

Solid Waste Management in Urban Areas of Vientiane Capital City using GIS

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The purpose of this project was to research solid waste management in urban areas of Vientiane Capital City; to survey about waste collection, composition of waste and recycling for the economy; to establish waste data for monitoring and management using GIS; to improve aesthetics of the city and increase public awareness. The map created by geographic information system (GIS) was proposed to generate GIS database of solid waste with data entry of the details - spatial and attributes - bins, routes, quantity of dry waste etc. The analysis techniques were composed of database generation and map visualization. Map overlay techniques were used to study the general sources of solid waste and waste distribution boundaries. The waste collected by the Vientiane Cleaning Unit under the Vientiane Urban Development and Administration Authority, and waste pickers is thought to be different from the landfill waste. There is a lack of a data sharing and also a lack of database generation using geographic information system. Therefore, good methods of waste management and appropriate technology are needed to improve this trend

Background

Vientiane is the capital of Lao PDR and has a land area of 3,920 square kilometers. The population of Vientiane is 639,326 (Vientiane Capital City, 2003) and is increasing at a rate of 4.7% (STEA, NORAD, UNEP, 2001). Vientiane Capital City consists of nine districts, but the waste management infrastructure currently mainly services the wards (ban¹) in four of these districts: Chanthaboury, Sikhottabong, Sisattanak and Xaysettha Districts. Waste collection at the landfill was 41,489 t/year in 2001 and 42,704 t/year in 2002 or about 200-250 t per day. This equates to on average 0.75 kilograms of solid waste per capita per day. (UDAA, 2004) There is one dumping site in Vientiane. The composition of waste collected by the waste pickers' is different from waste found at the landfill, informal sector, recycling, using in home gardens, burning and dumping (Photograph 1).

The key issues of solid waste management in Vientiane Capital City are:

- Lack of awareness on the proper disposal of solid waste.
- Excess of waste collection taken to the dumping sites.
- Problems arising due to poor waste management include bad odors, numerous flies and no separation of waste into different containers;
- The generally dirty urban city and environment;
- Solid waste-related activities for poor waste pickers posing a serious threat to public health as well as an aesthetic problem in the city.

The objectives of the solid waste management in urban



Photograph 1. Waste pickers at the Vientiane landfill

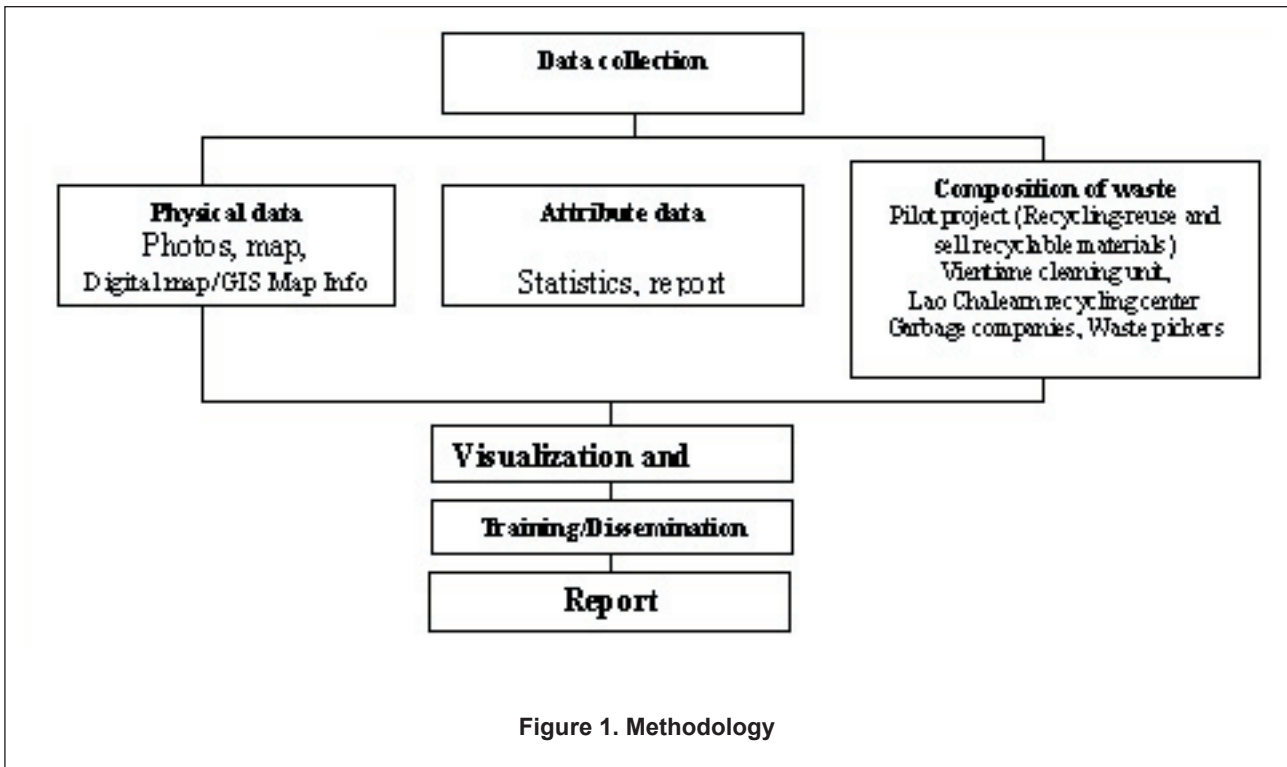
Photo credit: Sivannkone, EQMC, STEA, 2003

