TAMPERE POLYTECHNIC
Environmental Engineering

FINAL THESIS

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SOLID WASTE MANAGEMENT AND DEVELOPMENT: A CASE STUDY IN LIMA, PERU

Supervisor Principal Lecturer Marjukka Dyer
Commissioned by NGO Ciudad Saludable
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ABSTRACT

Peruvian society has experienced a vast urban growth during the last decades. Massive centralization has caused social, economical and environmental changes; it has been difficult to organize proper infrastructure for population who settle under urban conditions for only short periods. Solid waste management is one of the essential concerns in our societies and it also represents the level of an urban development.

The aim of this thesis is to analyze and establish the importance of public participation in solid waste management facilitating economical development in the community. These economical and social relations happen in the pilot project for solid waste management which takes place at Comas district in Lima, Peru. The project consists of an implementation of a new solid waste management program for a recent also urbanized area.

The main study research is based on questionnaires and interviews but also books, journals and electronic sources have provided important information for the background study. As this case study is a pilot project for solid waste management, there is also information about the NGO responsible for the project, the local municipality and also about the community.

This thesis may be useful when implementing a solid waste management system to societies remaining similar urban structure such as developing countries or other global areas. This work gives recommendations for further studies based on the study research that may lead to improvement and efficiency in different areas concerning to environment, social and economical development.

TAMPEREEN AMMATTIKORKEAUKOULU

Environmental Engineering

Lopez Garcia, Angel Alberto

Yhdyskuntajätteen käsittely ja kehittäminen Liman esikaupungissa

Tutkintotyö 34 sivua, 2 liitettä
Työn ohjaaja Yliopettaja Marjukka Dyer
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Toukokuu 2007
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TIIVISTELMÄ

Viimeisten vuosikymmenten aikana myös perulainen yhteiskunta on kokenut voimakasta kaupungistumista. Lisääntyvä palveluiden keskittyminen on aiheuttanut sosiaalisia, taloudellisia ja ympäristöllisiä muutoksia, sillä infrastruktuurin kehittyminen ei ole pysynyt nopeasti kasvavien asukasmäärien mukana. Yhdyskuntajätteen käsittely on yksi tärkeä osa jokaista yhteiskuntaa ja se myös kuvastaa hyvin kaupungin kehitystä.

Tämän työn tarkoitus on tutkia paikallisten asukkaiden toimintaa sekajätteenkäsittelyssä sekä sen myönteisiä vaikutuksia talouden kehittymiseen, joka voi seurata jätteenkäsittelyn tehostuessa. Tutkimuskohteena on sekajätteenkäsittelyn pilottiprojekti Comasissa, joka on yksi Liman, Perun pääkaupungin, kaupunginosa. Projekti käsittää uuden sekajätteen käsittelyohjelman toteutuksen vastikään syntyneellä kaupunkialueella.

Tutkimusmenetelminä on tässä selvityksessä käytetty kyselylomakkeita ja haastatteluja, sekä myös kirjoja, artikkeleita ja joitakin sähköisiä lähteitä. Koska kyseessä on sekajätteen käsittelyyn liittyvä pilottiprojekti, työssä on esitelty myös projektista vastaava kansalaisjärjestö, samoin kaupunginosa, missä projekti toteutetaan sekä se yhteisö, jonka jäsenet ovat olleet jollakin lailla projektissa mukana.

Tätä tutkimusta voidaan käyttää pohjana vastaaville jätteenkäsittelyprojekteille edellyttäen, että kyseessä oleva projekti tapahtuu samankaltaisessa sosiaalisessa yhteisössä, kehitysmaissa tai maailmanlaajuisesti. Työ sisältää myös suosituksia, joista voi olla hyötyä jatkotutkimuksia varten ja joiden käyttöönotto voi tehostaa ja kehittää eri alueiden ympäristöä ja sosiaalista hyvinvointia

Foreword

This final thesis would not have been possible without the support from my mother, my father and my brother; Thanks also to Sanni, my teachers, classmates, NGO “Ciudad Saludable” and TAMK.

Tampere, June 2007

Angel Lopez Garcia

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List of abbreviations

MSW	Municipal solid waste
NGO	Non governmental organization
ENV	Environmental
INEI	National institute of statistics and information
CONAM	National committee for the environment
WHO	World health organization
LAC	Latin America and Caribbean
PROPOLI	Metropolitan Lima area poverty programme
SW	Solid waste
S/.	Peruvian Nuevo Soles

1 Introduction

A rapid enlargement in urban areas has taken place in Peru during the last decades. Caused by the severe social and economical centralization, it has happened especially in the capital city Lima. This rapid demographic growth has brought a change in social and environmental aspects. /3/

Solid waste management is one of the main environmental concerns, especially in the suburbs where the concept is still unknown. The authorities in charge of the solid waste management have not succeeded in the past years and that is the main reason why there has been intervention from non- governmental organizations to find a solution to this problem. /3/

The NGOs specialized in environmental issues took the initiative in certain sites around the country; their participation gave a different perspective in comparison to the classic system used before. Within the non-governmental organization's procedure, the socio-economical and environmental situation of the placements has efficiently improved. Apart from the environmental improvement, there are also other important issues related to social and economical development in the urban areas that determine issues such as environmental education and employment rise.
The achievements obtained by the organizations set up the parameters in order to refer to sustainable development of urban areas by the means of solid waste management.

The present work is based on a case study for a solid waste management project run by non-governmental organization "Ciudad Saludable" in the urban area of the district of Comas in Lima-Peru during year 2006.

