Application of the Geographic Information Systemon for Hazardous Waste Management: A Case Study of the Ninh Kieu District, Can Tho City

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ABSTRACT

The study was conducted to build a geo-spatial database for hazardous waste management in the Ninh Kiều district, Cần Thơ city to support managing a large database which was mainly available in the hard-copy format. The data included location of facilities producing hazardous waste, quantity and composition of waste released over the period from 2010 to 2013. Such database were collected through field surveys in combinationwith collecting secondary data from the Agency of Environmental Protection at the Can Tho city. Digitizing and structuring the collected data from different formats were done in order to standardise the available database in a GIS format. In addition, descriptive statistics and spatial analysis were applied to evaluate the hazardous waste released in the period as well as the spatial distribution of waste. The obtained results showed that the number of waste sources and volume of hazardous waste released tended to increase in the period from 2010 to 2013. In addition, there were differences in terms of quantity waste as well as unevenly spatial distribution of the existing facilities. Thematic maps were created as a suitable base supporting hazardous waste management.

1. INTRODUCTION

Geographic information system (GIS) was formed in the 1960s and strongly developed in many countries globally. In the recent years, in Vietnam, GIS and GPS (Global Positioning System) have been significantly developed to support monitoring and managinggeo-spatial database. Especially, an example of such application is the municipal solid waste management (Nguyen Thi Lanh et al., 2011, Nguyen Tien Hoang et al., 2010 and Vo Minh Canh et al., 2013). However, hazardous waste (HW) that can be harmful for human health and ecosystems (Pham Viet Hung, 2013) has not been well managed in cities. Difficulties in managing HW in urban areas include: (1) Database was stored in different forms of hard-copy (difficult to update and prone to data-lost), and (2) Attributes data were not well geo-referenced. Therefore, the aim of the study was to build a geo-referenced database to support HW management (with the case study of the Ninh Kieu district, Can Tho city (Figure 1)) to: (1) Evaluate trend of changes (in terms of quality and quantity) of HW generated through the study period (2010 - 2013); and, (2) Support the management and HW -collection efficiently.