areas of Vientiane Capital City project are as follows:

- To survey about waste data collection, composition of waste and recycling for the economy;
- To establish waste data for monitoring using GIS.
- To increase public awareness;

Geographic Information System (GIS)

The Geographic Information System (GIS) helps to manipulate data in the computer to simulate alternatives and to take the most effective decisions (Narayan, 1999) GIS is a tool that facilitates mapping and spatial analysis of the Earth's features and events. Using GIS, otherwise disparate data



can be related on the basis of common geographical components: an address, postal code, census block, city, country, or latitude/longitude coordinate. GIS provides the facility to extract different sets of information from a map (roads, settlement, model the path of air pollution, solid waste and much more.) It is a dynamic system to select or remove any criteria on the map to quickly analyze and ultimately make decisions for complicated problems.

Methodology

In 2003, survey work was divided into three parts physical data, attribute data and composition of waste in the landfill - to generate GIS database and data collection of solid waste. Referring to Figure 1 for the project methodology the physical data is composed of the digital map and photos.

The attribute data are the statistics data and report. A Pilot project on the composition of the waste, recycling-reuse, sale of recyclable materials by the Vientiane Cleaning Unit, and the private company. The map is created by MapInfo software. Analysis techniques are composed of database generation and map visualization. Map overlay techniques were used to study the general sources of solid waste and the waste distribution boundary.

Results are disseminated about the environment and solid waste management using GIS knowledge to the university increasing public awareness and supporting the state of environment report².

Community-based recycling

In the year 2001 a partnership project was initiated to promote recycling in three village communities and three

schools within the central districts of Vientiane. The partners include the Participatory Development Training Center (PADETC); the Rural and Urban Development Committee (RUDC); the Vientiane Urban Development Administrative Authority (VUDAA); Lao Chareon (a private recyclable waste exporter); the respective village authorities; the school directors of the three communities; and the three schools involved.

The funding for this project was originally from the Netherland’s Embassy in Bangkok for a total of US\$10,000. More recently, for its second phase, the project has received funding from the United Nations Development Program under the Public Private Partnerships for the Urban Environment (PP-PUE) initiative (Esther, 2003). Partners include the Science Technology and Environment Office, Vientiane Capital City (STEO), VUDAA and Lao Chareon. The objective of the project is to educate people to separate their waste in order to reduce the amount of material that goes to the landfill. The main role of PADETC is to help in the administration of the project, to train village volunteers and to monitor the progress of each participating village and school. PADETC staff provide training and education to promote recycling and they prioritize children in their efforts.