2 NGO Profile

"Ciudad Saludable" is a non-governmental organization founded in Lima, Peru year 2002. It is based on social and environmental management; it has a wide experience in solid waste management operating in different cities around the country. /2/

The organization is formed by a team of professionals who have a significant experience and skills at designing, managing, implementing and evaluating projects related to the environmental field for basic social organizations, public and private entities in order to promote sustainable management of environmental and natural resources and consequently protect the health of the population. /2/

The main accomplishments that stand for the organization are the co-operation to create permanent jobs for about 150 people at 13 micro enterprises, solution of waste segregation in the northern suburbs, participation in the waste management legislation, creation of the association for independent workers in recycling areas and finally cultural activities for sanitation campaigns in schools. /2/

The main objectives of the organization are:

- To develop skills in basic social organizations related to social and environmental management.
- To contribute for the improvement of local, regional and national environmental management.
- To develop environmental solutions that are technically, economically and sociably fair for the different issues happening in the country.
- To promote social and environmental responsibilities within public and private organizations. /2/

The main organization's activities are:

- Healthy cities

The main working area of the organization is solid waste management in the cities and this happens by implementing systems for the optimal control of solid waste.

- Training

This is a very important part in the organization's work because of the sustainability purposes of the projects. The training is based on research of target group, public demand, etc.

- Consultancy

The organization is also doing consultancy services to clients from public and private organizations. /2/

3 Overview on the study area

3.1 General information

Comas area has been politically recognized as a district on the 11th of September 1963. Since then, most of the migrating population from outer provinces and regions from Peru (especially from central and northern highlands) settled in its territory. The specific area where the studies are done is named "Urbanizacion Carabayllo" which is located in the southern party of the district. /5/

3.1.1 Location

The district of Comas is located in the northern side of Lima metropolitan area. It has a total area of 49 036 53 ha or 49 km^2, which represents 5% of the northern suburbs also called CONO NORTE and 1.7 % of Lima metropolitan area. /5/

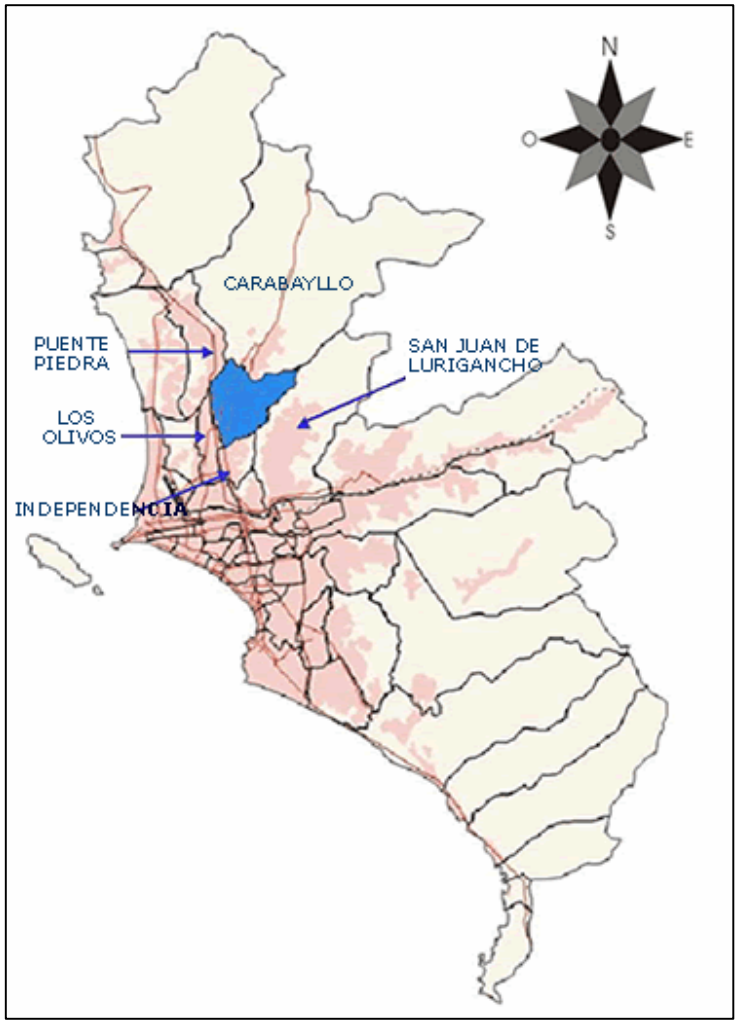

Figure 1. Location of Comas /5/

3.1.2 Population

The district of Comas has 468 932 inhabitants. It is the second most populated district in Lima metropolitan area. It represents 25% of Cono Norte (northern suburb area) and 6% of Lima metropolitan area. /5/

The estimation for Comas in 2010 is about 550 542 inhabitants and hypothetically it would increase up to 980 098 inhabitants in 11 years, approximately 9000 people per year. The district has one of the highest demographic growth rates says the Statistical National Institute (INEI), it has grown during 1994 and 1996 about 3% (including the migration aspects) /5/

In Comas district there is a higher number of women than men, mainly between the ages of 15 and 19 where women posses 4% presence more than men. In general terms, the majority of population in Comas district is young people between 14 and 25 years old. /5/

3.1.3 Economical aspects

The income distribution in Peru is divided into 4 sectors (From A-D) and it includes urban and rural population as shown in the following table:

Table 1 Economical income rates in Peru /6/

Status	**Income per month (in US Dollars)**	**Population (%)**
A1	2,854 +	1.25
A2	901 - 2,853	2.88
B1	778 – 900	8.63
B2	419 – 777	11.25
C1	313 – 418	15.50
C2	222 – 312	22.87
D1	179 – 221	32.0
D2	0 - 178	5.62

Comas district is among the poorest districts in Lima with a large amount of its population living by the C2, D1 and D2 status conditions. On the other hand, Comas is the leading economical district of the Cono Norte. It is being keeping a fast economical growth during the last 10 years because of its wide commerce and cheap labour which are convenient for private investment opportunities. The economical activities in the district are formed by micro enterprises which represent 99.5 % and the other 0.5% is formed by large businesses.

