

Application and Spatial Analysis of Geographical Information System (GIS) Tool on Farm Compensation – A Case Study of Bibiani Gold Mine

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Abstract: Application of Geographical Information System (GIS) on Farm Compensation at Bibiani Gold Mine Concession in Ghana has addressed challenges and provided clarity to Farm compensation issues which often than not generate misunderstanding, cause double payment and hijack projects' take off among parties involved. The results revealed successful development of robust database and interactive maps that provided reliable and efficient information about affected lands, crops, farm owners, date evaluated and payment made. Now, with Geographical Information System (GIS) platform, easy access to any information regarding farm compensation in the mine can be tracked quickly from the in-built database and the interactive maps without difficult. This project would aid decision-making and efficient responses to any related Farm compensation issues in the mine for now and the future. Therefore, any farm compensation issue in the future should focus on Geographical Information System (GIS) tool or platform. For it has what it takes to store, manage, analyse, model, display, visualize and present information about spatial data, attribute data and images of objects under investigation with a click of mouse.

Keywords: Geographical Information System, Farm Compensation, Farmers

1. Introduction

Commercial gold production at Bibiani Gold Mine Concession commenced in the early 1900s and was suspended in 1915. In 1927 mining activities recommenced as the mine was developed and operated by foreign investors until it was nationalized in 1958. In the late 1980s and early 1990s GLAMCO (Ghana Libya Mining Corporation) and IGR (International Gold Resources) acquired various rights to the old Bibiani Mine and respectively embarked on separate tailings reclamation and surface exploration programmes (Smith, 2010). Due to economic mineral potential in the mine, several exploration activities and satellites pits were commissioned. As a result, number of farming activities were also affected and compensated at each new development. Some compensation were also made not to the effect of new development in the mine but the occupational safety of human beings that used the same concession for agriculture purposes. Often than not, terms and conditions about farm compensation are thrashed out but in the future when the affected farms are not demolished and new company takes over; issues like re-compensation, new crops not compensated and the compensation not

fully paid are common phrases hungered and unscrupulous farmers alarmed. Moreover, problems of different magnitudes do set in during the compensation process. Controversies over the exact farm size, the original crop types evaluated, argument over original farm owners and wrongful claims of landed property are but a few of the problems encountered during farm compensation (Mensah et al., 2010). These problems sometimes delay project commencement, and production and incur huge losses to the mining companies.

In order not to lose economic derive from Bibiani Gold Mine or delay project take off, there is the need to find an alternative method which is more efficient, reliable and business friendly to address the problem at stake. This paper therefore used Geographical Information System (GIS) tool to develop robust database and interactive maps to address the problem. In 2015, Stemn and Bilintoh used Geographical Information Systems or Geo-information System (GIS) tool that enabled them to undertake capturing, modelling, manipulation, retrieval, analysis, displaying and presentation of geographically referenced data. One of the most important

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innovations in GIS is its data visualization or graphic tools. Data visualization is the presentation of data in graphical format; current computer technology offers sophisticated techniques of data conversion into more pleasing and understandable displays. Hitherto, tables and lists of numbers were difficult to understand and their interpretation needed a careful scrutiny of the whole data. Visualization is a convenient and effective way to communicate complex information. Greater importance is being put on data visualization today and GIS is a leading technology in this movement.

2. Methods and Materials

2.1 Location and Physiography of Study Area

The Bibiani Mine concession is located at approximately 6° 27' latitude north and 2° 17' longitude west in the Western Region of Ghana. The combined size of the licenses is approximately 49 km². The southern boundary of the license is about 2.5 kilometres north of the town of Bibiani. The Bibiani mineral concessions lie approximately 80 kilometres south west of the Ashanti capital, Kumasi. The principal and most practical access to the mine is from the east, along the Kumasi – Bibiani – Sefwi Bekwi highway. The elevation of the river valleys is around 200 meters with the surrounding hills reaching 500 meters (Smith, 2010). The hills occur in ranges trending SSW to NNE, following the main structural grain of the area. The Pamunu is the main river dewatering the license area and flows in a westerly direction into the Tano.