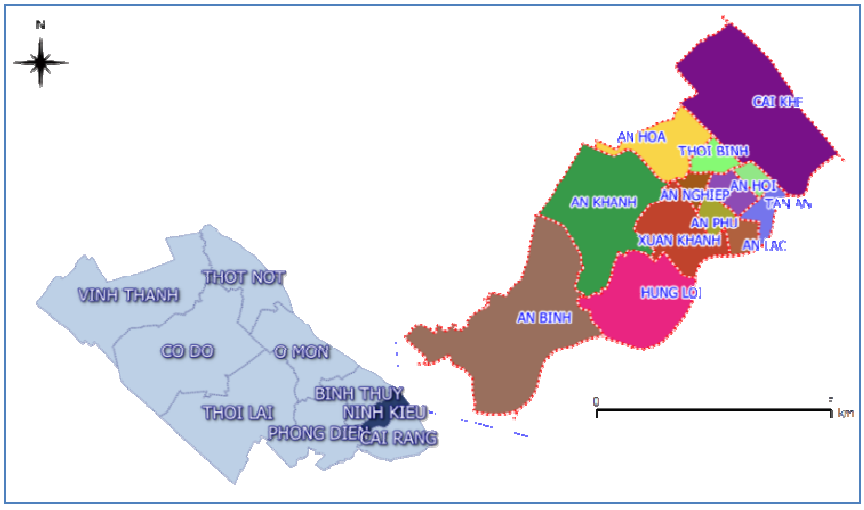

Figure 1:Geographical location of Can Tho city and Ninh Kieu district

2. METHOD

The study framework is shown in Figure 2

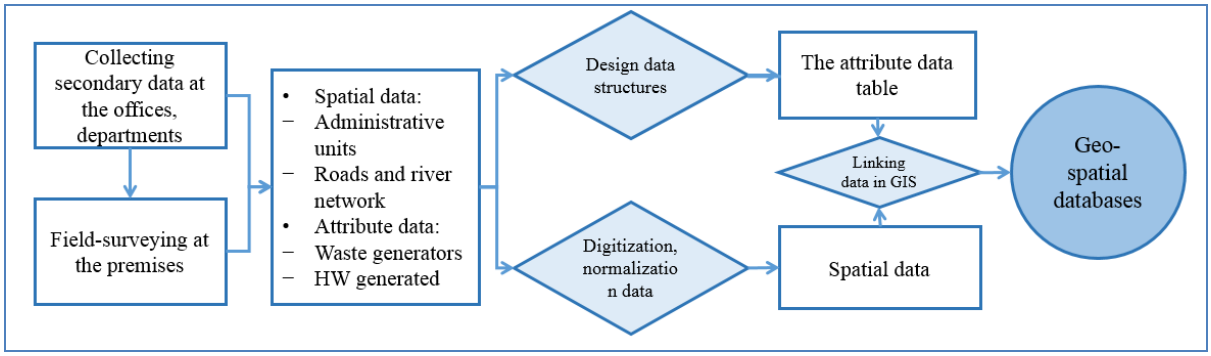

Figure 2:Study framwork

2.1 Data collection

Information of factories where generated HW in the period 2010 - 2013 were collected from the Agency of Environmental Protection of Can Tho city (ANPCT), including: (1) HW management code of waste generators, (2) Postal dddress, (3) Quantity of HW generated annually, (4) Name of sources of HW, and (5) Quantity of HW factory self-handling. After that, field survey was conducted to verify data which was collected at ANPCT as: (1) Geographic coordinates, and (2) Operational status of factory. Base map of the Ninh Kieu District such as river network, road network, map of administrative units were collected from the Department of Natural Resources and Environment of Can Tho City.

2.2 Data processing

- Descriptive statistics was applied to assess quantity of HW of factories during the study period (2010 - 2013) and amount of HW generated of each administration unit.

- Digitizating hard-copy of collected maps and other data sheets was done in Quantum GIS (v. 2.4). All layers are homogenized in the same coordinate system

- Structure of the database and associated data: Database included 6 layers that were linked by relation [1: many]. The relationship between the attribute tables are shown in Figure 3, from which central table *'chunguonthai'*was linked with other attribute tables. The table was set with the main columns as: (1) *MS_ql*was set to link with HW table (*ctnh_ps*), (2) MDVHC was set to link with administrative units (*phuong*), and (3) Msduong was set to link with road network (*tuyen duong*).

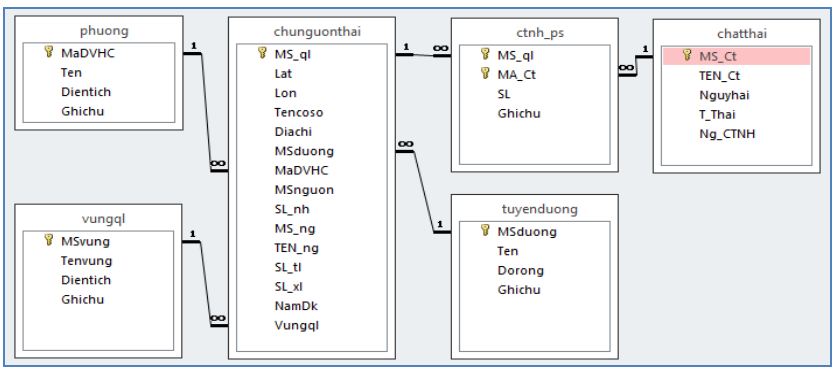

Figure 3:Relationship between the attribute table of the map layer (layer 5 maps)

- Management of hazardous waste: HW was managed by type of waste generated based on HW CODE. The management parameters included: (1) EC code, (2) hazardous properties, (3) status, and (4) the threshold of HW

3. RESULTS AND DISCUSSION

3.1Quantity of HW generated in Ninh Kieu district

HW quantity (kg) generated at 13 wards in Ninh Kieu in 2013 is shown in Figure 6. As hospitals were located in An Khanh Ward (i.e. Can Tho Central hospital, Center for transfusion hematology Can Tho, Phuong Chau International maternity hospital), the total amount of HW of An Khanh occupied the greatest percentage compared with other wards (66% of total amount of HW generated in Ninh Kieu). Althoughthe cottage industry could be found in the An Binh Ward, almost factories of the cottage industry were of the production of handicrafts and at small and medium scale;therefore, HW quantity was generated less than that of the An Khanh ward.