3.1.4 Services

The presence of services in Comas has being increasing rapidly during the nineties. The basic services in the district are represented in the following table:

Table 2 Access to basic services in Comas district /8/

Service	Population (%)
Drinking water	80
Electricity	90
Sewage system	75
Health care	20
Public education	87.5

The part of the population who has better access to services is located in the oldest area of the district. The population living in complicated areas such as hills or near the district borders has most of the lack of services. /8/

3.2 Environmental information

3.2.1 Environmental situation

Comas district environmental situation is very sensitive due to many different facts. The district has the highest record of amount of particulate matter in the air in Lima. This is caused mainly by land structure and winds blowing that make the particulate matter from the capital to accumulate in there. The recorded volume of particulate matter is of 46.2 tons/km^2 which represents 9 times higher value than the recommended values acceptable for human activities by the World Health Organization (WHO) which is 5 tons/km^2. The main polluting sources in Comas are the gaseous emissions from traffic and industrial activity. /8/

There are other environmental problems as the almost extinction of green areas, noise pollution remaining in the main avenues, soil erosion, risk of natural disasters (earthquakes, landslides, inundation, etc), etc. /8/

3.2.2 Solid Waste management

The municipality is the organization responsible for the solid waste management in Comas and the service is operated by the municipal public cleaning department. The municipal solid waste is collected from 3 to 4 times a week. /5/

In a general context, Lima remains intense problems in solid waste management in comparison to other Latin American cities as it is mentioned in the table located in the following page.

Table 3 Collection and final disposal of MSW in some cities/metropolitan regions in LAC countries, with 2.5 million inhabitants or more /4/

City (year)	Inhabitants (millions)	Waste generation (tons/day)	Collection (%)	Final disposal site [2] (%) Good	Medium	Bad	Institution responsible	Service operated by:	Revenue / Cost ratio[3]	Number of employees	Tons per employee per day
M.R.[1] Sao Paulo (96)	16.4	22100	95	100	0	0	municipality	private	good	10000	2.2
M.R. Mexico (94)	15.6	18700	80	50	25	25	municipaity	municipality	bad	17000	
M.R. Buenos Aires (96)	12.0	10500	91	100	0	0	municipal company	private	good		
M.R. Rio de Janeiro (96)	9.9	9900	95	0	100	0	municipal company	mixed	medium	12000	0.8
M.R. Lima (96)	**7.5**	**4200**	**60**	**0**	**40**	**60**	**municipal company**	**municipality**	**bad**	**5500**	**0.5**
Bogota (96)	5.6	4200	90	100	0	0	municipal company	private		2600	1.6
Santiago (95)	5.3	4600	100	100	0	0	municipal company	private	good		
Belo Horizonte (96)	3.9	3200	90	100	0	0	municipal company	mixed			
Caracas (95)	3.0	3500	95	0	100	0	municipal company	private	bad	5110	0.7
Salvador (96)	2.8	2800	93	0	100	0	municipal company	mixed		2345	1.2

[1]M.R. =Metropolitan Region [2] *Good*: sanitary landfill, *Medium*: controlled landfill, *Bad*: open dump[3]*Good*: I/C >0.99; *Medium*: I/C= 0.66-0.99; *Bad*: I/C <0.66

The district of Comas represents well the municipal solid waste statistical records of Lima and unfortunately does not contribute in a good way to it. Despite the deficient solid waste management, the whole situation has brought a phenomenon named scavenging, the term is defined in the following way:

Scavenging is an activity that may be considered a specific form of "casual work" distinguishable from "stable wage work" characteristic of capitalism production. It consists on collecting, separating and selecting valuable materials from waste. In countries lacking of a normal welfare system, scavenging is the ultimate safety net occupation. In cities where the solid waste management is not good, scavengers benefit from open access to waste bins mainly in urban areas and to open dumps around these areas. /4/

4 Project description

The pilot project for household solid waste selection and collection by applying alternative technology, takes place in an urbanized area called "Urbanizacion Carabayllo"in the district of Comas. It is a pilot project which aims to determine the success or failure of new solid waste management. This is a mere solid waste management project based on recycling, transformation and re-use of materials. The project covers an area of 6 250 inhabitants which represents 1200 families. /9/

4.1 Organizations involved

Apart from the NGO "Ciudad Saludable" there are other organizations involved in the project, for instance:

- PROPOLI which is a program dedicated to fight against poverty in Lima metropolitan area. This program was born as an agreement between the Peruvian government and the European Union. PROPOLI remains as the main financing part for the project.
- Ministry of women and Social development, also working through PROPOLI
- Municipality of Comas district /9/

4.2 Objectives

The objectives are divided into general and specific ranges:

General objectives

- To improve the environmental conditions of the urban area
- To guide informal scavengers to get legal employment
- To facilitate the municipal solid waste service

Specific objectives

- To reduce soil contamination (illegal dump yards)
- To reduce air pollution caused by informal waste incineration
- To provide environmental information to inhabitants

4.3 Methods

There are different methods used in this project, these represented gradually. These methods are:

- To identify scavengers

  The informal scavengers are identified by the municipality as legal workers. This gives the scavengers the chance to create their own enterprise and also being sponsored by the local authorities.