Fig. 1.1: Location of Bibiani Gold Mine Concession

2.2 Data Acquisition and Geographical Information System

Developing GIS platform to monitor and evaluate farm compensation entails preliminary reconnaissance on the affected farm lands; survey and

collection of farm data; compilation and validation of data; Creation of farm database; Plotting of data; Creation of thematic layers and maps; Analysis, display and visualization of data on map and Hot linking images to file. Compilation of survey data began by collection of geographical location (x,y,z) of affected farms using survey instrument, Geographical Positioning System (GPS). Position of each affected farms were picked and the data processed. Other attribute data such as crop types, farm owners, date of evaluation and payment were also captured. Because the survey data is often extensive, we decided to present the data compilation into Microsoft Excel spreadsheets, each of which includes all the information about the compensated farms. The data compiled in the Excel spreadsheets include spatial data of each farm land and affected crops and corresponding attribute data. The GIS tools have no extension for importing attribute data for spatial data unless incorporate with SQL server.

Data were further validated to eliminate points that overlap or crosses each other during the course of plotting. During the creation of database for compensated farms in the GIS environment, four main steps were involved: 1) Data investigation – this includes, considering the type, quality and quantity of data to be included in the database. Here the nature of entities and attitudes is decided. 2) Data modeling – this is the process of forming a conceptual model of data by examining the relationships between entities and characterization of entities and attributes. This stage like the data investigation stage can be carried out independently of the software to be used. 3) Database design – is the creation of a practical design for the database. This will depend on the database software being used, and its data model. This is the process of translating the logical design for the database into a design for the chosen DBMS. Here, field names, types and structures are decided. In practice, the design is compromised to fill the database design model with the chosen DBMS. 4) Database implementation – this is the procedure of populating the database with attribute data, and this is always followed by monitoring and upkeep, including fine tuning, modification and updating.

After completion of the database, the data were then plotted in the ArcView GIS environment. Thematic layers showing the spatial distribution of a particular geographic feature or phenomenon were generated, categorized and symbolized using three basic symbol types: point symbol, line symbol and area symbol. In this project particular, two layers together formed thematic map. Which are; point symbol (such as cropdata.txt and farm data) and the polygon symbol (such as farm.shp which was digitized). Switching on

or activating two or more thematic layers formed a thematic map.

3. Results and Discussion

3.1 Farm Database Modelling

The result shows master database (Fig.1.2) for both spatial and attribute data of the affected crops, farm lands and farm owners. In the database, the

geographical reference points, farm size, farm owner, types of crops affected or evaluated, date of evaluation, date of payment and images (crops and farm owners) were captured. This helps any other analysis like display, query, visualisation, identification, hotlinking and mapping to be done from the master database.

Shape	ID	Farm Owner	mature crop	medium crop	small crop	Farm location	Farm size(acres)	crop counted by	ps
Polygon	1	Juliet Asante	oilpalm agric, citrus	cocoa, oilpalm agric, cashew,	oilpalm loc, cocoa	Ahimman	2.26	Garboo	NGBL
Polygon	2	Kwaku Sunkwa	citrus	cocoa, oilpalm agric, citrus	oilpalm loc	Ahimman	0.08	Garboo	NGBL
Polygon	3	Sera Nyamekye	citrus, yam, cola, oilpalm loc	cocoa, oilpalm loc	none	Ahimman	2.76	Garboo	NGBL
Polygon	4	Elizabeth Asamoah	cocoa, oilpalm loc, cit	cocoa, cassava, plantain,	oilpalm loc, cocoa	Ahimman	2.02	Garboo	NGBL
Polygon	5	Abena Amanfo	oilpalm loc, citrus	cocoa, oilpalm loc	none	Ahimman	0.07	Garboo	NGBL
Polygon	6	Florence Tawia	cocoa, oilpalm agric, citrus	oilpalm agric, citrus, teak	teak	Ahimman	2.14	Garboo	NGBL
Polygon	7	Felix Owusu	cocoa, oilpalm agric, yam, pea	pineapple, citrus, pear, mango	citrus	Ahimman	2.10	Garboo	NGBL
Polygon	8	Osei Kofi	oilpalm loc	oilpalm loc	oilpalm loc	Ahimman	2.25	Garboo	NGBL
Polygon	9	Yaw Mensah	teak, cocoa, citrus	cocoa, plantain	plantain, cocoa	Ahimman	0.80	Garboo	NGBL
Polygon	10	Kwame Tsibu	plantain, yam, maize	plantain, maize, cassava	teak	Ahimman	1.50	Garboo	NGBL
Polygon	0						0.00		