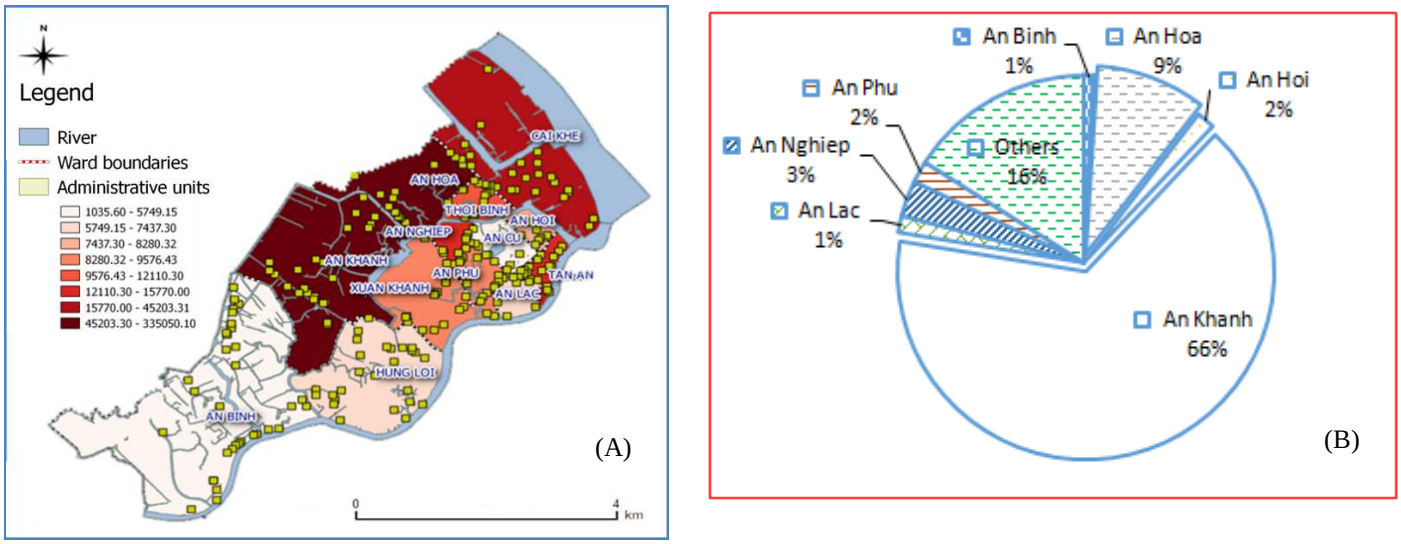

Figure 4: Distribution HW(A) and percentage of HW quatity of wards of Ninh Kieu District in 2013 (B)

Quantity of HW (kg) generated from 2010 to 2013 in the study area is shown in Figure 5. In genernal, the increasing trend during the period could be found. Although amount of HW of An Khanh and Cai Khe Ward were greatest of Ninh Kieu District, An Khanh Ward were indentied as the fastest growth in generating HW; in fact, there were many hospitals located in the ward, especially the Can Tho Central Hospital registration was just licensed with HW generated at 268,257 kg per year (it was greater than the old registration in 2008 at 156.812 kg/year).