- To provide training for scavengers

  The scavengers get environmental information related to solid waste management. This knowledge must be also used to spread information to inhabitants of the urban area.

- To sensitize inhabitants

  The informative function is an essential part in this project. It determines the public participation and respectively the success or failure of the project itself. This task is performed by a team of volunteers working for the NGO.

- To determine a commercialization placement

  A commercialization placement is necessary in the project area to deal the solid waste obtained from the inhabitants. The placement is decided by the means of location, price and availability of services.

- To set up a temporary storing placement

  The collecting of valuable solid waste often happens in a primary stage; therefore a better selection of materials should be done. The solid waste collected is taken into a placement where it is temporarily stored and sorted in different types of valuable materials, for instance: White paper, cardboard, newspaper separation.

- To organize and distribute scavengers

  A route plan is designed for the scavengers to keep organized shifts. The distribution brings a better comfort for the inhabitants participating in the project. There are 2 shifts in two sequences:

  Route 1A: (Days: Monday, Wednesday and Fridays) (Time: From 07.00 to 13.00 hours).

  Route 1B: (Days: Tuesdays, Thursdays and Saturdays) (Time: From 07.00 to 13.00 hours).

  Extra route goes from 21.00 to 22.00 hours.

- To encourage public participation by reducing taxes

  The municipality administration analyzes the possibilities for reducing household taxing to inhabitants. It is an innovation to encourage people to participate in the project. /9/

4.3.1 Specifications for solid waste selection

The specifications for solid waste selection are based on the production of solid waste generated by the inhabitants and the price given to the different collected materials.

Materials flow and waste generation can be easily demonstrated with the following flow chart where usable materials and waste are separately indicated.

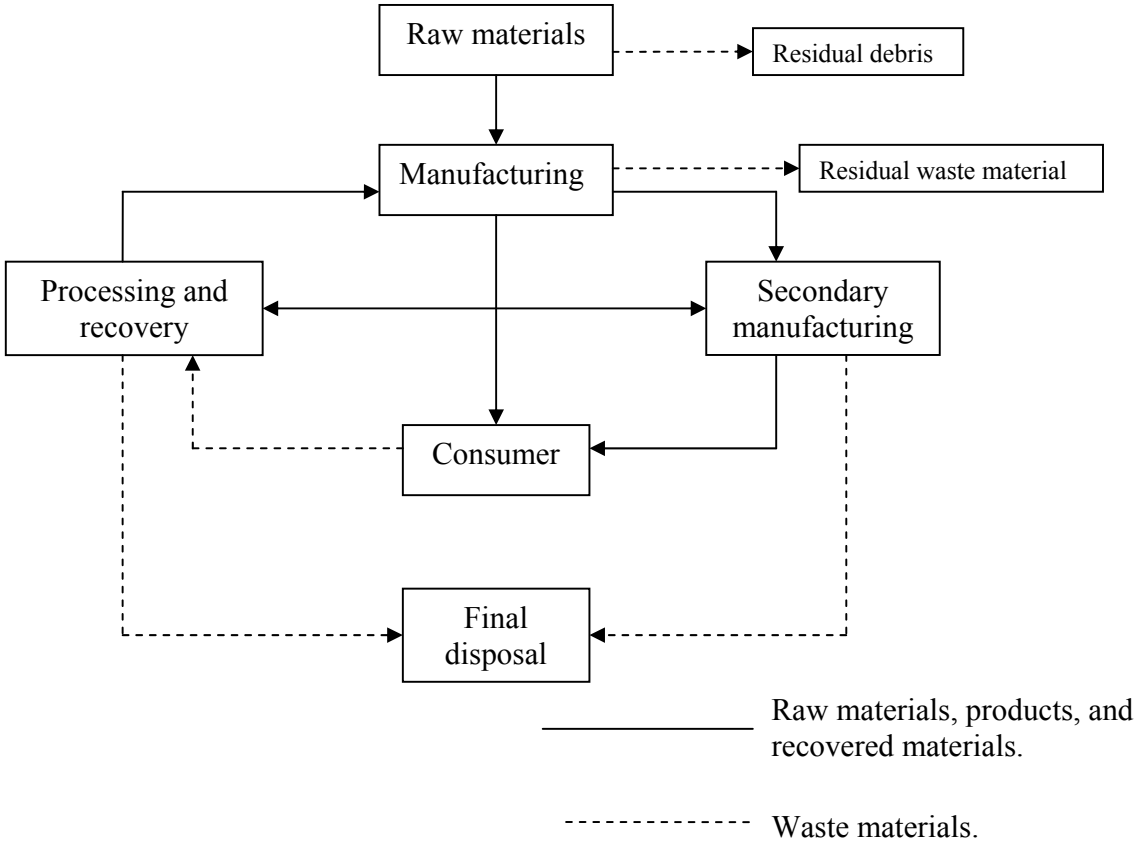

Figure 2 Material flows and the generation of solid waste in a technological society. /7/

As seeing in the figure above the amounts and thus the reusable materials are quite substantial. The processing of products results in waste generation which is handled to return into the production cycle as a raw material.