GIS For Solid Waste Management

A comprehensive GIS project for solid waste management in urban areas of Vientiane Capital City has been developed. The activities of this project are the following:

- Data collection and creation of the existing conditions on maps and attribute data stored with the GIS database so that waste generators can determine what specific types

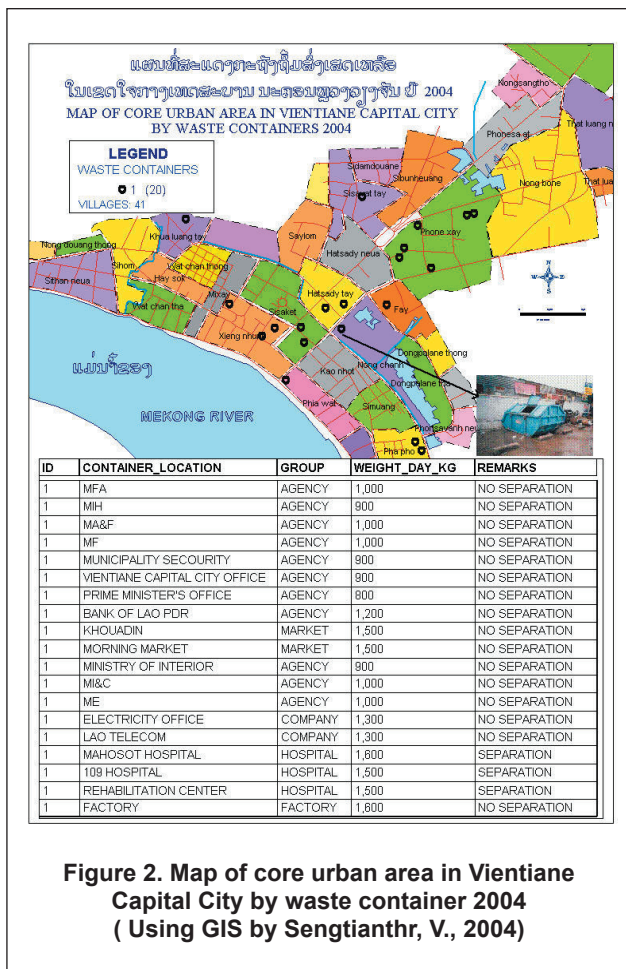


Figure 2. Map of core urban area in Vientiane Capital City by waste container 2004 (Using GIS by Sengtianthr, V., 2004)

of wastes are taken at each of the sites;

- Creation of waste quantity details;
- Data entry of the details - spatial and attribute container, routes, building, district and villages.
- Thematic mapping and analysis for solid waste management and monitor;

An example of solid waste management using GIS in urban area of Vientiane Capital City is show in Figure 2.

Waste transport: Collection of waste to the Vientiane landfill is from the following two generation sources:

1. Household collection: Solid waste collected by public or private company from residential areas; and
2. Communal container collection: Solid waste collected by public or private company from any non-residential source, such as from the line agencies, hospitals, hotels, markets, schools, banks, companies and factories.

Composition of Waste: A pilot project for determining waste composition is has improved the accuracy of estimates of the amounts of each material disposed. The landfill sites are clay lined, bulldozer-operated and equipped with a computerized weighing bridge. Frequent samples of waste

were taken from garbage trucks and separated in the field because of lack of separation of the different types of waste in to different containers and because the waste become mixed and compressed together in the garbage truck. For example, the staff of the Vientiane cleaning unit separated waste from the Khouadin bus station in Vientiane Capital City. The solid waste contained more food waste, paper and plastic than other. Types of waste see Table 1.

Table 1. Composition of waste at Khouadin bus station

Type	Weight (%)	Weight (kg)/day	Reuse/ recycling (kg)	Disposal
Paper	25	225	112.5	112.5
Glass	3	27	-	27
Plastic	25	225	157.5	67.5
Metal	1.5	13.5	9.45	4.05
Aluminum	1.5	13.5	9.45	4.05
Food waste	43	387	-	387
Other	1	9	-	9
Total	100	900	288.9	624.6

Data Entry: The spatial data and attribute data is entered into the computer systems to create maps and analysis by MapInfo software. This includes photos, building layers, routes, ward boundaries, district boundaries, quantity of waste, waste location etc.

