of the SPD are to:

(1) Identify the social needs in the communities and plan communal projects;

(2) Propose the communal projects to the Mayor; and

(3) Supervise these projects, if they are approved by the Municipal Council.

The daily work of this office is to legalize all the land has been intervened for this mission. They have 8 pollsters to verify the legal situation of the lands. They also have to manage all of the land belongs to the municipality.

M.3.3.2 Developing Committee

Around 1994 to 1995, the JUVED was replaced by the Committee because: (1) majorities of the members were not sure or satisfied with its management and system, in addition, (2) the municipality formed it's own agent for social promotion, that is, SPD.

Namely, this autonomous Committee worked together with the municipality at the beginning. However, the Mayor decided to work together with all the organizations and communal actors, - not only with the Committee -, after the change of government.

Now the Committee is active as an independent organization, and objected to form communal projects and get access to financial support from NGOs, the municipality and other organizations.

The Committee is integrated by all of the presidents of the *Community Committee*, the Community Committee is formed by all of the leaders in the neighborhoods; and the leaders are chosen by the community. It basic structure is shown as Figure M-3

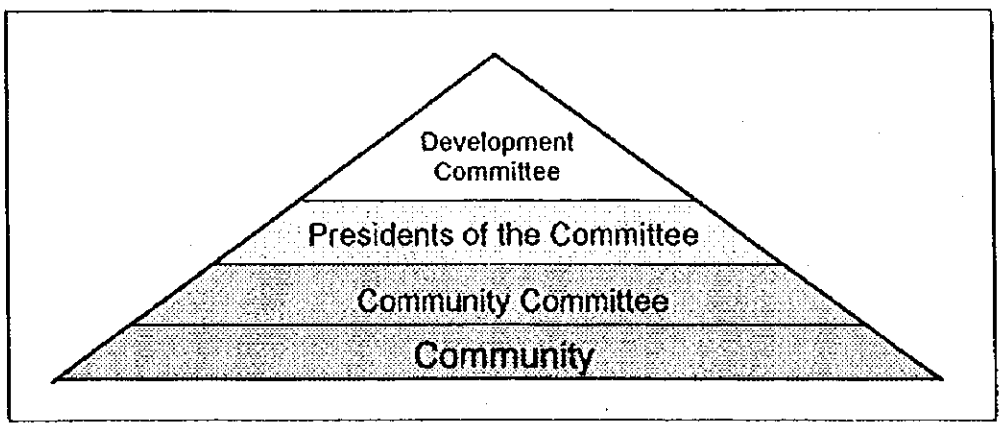

Figure M-3: Structure of the DC

If the *Reparto or Barrio* is big, one leader is chosen from each street or block , all part of the neighborhoods could be represented in the Community Committee. The Committee is integrated by 20 members from 54 Community Committee each with 5 to 7 members.

Namely, no clear definition on '*Reparto or Barrio*' has declared by the municipality up to now, because they don't posses any sources to base there statement.

M.3.3.3 FISE and MAS

Other actors, such as *FISE* (Emergency Social Investment Fund) and *MAS* (Ministry of Social Action), by appropriating funds from the national budget and/or foreign donation, finance community base projects such as the construction of schools, latrines, health centers, access roads, and forming environmental protection activities, etc.

Besides this, MAS implements sanitary education programs, trains residents on the adequate use of latrines, and helps low income people improve their skills for better chances in getting jobs.

M.3.3.4 International Institutions and Other Organizations

Meanwhile, world-wide assistance in the area is also traced as follows:

(1) *IDB* finances the conduct of projects that place emphasis on public welfare. It also finances the training of volunteers *(brigadistas)*;

(2) *WHO* finances activities concerning the improvement of public health, cleanliness sessions, and public training;

(3) *NGOs*

In the developing countries, NGOs have been contributed to create and enforce local communities' self-reliance character via:

- Establishing *an adequate basic education system for health and environmental sanitation*
- *Creating new facility to mitigate poverty*
- *Modifying local communities into the highly public-spirited and create resident participatory environment.*

There has observed key factors for success:

- An independent re*search and evaluation division (IRED)*
- *Trained local field specialists: Field Officers*
- *Sound management bas*ed on detailed field research

The IRED will choose ***Field Officers*** within local community members; and monitor their performance in the routine mission.