4.3.2 Production of solid waste on the field

The solid waste production in "Urbanization Carabayllo" can be seen best in the table below:

Table 4 Solid waste production at the "Urbanization Carabayllo"/5/

Population (Inhabitants)	**Production per capita (Kg/Person/Day)**	**Production per day (Kg)**	**Production per month (Kg)**
6250	0.62	3875	116 250

4.3.3 Composition of solid waste

The composition of the solid waste generated in the "Urbanization Carabayllo" is defined by the following distribution:

Table 5 Composition of solid waste at the "Urbanization Carabayllo" /9/

Component	**Composition (%)**
Organic waste (food)	34
Paper	11
Cardboard	3
Hard plastic	4
Soft plastic (Bottles)	8
Metals	3
Textiles (mixed)	6
Glass	2
Others (Inorganic material)	29
Sum	**100**

4.3.4 Valuable solid waste

From the SW generated by the inhabitants, only the valuable materials are taken into consideration for the project. Regarding to composition and daily SW production, the approximated composition and weight of the valuable materials are shown below:

Table 6. Composition and weight of valuable solid waste /9/

Component	**Composition (%)**	**Weight (Kg)**
Paper	11	425.7
Cardboard	3	116.1
Hard plastic	4	154.8
Soft plastic (Bottles)	8	309.6
Metals	3	116.1
Glass	2	77.4
Total	**31**	**1199.7**

The demand for certain type of SW valuable materials also depends on the prices present in the market. In the following table there are the prices in Peruvian Soles to each valuable material and the estimated profit that could be achieved in the project:

Table 7. Prices for solid waste valuable materials and estimated profit making /9/

Component	**Composition (%)**	**Weight (Kg)**	**Cost per unit (S/.)(*)**	**Total cost (S/.)**
Paper	11	425.7	0.50	212.85
Cardboard	3	116.1	0.30	34.83
Hard plastic	4	154.8	0.45	69.66
Soft plastic (bottles)	8	309.6	1.00	309.6
Metals	3	116.1	0.15	17.415
Glass	2	77.4	0.10	7.74
Total cost per day (S/.)	**652.095**			
Total cost per month (S/.)	**19562.85**			

(*) Information obtained from the local market

4.4 Procedure

The activities developed in the project started after the planning part had been set. These activities are performed mainly by the volunteer's team within the participation of the community, municipality and NGO members. The activities present in the procedure are as it follows:

- Coordinating meetings within the community members to inform the inhabitants about the program of the project, this happens through verbal speech and media sources as radio spots.

- Offering information concerning to solid waste selection to each household, performed by the volunteer's team aiming to persuade people to collaborate in the project.

- Giving out collecting racks to inhabitants aiming to get valuable solid waste material in return.

- Generate employment for scavengers; an enterprise is registered to operate legally.

- Authorizing scavengers to operate in the area, authorized by municipal authorities and the community.

- Environmental education sessions given to inhabitants and scavengers through diverse activities, for instance theatre acts, pamphlets distribution and public speech.

- Advising scavengers to keep the enterprise with sustainability and prosperity.

- Implementing better equipment and material to scavengers to facilitate their tasks. /9/

Picture 1. Picture showing volunteers informing inhabitants about solid waste management.

Picture 2. Picture showing the volunteer's team having a theatre act performance about environment and solid waste management importance.

4.5 Results

The results that were obtained after the operation time of the whole procedure are represented in the following manner:

4.5.1 Public participation

The participation in the "Urbanization Carabayllo" represents about 30.2 % of the total population. A similar percentage of inhabitants (33 %) do not participate, only 1.4 % rather recycles independently and 35.4 % did not answered.

Table 8 Participation and quantity results for the solid waste management project /9/

Description	Population (inhabitants)	Amount (%)
Participant	1088	30.2
Non-participants	1190	33
Recycle independently	52	1.4
Unknown	1275	35.4
Total	3605	100

4.5.2 Scavengers

The scavengers are one of the most important parts in the project. The improvement in production of valuable solid waste determines the improvement caused by the project. The economical results show clearly a better performance by the means of profit increase and landfill payment decrease. This makes possible to generate savings for the municipal budget.

The individual results given for the scavengers are an average from the total amount represented in the table. Usually the amount of valuable solid waste collected varies due to season, route distribution and availability of participants. Therefore the profit also depends on the factors mentioned before.

Table 9 Scavengers collection and profit obtained in the project. /9/

	Amount collected per day (Kg)	Amount collected per month (Kg)	Profit per day (S/.)	Profit per month (S/.)
Scavenger (Individually)	78	1914	22	512.5
Total	319	7655	88	2050

Table 10 Savings obtained from collected material

Participants	Valuable SW collected per month	Landfill fee/TM (S/.)	Savings per month (S/.)
1088	7655	9.58	73.3

Picture 3. Picture showing the scavengers team's equipment sponsored by municipal authorities.

Picture 4. Picture showing the scavengers keeping a formal job after the creation of Jerusalem S.A.C. enterprise.

5 Research analysis

The whole chain of solid waste management may be defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing, and disposal of wastes in a manner that is in accord once with the best principles of public health, economics engineering, conservation, aesthetics and other environmental considerations, and that is also responsive to public attitudes. The solutions to handle solid wastes may involve interdisciplinary relationships among environmental, social and economical fundaments as it is present in this case study. /7/

5.1 Environmental settings

The main environmental issues related to MSW management project are analyzed and shortly discussed. This part is divided into two main issues terrestrial environment and solid waste management.

5.1.1 Terrestrial environment

Urban areas remaining inappropriate MSW management represent an environmental treat. The main problem identified is the utilization of urban space for illegal MSW disposal which also brings some consequences as:

- Contamination caused by illegal incineration in open areas. This causes hazardous liquid, solid and gas emissions to the environment.
- Pathogenic risks, for instance lay in degradation of waste in aerobic conditions that causes existence of micro organisms and also intromission of insects, rodents, etc. which may cause disease spreading in the urban area.