Fig.1.2. Master Database for Affected Farms

3.2 Analysis and Discussion

GIS-based analysis plays a essential role in interactive mapping, efficiency and decision making support. For instance, to quickly and efficiently show information about the types of crops evaluated and compensated, thematic map in Fig. 1.3 addresses the problem as such with a click of mouse. The affected farms in the map are the polygons with different farm sizes, colors and corresponding farm owners. Quickly, to know which crops are evaluated in the green polygon (affected farmland) then querying crops from the master database will display crops like cocoa, pear and agric oilpalm. This quickly helps in the decision-making to know at hands the number of lands/farms and types of crop compensated with a click on computer house.

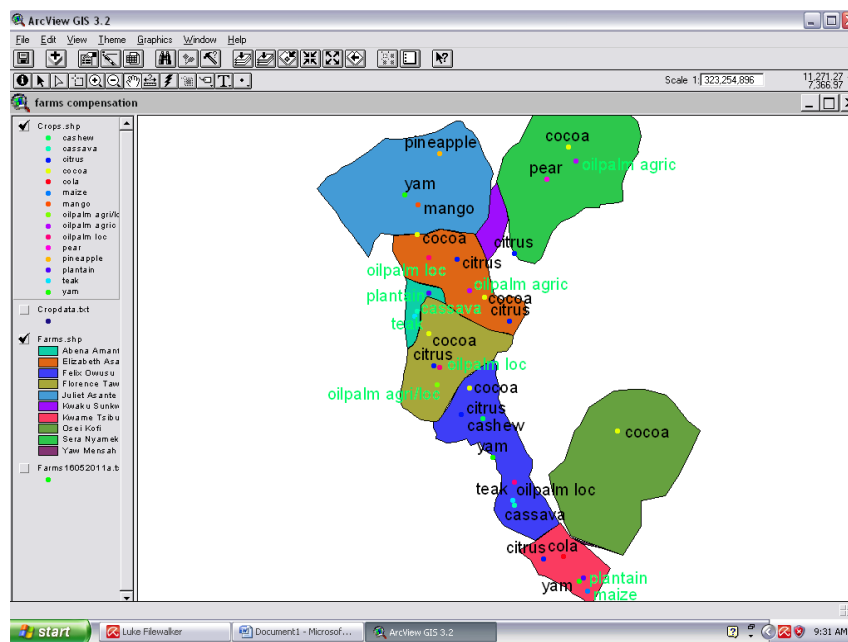


Fig.1.3. Thematic map of affected crops at individual farm land

Similarly, to know or identify the farm owners whose farms were affected and compensated, the analysis tool on the thematic map can also help to display that information quickly as as possible as shown in Fig. 1.4. In fact, this analysis helps the company to quick

know the types of crops evaluated and the period at which payment was made without difficulty. This help to reduce time and aid decision making process accurately and efficiently.