Field Officers, junior or high school graduates are preferable, will be trained under the IRED to support local communities and especially mothers. They will be expected to play an active and neutral role in harmonizing the health and sanitation education program.

Their knowledge earned on the routine field work will be feed back as soon as possible to modify and adjust the program more community-needs oriented.

Namely, NGOs directed to the community are observed as :

- World Vision (Vision Mundial), an active NGO assisted by USAID, works in coordination with MINSA sharing common sanitation education targets, and finances community base projects. The sanitary education program conducted by this organization basically focuses on women and their development, and trains mothers with children less than 2 years old. In addition, they also have introduced other programs as latrines installing in the Granada urban fringe areas.
- FINCA (International Community Assistance Board: headquarters in Washington DC) is working in 16 countries in Central and South America. They promote a program mainly targeting women in development (WID). The program finances women offering credit (US$ 100 to 1,000) enough to start their own business. They are required to organize a group with 20 to 30 members and compromised to pay back the credit.
- Caritas Diocesano coordinates donations for basic necessities in the areas where the residents are suffering major sanitation risk or epidemic emergencies.
- CHISPA is directed to all merchandiser in the local markets and their neighborhoods, and offers credit to micro enterprises.
- ADES provides special credit for individuals in the rural agricultural areas.
- and so on.

M.4 Public Education for Sustainable USE Improvement

M.4.1 Program Guideline

The guideline may be consist of these elements below:

First, the present public education system in Granada will offer the basis for the education program proposed. No drastic reforms or changes may not be applied for the system, since these will require extra governmental expenditure and, at the same time, create unwelcome disorder within the system.

Second, harmonious coordination is required among "formal education programs", "community-based education programs", and "family-based education programs". This mutual tri-modular will en-firm the social structure; stabilize the ties between government and private sectors; and encourage sustainable USE improvement in Granada.

Third, the program should take stepwise deployment onto the short, middle and long range targets: the short term program aims to establish a fundamental basement and plays the role of a 'booster' for taking the middle and long term programs off; the middle and long term programs will be an engine of sustainable USE improvement in Granada.

Fourth, each roles of the related entities and actors should be clarified both in the cooperative program planning and implementation. The program will provide each

entities adequate occasions to practice cooperative actions. This may lead an moderate institutional reform in the field of cooperative USE improvement.

And finally, it is also expected to qualify the respective program materials; its selected application methodologies; appropriate venue selection for program implementation; and so on.

M.4.2 Triple Layers Approach: Key of Sustainable Development

And integrated amalgam of the each elements above may offer fundamentals for 'Triple Layers Approach' figured out as below (see Figure M-4).

This approach is consisted of three stages, that is, short range, middle range and long range programs:

Short range program: targeting the year 2000

This program identified as a booster for taking off the pilot project. It aims to enhance people's conscious on USE; introduce cooperative scheme on USE improvement; renovate former useful programs for USE management and community participation; and offer basic USE first-aid.

Middle range program: targeting the year 2005

This second booster will enforce and expand the basic ideas and strategy in the former stage bridging toward the next program. Review on the short program will be expected to indicate useful lesson in the next stage.

Long range program: targeting the year 2010

The final program will pursuit to review and estimate impacts of the first and second programs; and establish a harmonious sound USE management system with long span sustainability in total.