Therefore, the minimization of MSW makes possible the eradication of illegal waste disposal placements around the community. The practice of minimization is shown in the following graph:

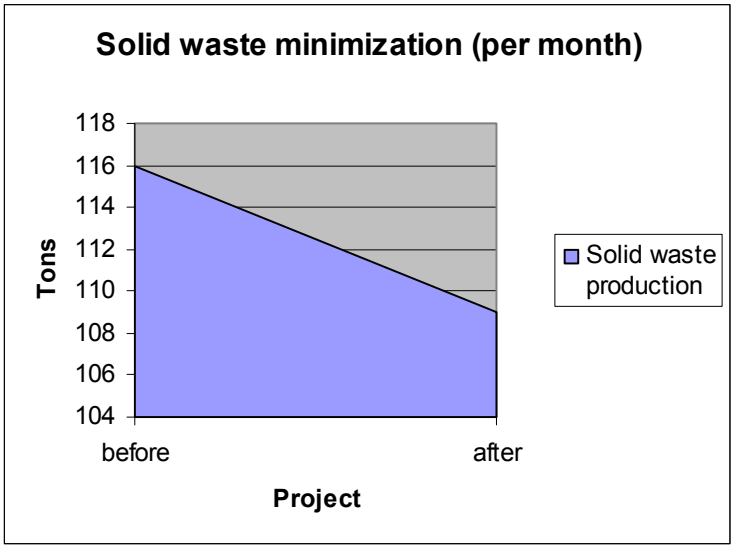

Figure 3 Municipal solid wastes minimization./9/

The graph shows the progress reached by the community in a short term of 30 days; it is decreasing the MSW production from 116 250 to 108 595 kilograms (116 to 109 tons approximately). This decrease determines the improvement done for the eradication of illegal waste disposal placements.

5.1.2 Solid waste management planning

The implementation of an alternative solid waste management system has led the community to a significant change for the MSW production. /1/

The structure of the traditional solid waste management model has changed, converting the community into an active participant for the whole Solid waste management. The distribution at the new model provides better efficiency in the processes of selecting and collecting of solid waste. The new structure is represented by the following scheme:

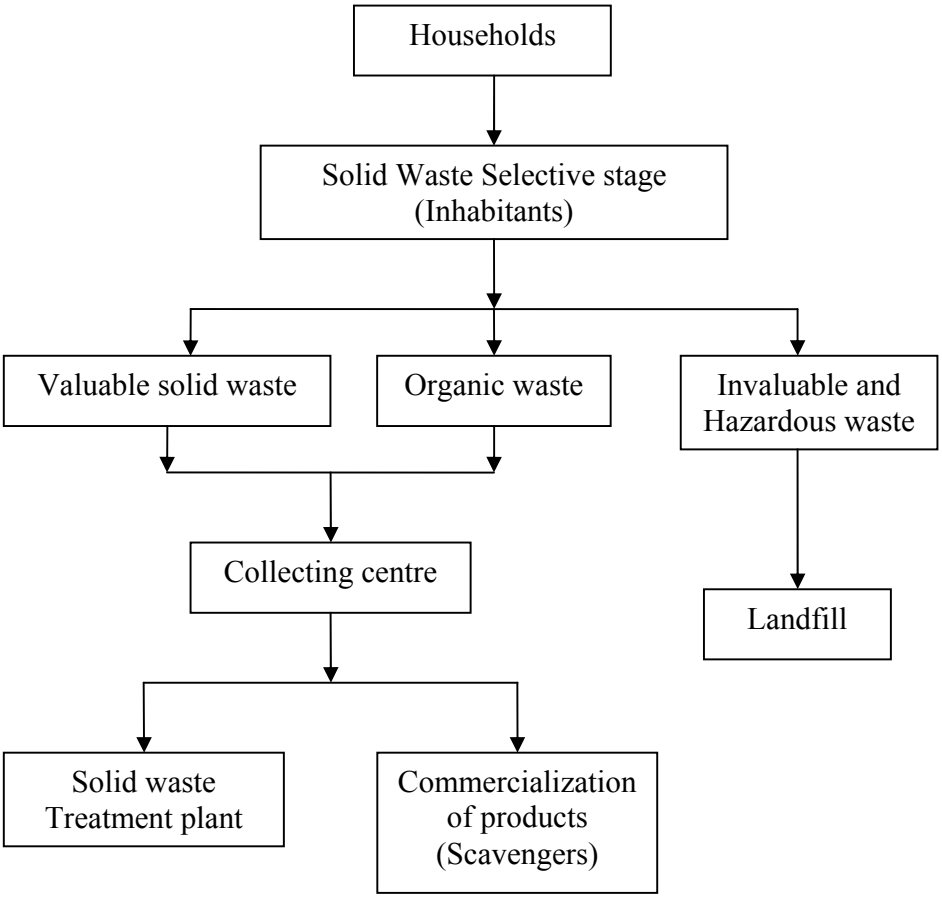

Figure 4 Solid waste management new structure /9/

In a primary stage, the solid waste is handled by the community who are responsible for the solid waste selection at the household. Later on the municipality is responsible for the transportation of the selected output. With the participation of the scavengers the valuable solid waste is commercialized. The rest of the output is handled by the municipal authorities.