Thematic Mapping and Analysis: This is the process of shading of maps according to a particular theme, and presented with regards to the particular attribute data. Using the thematic mapping, the project was able to analyse data, create thematic maps using ranges, pie charts, bar charts, graduations, dot density or individual attributes³. And example of thematic mapping of solid waste in Vientiane Capital City show in Figure 3

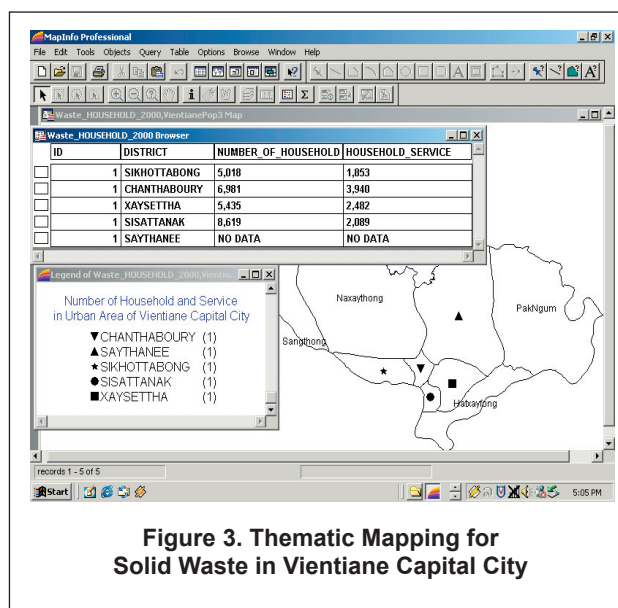


Figure 3. Thematic Mapping for Solid Waste in Vientiane Capital City

**An experience from Training Course on
Waste-Econ Project,
June 24-August 02, 2002, Vientiane, Lao PDR**

How can I reduce waste in Vientiane Capital City?

Tips to reduce waste are the following:

Reduce: The amount of waste production, source reduction, waste prevention, consuming and no throwing away. It can be as complex as redesigning a product to use less raw material in production or to use material again and dissemination awareness to people about the proper disposal of waste.

Reuse: Reusing items by repairing, or giving to someone who can repair it, donating and selling also reduces waste.

Recycle: Recycling is one of the best for the environment. recycling includes buying products with recycled content. After collection, materials (e.g., glass, metal, plastics, and paper) are separated for sale also creating jobs, reducing pollution, reducing waste to the landfill, incinerator and increasing income.

Conclusion

The number of people in urban areas in Lao PDR is beginning to grow more rapidly and the amount of waste is increasing. Therefore, good methods of waste management and also appropriate new technologies for monitoring need to be developed. Promoting waste markets and recycling would also create awareness to reduce the total volume of waste at the landfill. There is a need to improve the data system of solid waste for the monitoring and management to support environmental reports has been improved, for example, by the GIS methodology explained in this paper.

Comment

This GIS project is very important to support development of effective solid waster management, to improve environmental awareness, and for urban planning and monitoring. There have been difficulties in implementation, particularly in the lack of coordination between municipality, non governmental organizations, private sector waste collectors and local residents. Improving coordination is a key to improving waste collection systems and data sharing, through which it is hoped greater financial support can be generates.

The government of Lao PDR through STEA is seeking ways for financial and technical support to expand the knowledge generating mechanism (i.e. GIS data methodologies) to increase people's awareness and coordination of environmental issues and concerns to improve this situation.

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Footnote

- ¹ Village (ban) is the lowest level of administration in Lao PDR. This is equivalent to a 'ward' in the urban setting (English system).
- ² According to the mandate of Environment Data Centre
- ³ For more information, please see on the internet at: <http://www.mapinfo.com>

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