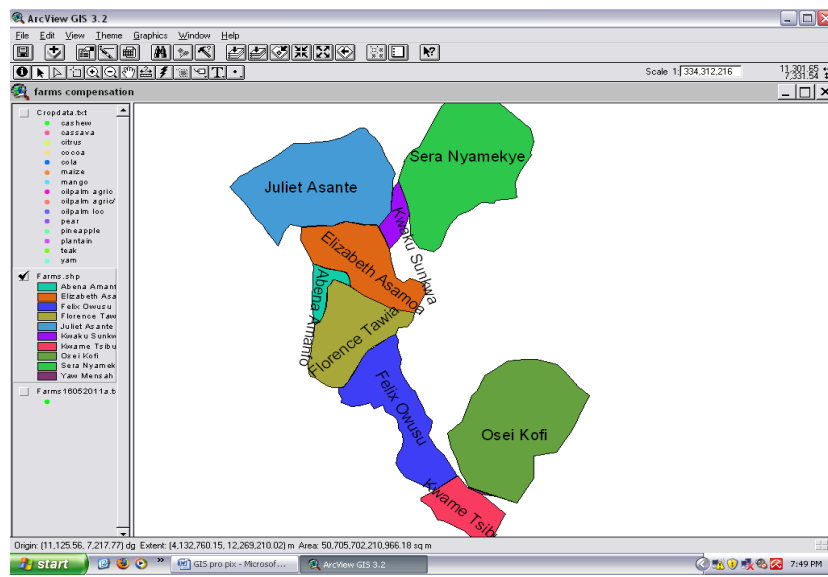


Fig.1.4. A thematic map of affected farm lands and the respective farm owners

Again, sometimes, the company would wish to know the size and image of crops such as mature, medium, small and seedlings that were compensated or evaluated. Therefore, to do this without delay and distortion the analysis tools help to query, display and visualize instantly the size of crops evaluated at each farm lands. Typical examples are what seen in Fig.

1.5., Fig. 1.6 and Fig. 1.7 which show crop sizes and images evaluated and compensated at each farm lands with the help of hotlink tool on the interactive maps. In fact, this helps management to cross check the field works, thus, enhancing transparency and accountability of compensation issues.

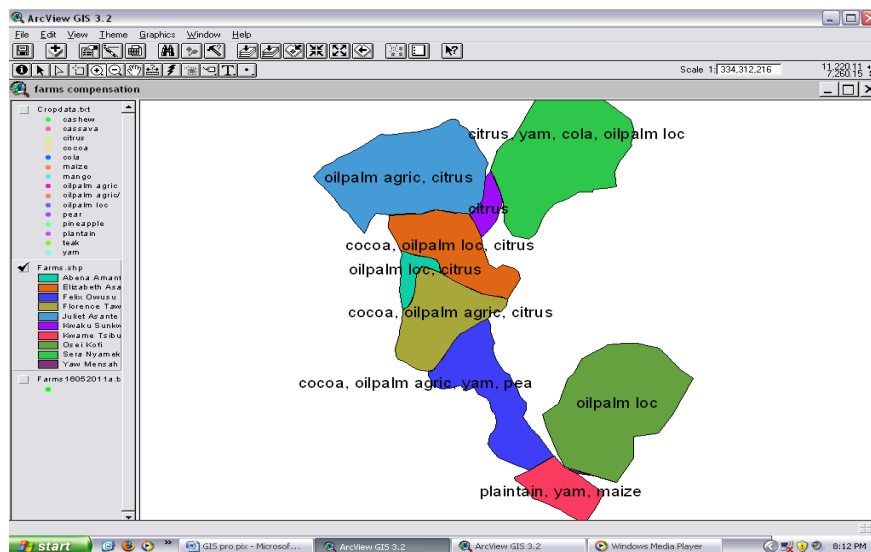


Fig.1.5. Mature crops at the affected farm lands

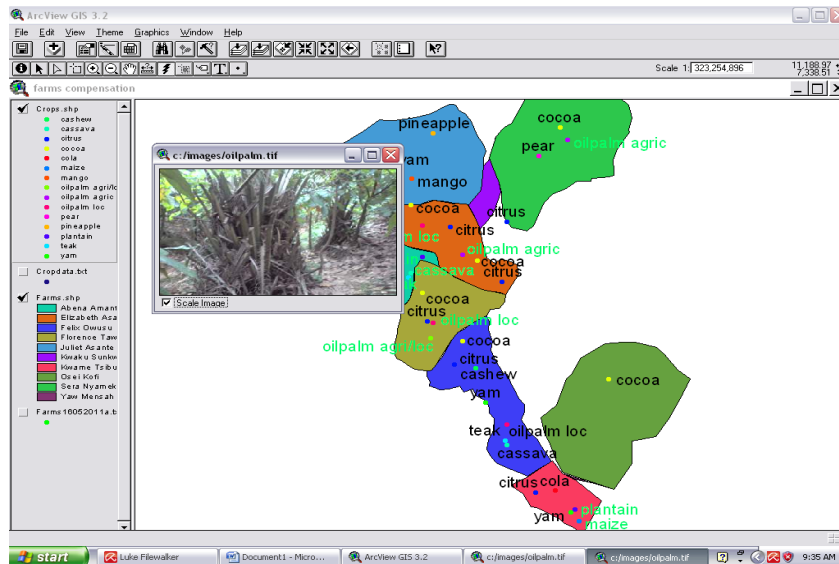


Fig.1.6. Sample Image of affected crop (i.e. palm oil) at Juliet Asante's Farm land