5.2 Social and economical settings

Solid waste management encompasses a wide range of individual activities, which must be combined in such a way that the public, decision-makers, and planners are able to recognize and understand the important relationships present in the whole process. /7/

Social and economical activities depend on the municipality and the community interests. There are four outputs resulting from the collaboration between municipality and community for this case study, there are municipality improvements, public participation, environmental education and employment for scavengers.

5.2.1 Municipality improvements

The MSW pilot project at the "Urbanization Carabayllo" has the following impacts on the municipality of Comas:

- Increase of savings in municipal budget. (1 000 000 soles per year)
- Facilities for a better MSW service.
- Opportunities for foreign investments.

The municipality gets positive results from the project in management and also in economical aspects. The municipal budget increases by reducing costs from the less amount of waste used in land filling; the municipal also simplifies the MSW service within less amounts and better organization of space.

Finally the municipality uses the project to advertise their district as an interesting placement for foreign investment, for instance: NGO's, world wide organizations, etc. /5

5.2.2 Public participation

Everyone in the studied community generates solid waste, and the environmental consequences of its handling and disposal are broad-based. /7/

The participation of the community is the most important part for the MSW project development. There were two different questionnaires used in the project, from which the most relevant questions are taken into consideration to determine the public participation in the community. Within the selection of questions there are three statements given by the community.

- Motivation to participate

The results for public participation causes in the project are represented in the following graph:

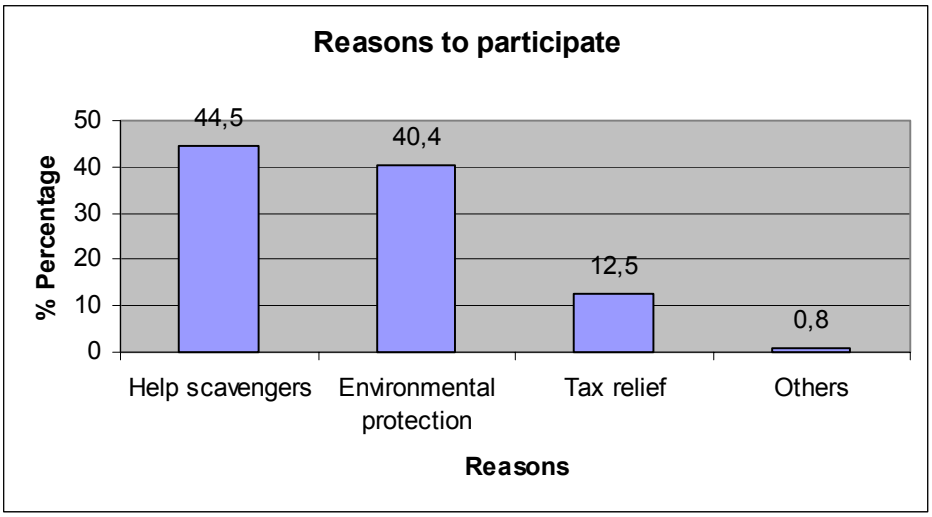

Figure 5 Participation reasons /9/

The majority of participants (84.9%) referred to pro-scavenging and environmental reasons. On the other hand, a 12.5 % of participants referred to tax relief expectations from the municipality.

- Rating the MSW project

The participants were asked their opinion about the MSW project as an alternative to solve the MSW problems in the community, it gave the following results:

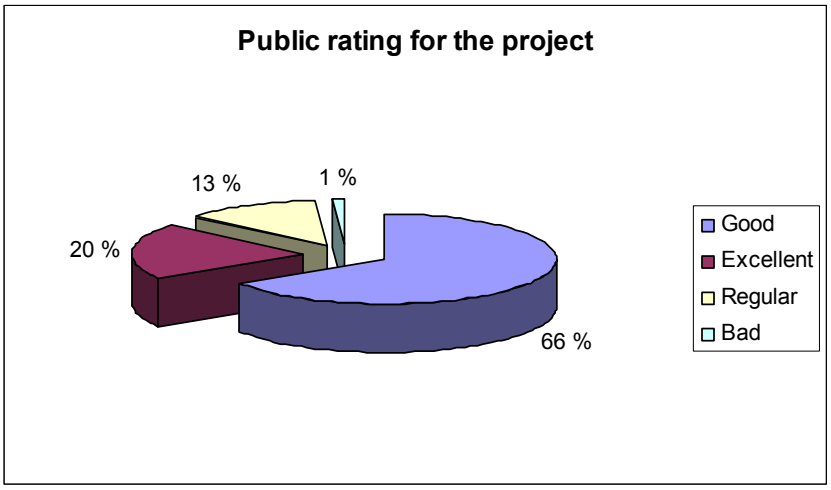

Figure 6. Public rating for the MSW project. /9/

Most of the participants (66%) coincided that the project was good for the community and 20 % showed enthusiasm to say it was an excellent project. A minor amount rated the project as regular (13%) and only 1% rated the project as bad.

- Community demands that may enhance public participation

Even though the participants are involved in the project for other reasons, there are some failures in the municipal services that could be improved and therefore enhance public participation in different projects.