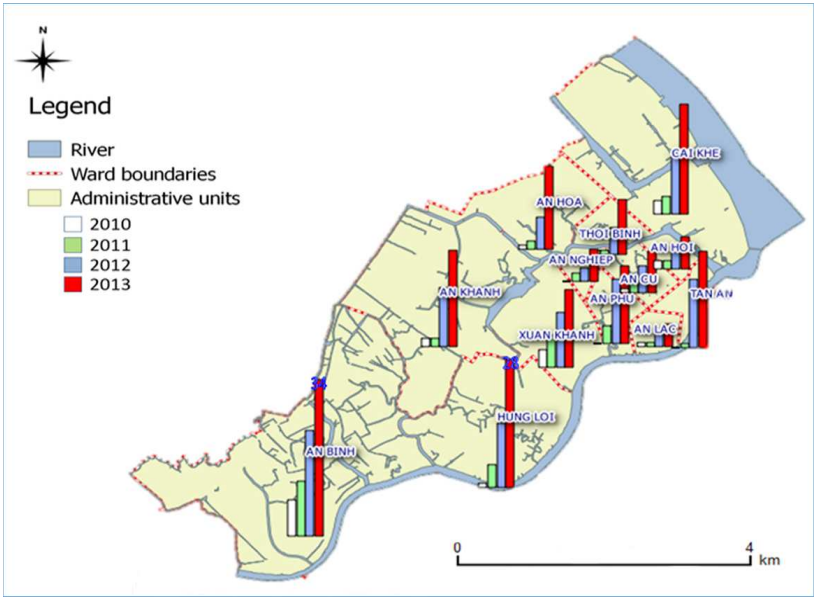

Figure 5: Distribution of the amount of HW (kg) during the study period (2010 –2013)

3.2 Movements of HW generator registration

Number of factory that registered to generate HW is shown in ***Figure 6***. The number of the factory growth fastest in Binh An Ward (from 8 factories in 2010 to 34 factories in 2013). Because this was a suburban ward of Ninh Kieu District, where population and traffic density was less serious than those of the inner wards, it was easy to build production and processing facilities such as noodle production and food companies (rice processing). The number of factory was also dramatically increasing, respectively 24 and 21 factory in 2013 (compared with 2 and 3 factories in 2010). In the An Lac and An Nghiep Ward, such the figure rose slowly (respectively 5 and 7 factories in 2013) because it was the center of Ninh Kieu District which was not particularly suitable for placing multiple manufacturing facilities.

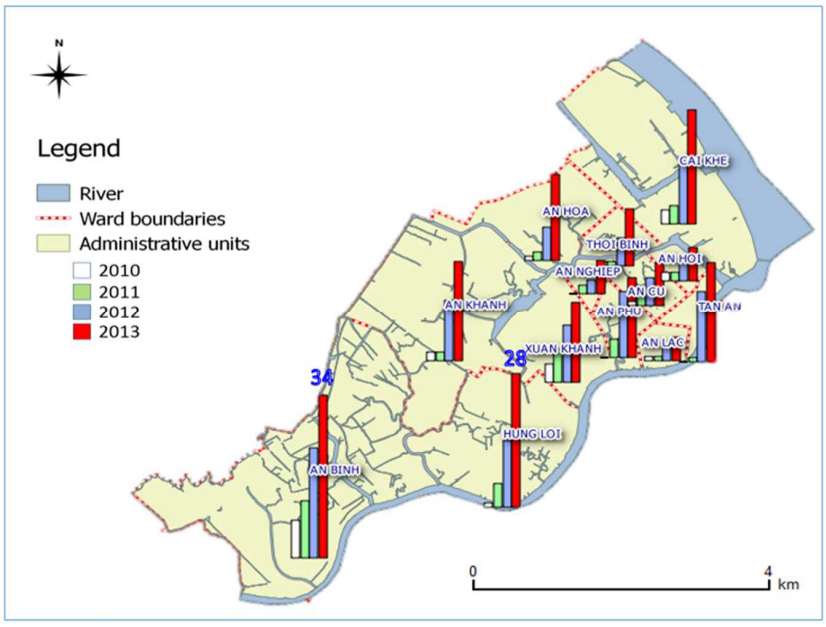

Figure 6: Number of factory registered HW during the study period (2010 –2013)

Distribution of the factories and HW quantity generated in the period from 2010 to 2013 are shown in Figure 7.The factories scattered largely in the district and often located along main roads and rivers. In 2010, quantity of HW was low (about 10 kg/year/factory). However, in the period from 2011 to 2013, HW increased in terms of quantity of HW that each factory generated, composition of HW and the number of factory. Specifically, the number of factory increased to 224 factories in 2013 and each of them released from 50 - 500 kg/year.