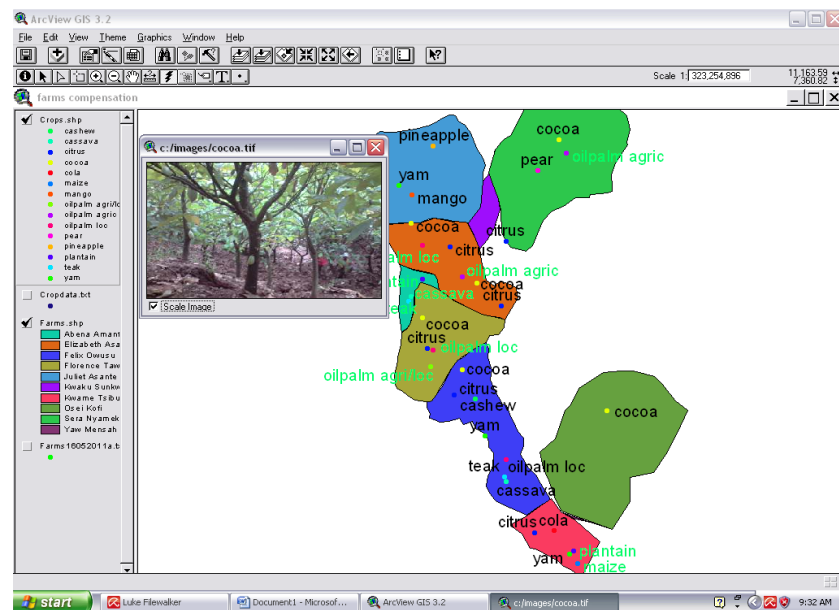


Fig.1.7. Sample image of affected crop (i.e. cocoa) at Felix Owusu's farm land

Sometimes management would like to ascertain the truth about the right crop evaluated and compensated at each farm land. At the same time, they may wish to see an image of the right farm owner whom they compensated and details about its affected land. Analysis on the GIS environment allows these problems or matters to be resolved. For an example, in Fig.1.8 detail information about cocoa crop in the

Felix Owusu's farm was viewed as such using identification and hotlink tools. Similarly, Fig.1.9 reviewed details information of farm owner, Felix Owusu (his own image and all information about crops evaluated in his farm) with just a click of mouse which can be applied to all farmers when the need arises.