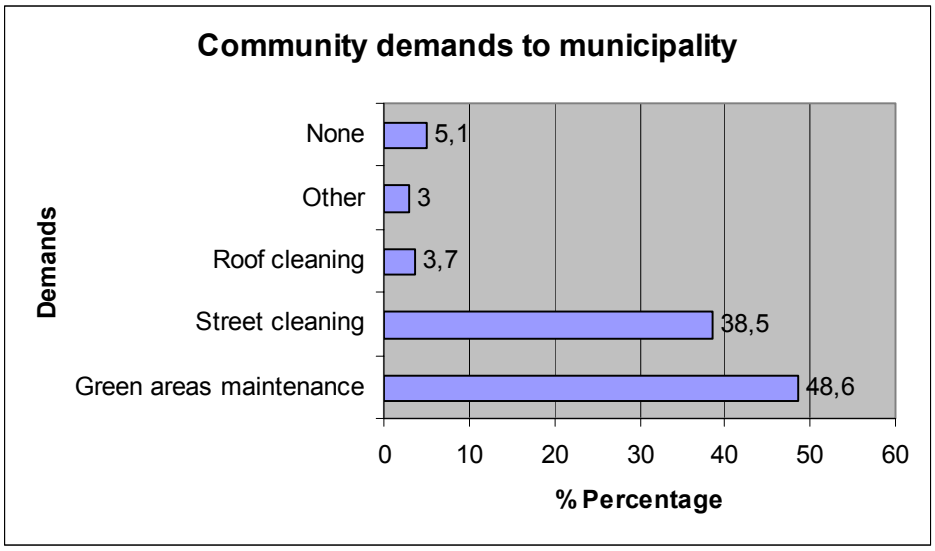

Figure 7. Community demands on municipal services /9/

The majority of participants (87.1 %) demanded improvement of the basic municipal services: green area maintenance and public cleaning. Roof cleaning was suggested by 3.7 % of participants. /9/

5.2.3 Environmental education

In the initial stage of the project, the most important method was SENSITIZING the community about MSW management and its relations to the environment. This method was the starting point to make the community to familiarize within the project aims. Therefore, knowledge none existent before, was provided to the community by informing and explaining about sustainability, improvement, quality and protection of the environment.

Individuals in the community seemed interested in the topic, and let themselves some time to think of their environment and what can be done for it. This represents a gain for those who acquired some new knowledge about environment and they might share it with others. /9/

5.2.4 Scavengers employment

The generation of employment for scavengers represents an economical and social achievement. Economical achievement, because an enterprise was created registered under municipal authorization and therefore being a formal business. Then it is a social achievement because scavenging is reported as an activity done by people from the lowest social status, but through the project scavengers do get labour rights, better employing conditions and more profit. /9/

6 Recommendations

In general, the MSW management project in "Urbanization Carabayllo" had positive and negative sides during its whole process. Even though most of the results given showed a successful profile for the whole project, there are areas that could be improved and worked better. On the basis of the results of the survey, the following recommendations are made by the author:

- **To provide better municipal legislation**

Generally, the community remains inactive in the solid waste management processes. Authorities play an important role here, by developing their legislative function as giving harder penalizations concerning to MSW disposal, dismissal, organization, recycling, etc. Proper legislation may bring order and discipline in societies which do not have strict rules.

- **Privatization of services**

The MSW services have been administrated by the municipality since its beginnings showing inefficiency and short coverage area which have led the services to constant failures. Private investment is an option that could facilitate improvement at the services.

There is an example where private MSW service is successful in similar placements, for instance: municipal solid waste services models practised in other cities in Latin America and Caribbean as Buenos Aires or Sao Paulo which has private investment remains successful in terms of coverage area, workers and efficiency. /4/

- **Solid waste management at schools**

In the recent years recycling and separation of solid waste has been introduced to schools, but this process still remains at an initial stage. Solid waste management workshops or lessons for few hours per week at schools could be an innovation to be considered for the educative institutions. It may be an optimal solution to encourage community members from early age so that solid waste management estimations for the future would have positive results.

- **Modernity**

The MSW services at the district of Comas usually remain deficiencies due to failures in different areas, for instance: constant mechanical fixing for old collecting trucks, need for waste compacting machinery, etc. Introducing modernity in MSW services may improve collecting activities but also could provide a wide range for the coverage area services. However, modernity represents improvement of services it also means high costs; private investment might be necessary for this process depending on the municipality.

7 Conclusion

A traditional solid waste management has been transformed into a collaborative system between municipality, community and scavengers despite the economical, social and educative disadvantages remaining in the area.

This project followed a methodical process which had difficulties at its beginnings within concerting between the three parties involved. Furthermore, procedures were applied on the field focusing on main targets as public participation, urban development and scavenging.

Once, collaboration between municipality, community and scavengers happened, each of them gained experience, knowledge and development at environmental, economical and social levels.

The study showed clearly the importance of public participation, in this case community. Apart from the conflictive relation between municipality and community, public participation remained active in the process. Even though it is only a pilot project, further similar works might be done more intensively and optimal conditions for an efficient MSW management can be reached.

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Appendixes

Questionnaire 1

This questionnaire is meant to obtain public opinion about the solid waste management pilot project in Comas district so that it could facilitate to identify mistakes.

Name:
Address:

1. Dou you participate in the pilot project for solid waste management?

Yes, why?

- To get some benefit
- To help scavengers
- To protect the environment
- Others reason:

2. How do you rate the project?

- Excellent
- Good
- Regular
- Bad

3. Which problems do you see in the project?
4. How could we solve those problems?
5. What kind of motivation would you want to participate in the project more actively?

Questionnaire 2

This questionnaire will be a reference for the solid waste management pilot project happening in Comas district. Through public opinion we aim to get statistical results and also identify mistakes carried out along the project.

Name:
Address:

1. Dou you participate in the pilot project for solid waste management?

2. Why do you participate in the project?

3. Do you have any complains about the project so far?

4. What can be improved in the project?

5. Would you like to have a better identification signal for municipal scavengers?

    - Sound
    - Visual
    - Alarm noise
    - Other