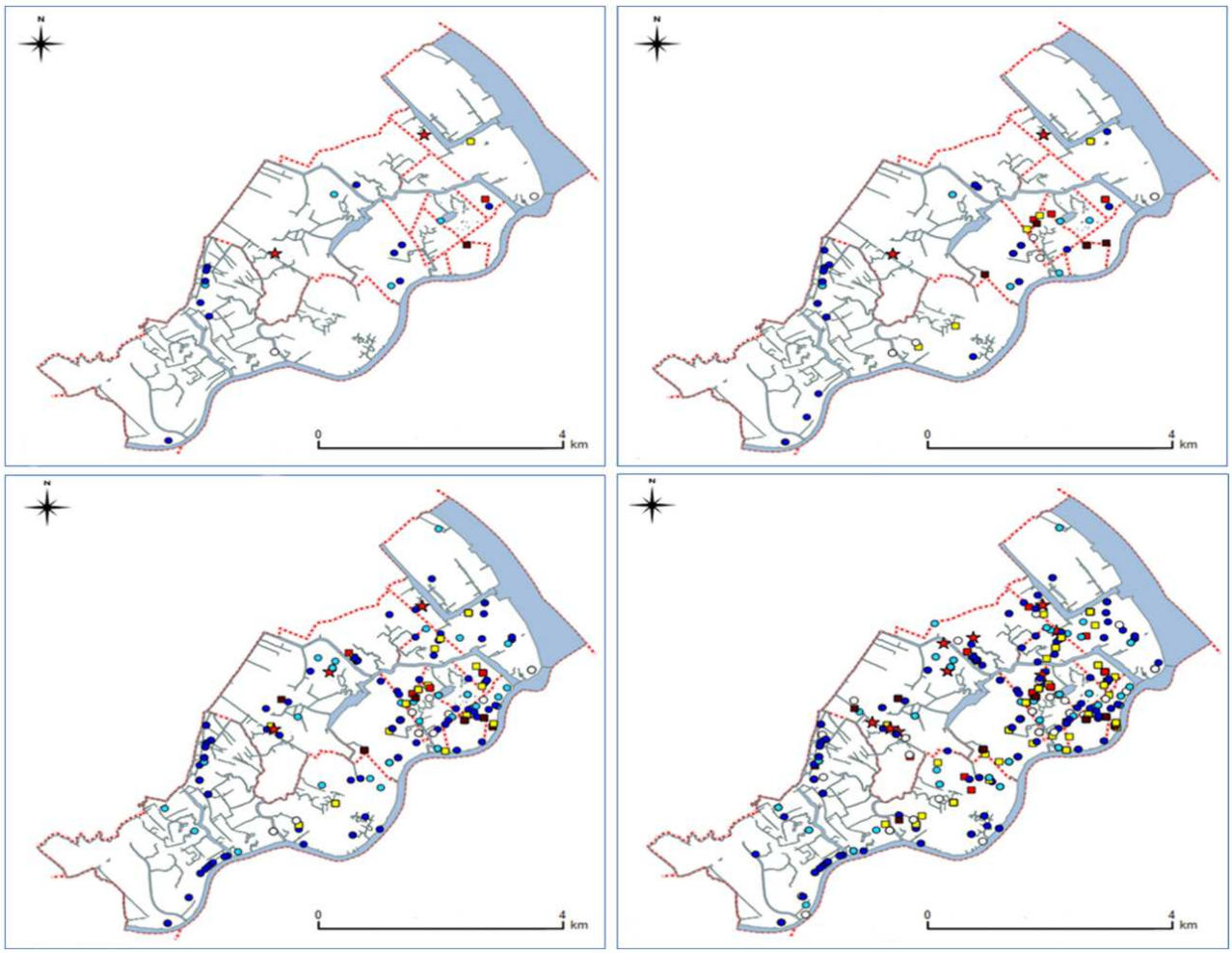

Figure 7: Distribution of the factory in 2010 (A), 2011 (B), 2012 (C) and 2013 (D)

4. CONCLUSIONS AND RECOMMENDATIONS

This research developed successfully a GIS database to manage HW in the Ninh Kieu district, Can Tho city. Such the developed GIS database include information on types of waste generated at each factory and at the administrative unit. In general, HW-generated factories and quantity of HW increased over the study period and distributed unevenly across space.

In the period before 2012, the rate of collection and treatment HW has not kept pace with waste. However, from the period of 2012, the waste has to be handled more efficiently and pass rate of waste generation.

The GIS-database was developed to manage HW at Ninh Kieu District by type of waste corresponds to a different code.

The GIS-database should be developed to be able to share many of the same uses.

5. REFERENCES

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