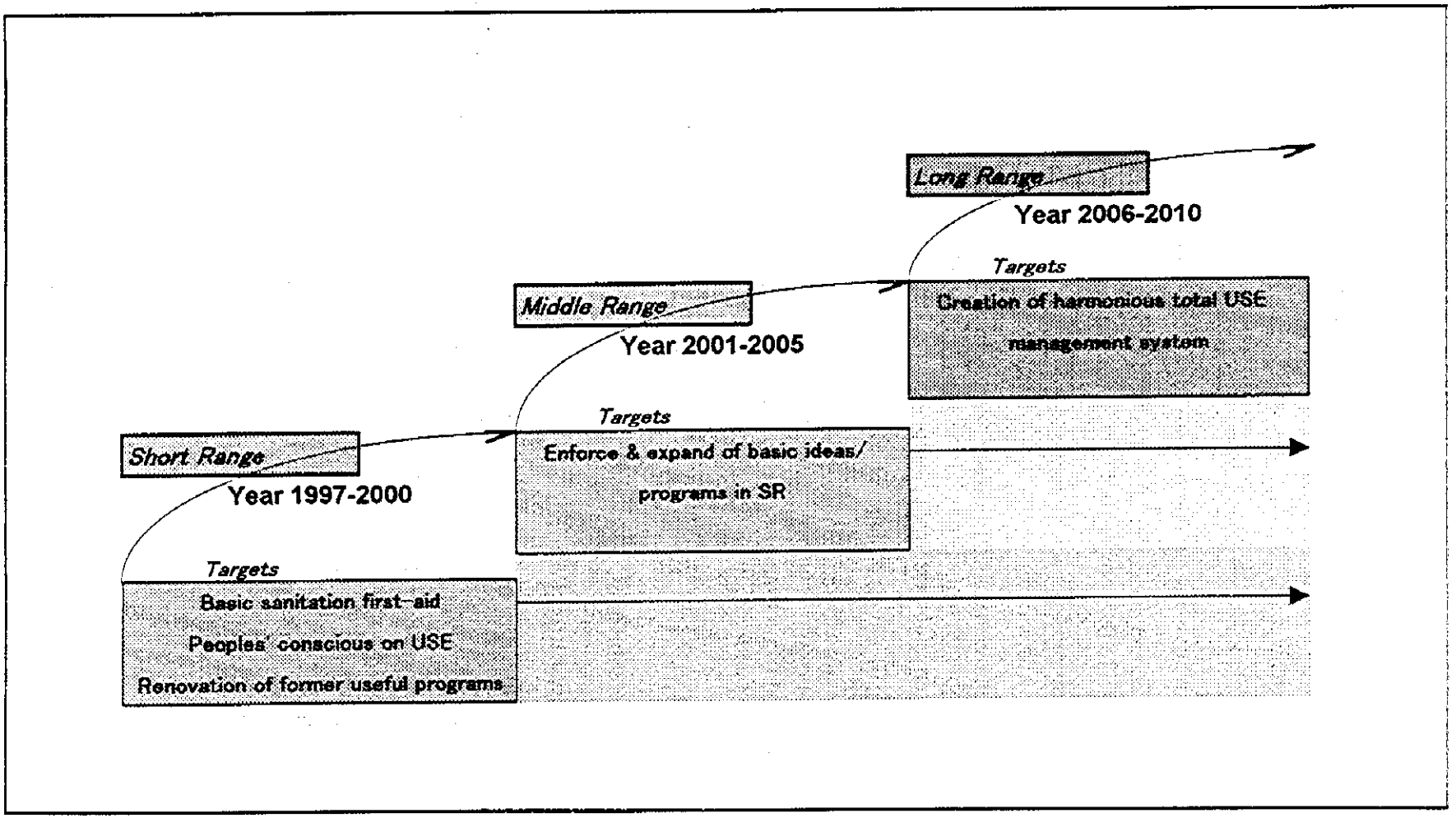

Figure M-4: Triple Layers Approach

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This program identified as a booster for taking off the pilot project. It aims to enhance people's conscious on USE; introduce cooperative scheme on USE improvement; renovate former useful programs for USE management and community participation; and offer basic USE first-aid.

Middle range program: targeting the year 2005

This second booster will enforce and expand the basic ideas and strategy in the former stage bridging toward the next program. Review on the short program will be expected to indicate useful lesson in the next stage.

Long range program: targeting the year 2010

The final program will pursuit to review and estimate impacts of the first and second programs; and establish a harmonious sound USE management system with long span sustainability in total.

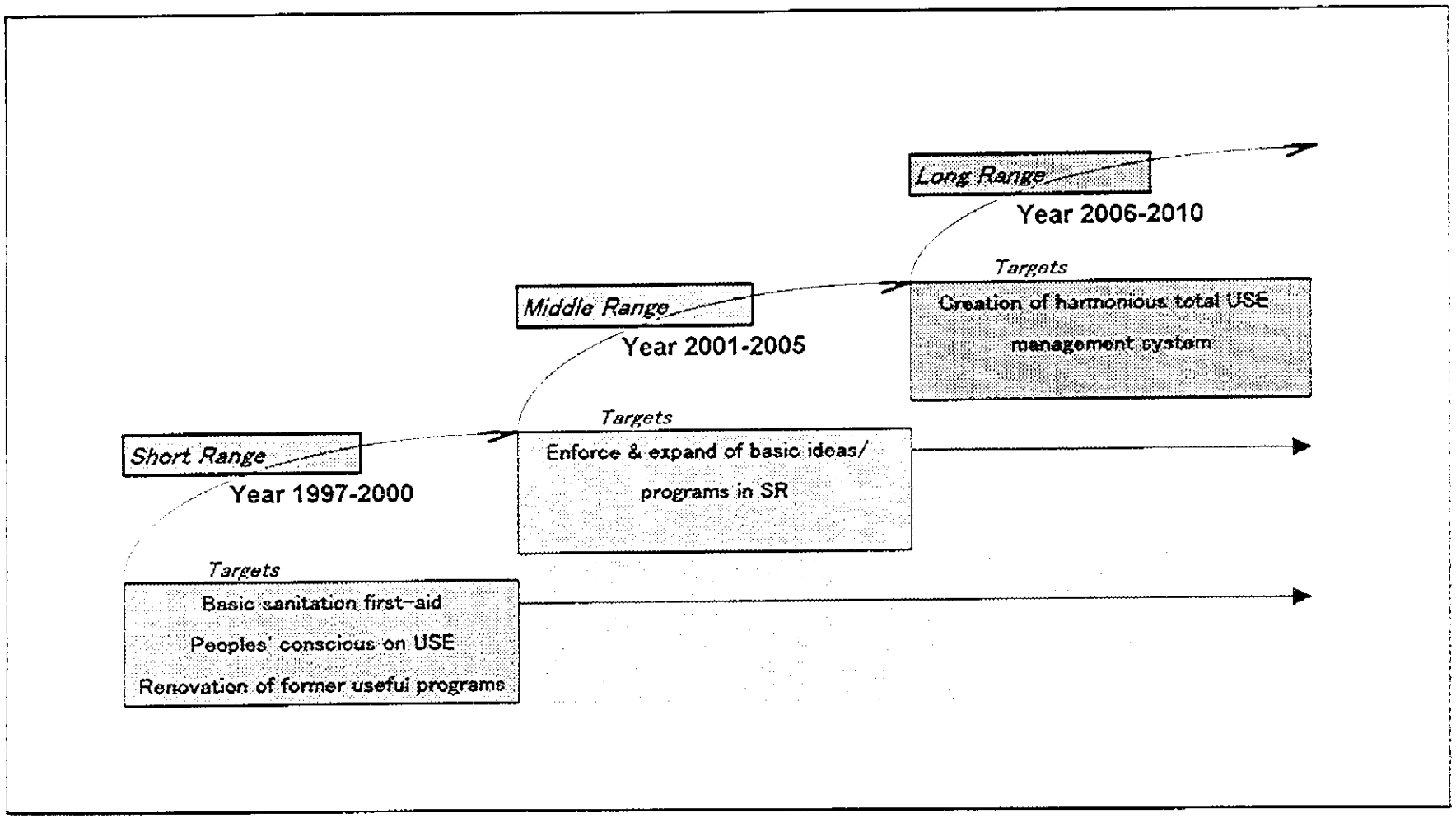

Figure M-4: Triple Layers Approach

M.4.3 Strategy of Public Education: a Seed of Cooperation

M.4.3.1 Scheme and Skills in Communal Education

It is very difficult to seek number of good examples that any entities or organizations directly targeting communal education and indicate acceptable performance especially on USE improvement.

We may describe, however, some keys of success in communal oriented programs:

(1) Resolute discipline and sincere dedication onto communal development;

(2) Sound budget management system and budget/cost oriented behavior; and its transfer into the communities in modified manner for sustainable development;

(3) Maintain good communication and coordination with all relevant entities and actors;

(4) High cultural and social intimacy to grass roots in the areas where they introduce the programs: high density of the local staffs and employment of experienced both internal and external consultants;

(5) Offering training and education to the coordinators and supervisors as key actors;

(6) These staffs will train *volunteer workers* in the communities and transfer specified knowledge and skills on sanitation improvement. The volunteer workers are expected to transmit and teach community members about the key information and scheme for communal and household sanitation improvement.

(7) Quick and effective information transfer via skilled and with community intimacy personnel, and;

(8) Consideration onto and valuation of the staffs, and so on.

M.4.3.2 Community Empowerment

Public education may be introduced as a vehicle of community empowerment into the communities. A series of education methods will be applied for the sectors via *Town meetings; House visits; Mini-workshops,* and so on, as noted in the Table M-1 below.

Table M-1: Community Training

Activity	Participants	Venue Selection	Responsible Organizations
Town Meetings	Residents, community leaders and the Development Committee	Town Halls, Community Halls, Schools	MGG, MINSA-SILAIS, SPDM
House Visits	Family members	Individual Houses	MGG, MINSA-SILAIS, SPDM
Mini-Workshops	Residents	Community Leaders' Houses, Community Halls, Schools	MGG, MINSA-SILAIS, INAA, MARENA, SPDM

In a series of *workshops and meetings* conducted by the Counterparts with the Team's support, important components will be offered as followings:

(1) Briefing on present sanitary conditions, SWM and wastewater, etc., in general and in the communal neighborhoods;

(2) Explanation on the purposes, importance and expected out comes of the pilot projects, that is, of the short range project;

(3) Notify the communities about the roles and cooperative works of the relevant public and moderate entities in the program, and;

(4) 'Q & A' session to bring mutual understanding on the cooperative actions on SWM and USE, and to create harmonious environment among the society.

These educational activities shall be conducted by the public and communal entities with supports from the Counterparts and Team. These may be reinforced through additional publicity by all means of media

In addition, during the program, the following researches will be carried out examining the feasibility of the proposed plan: (a) Observe the change in degree of public awareness before and after the USE campaign; (b) Check the adaptability of the proposed USE education program tools and method.

The bureaucratic entities can play crucial roles in this activities, however, direct communal education and training require kinds of special skills and knowledge as:

(1) Close contact and familiar relationship with the community and the residents;

(2) Deep knowledge and keen analytical sense on each unique communal affairs, humane networks, social structure and hierarchy, and so on;

(3) Maintain its own neutrality and sound manner with the actors and organizations encountered. Any careless actions will terminate communal harmony to cause social disorder.. This will erase the basement for cooperative action in SWM, and;

(4) Experiences and expertise on conducting communal programs that is oriented to the population.

Therefore, there rises a need for neutral actors and entities who poses great knowledge and skills noted above. They are expected to work as a moderator or media to cross a bridge over gaps lying between the government and communal sectors.

M.4.3.3 Education Materials

Persons who in charge, as community leaders and field officers will chose adequate sanitation education materials regarding on specific local features of communities where he/she will be responsible for: social-structure, sub-culture, educational background, utilities, access, and so on (See Table M-2).

Table M-2: Education Materials

MATERIALS	ADVANTAGES	DISADVANTAGES
Handouts & Other Printed Matter	Repetition effect Re-usability	Not effective in high illiterate areas
Blackboard	Low cost Easy maintenance	Not effective in high illiterate areas Difficult access on erased data and writing
Charts and Posters	High portability	Limitation of information Not for mass people
Flip-Charts	High portability Story-like explanation	Not for mass people Hard preparation
Overhead Projector (OHP)	Materials Can be used in	High cost (projector) Heavy & low mobility,
Slides	Good for a large number of people Relatively low cost	High cost (projector & development) Heavy & low mobility
Sound Filmstrips	Good for a large number of people Story-like explanation	High cost (projector & dark curtain & film making)
Use of Real Examples	Instant explanation with local materials(easy access and high familiarity)	Seasonal & locational constraint
Radio and Television	High impact with repetition effect	Less impact expected in low coverage areas
Video Film	Highest impact Quick replay	Needed electric facilities High cost (VCR & parts)

M.4.3.4 Spontaneous Public Education

Education basically needs long time efforts on it. Since, not like economic activity, this requires not only human and capital investment but also chronological step wise transfer of knowledge, feed back, changes in human behavior and way of life, motivation, and so on.

If we expect fruitful out comes and trickle down effects through this process under budgetal and human resource constraints that Nicaragua has been suffered, we must seek effective education structure or system of input-min and output-max.

In this context, two streams in education, that is, 'formal education' and 'informal education', should be organically integrated to create and enhance of sustainable education system on USE improvement.

- Consensus on common goals toward USE improvement should be reached among the persons and institutions concerned with the two streams of education .
- Common goals in USE education are (1) to provide information on USE in Granada; (2) to spread basic knowledge on USE management; and (3) offering chronological targets on USE improvement.
- In formal education, three goals above will be transmitted to juvenile. They transfer their new knowledge on USE in their families and communities.

- Informal education also transmits these knowledge to communities and mothers through community meetings, work shops, house visiting, etc.

To make the integrated educational actions mentioned above durable, we must introduce new scheme or system to monitor and evaluate the process and activities. Since educational act requires *motivations/ incentives* and *evaluation* to boost up its process and to produce reciprocal effect (See Figure M-5) .

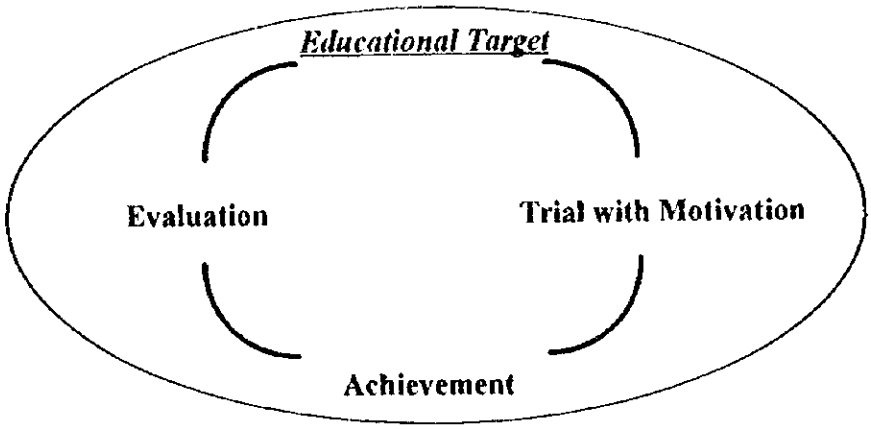

Figure M-5: Reciprocal Effect of Education

Therefore, a series of schemes as below had better be introduced:

- School competitions on USE improvement activities as river and town cleansing.
- A series of contests of poster; paintings; short essay; research report; etc on USE improvement.
- PR USE improvement activities through media as TV, radio and news papers.
- Official commendations for model communities that achieved high USE improvement goals.
- Get-together meetings for volunteer students joined cleansing works in communities with the community members.
- And so on.