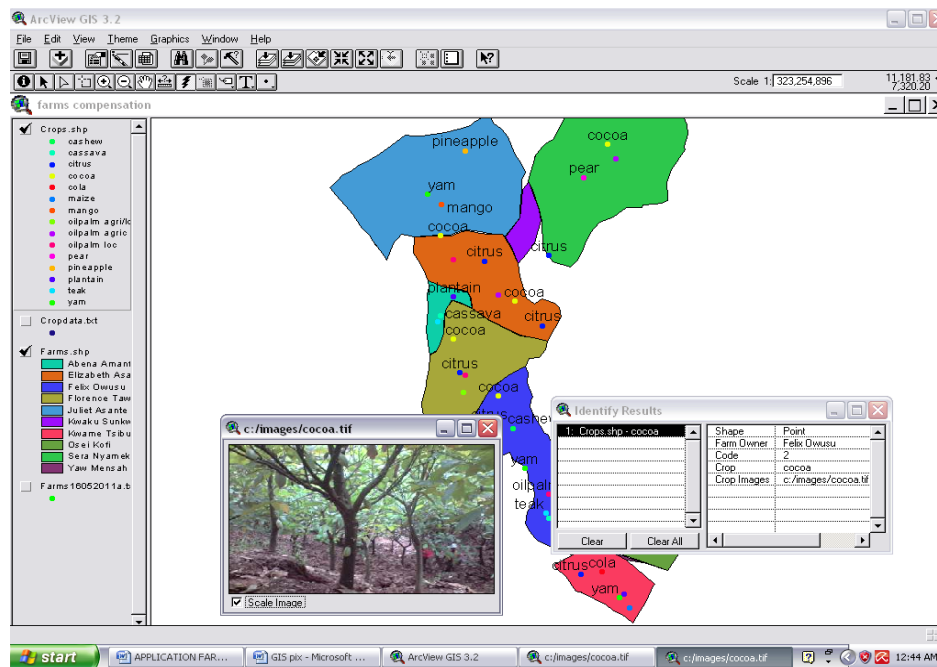


Fig.1.8. An image and quick information about cocoa crop in Felix's Owusu farm

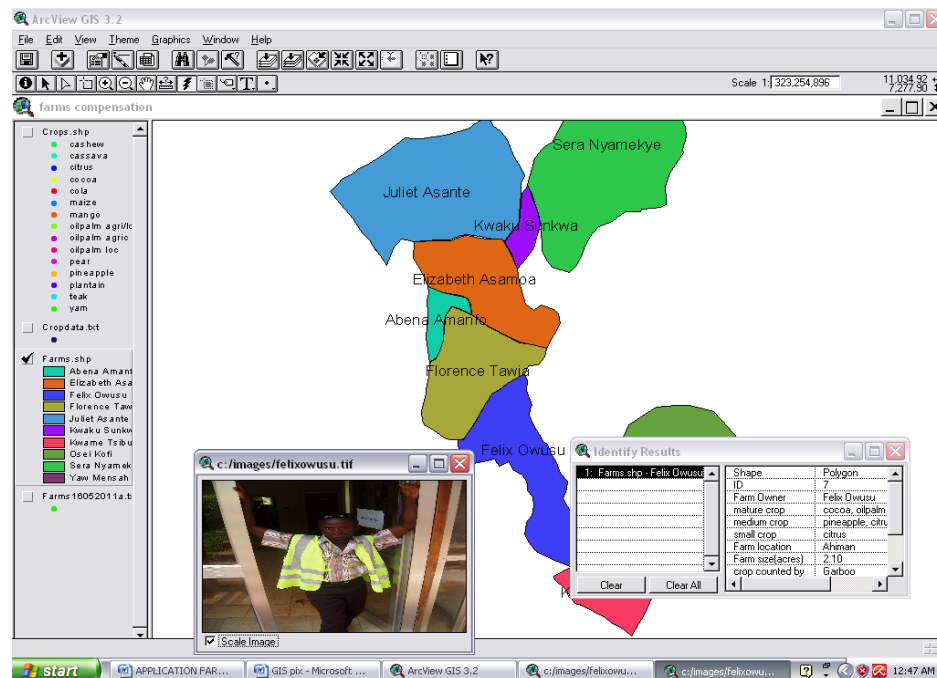


Fig.1.9. An image of Farmer (e.g. Felix Owusu) and a quick information about the affected land

4. Conclusion

Geographic Information System (GIS) tool has enabled capturing, modeling, manipulating, retrieval, analyzing and presentation of geographically referenced data of affected farm lands and crops compensated at Bibiani Gold Mine Concession. This paper further provide the company with quick access to any information about the affected farms, crops and farm owners evaluated. All the information that are needed about the farm compensation such as

attribute data, spatial data and images on the affected farms can be retrieved, displayed and analysed from master database. This project will help current and future company to curb frequent compensation issues that arise from this mine. Because Geographical Information System (GIS) has stood for the test of many challenging problems especially in surveying, mining and exploration fields; I do recommend that farm compensation should be monitored and evaluated by GIS tool. I also recommend that

managers such as mine manager, exploration manager, survey manager and managing director who have interest in day-to-day affairs of the mine install and run GIS software in their computers to monitor what goes on in farm compensation. For compensation issues are expensive and delay projects.

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References

1. Smith S. M., 2010. Independent Mineral Resource Estimation Report by SEMS Exploration Services Ltd conducted on behalf of Noble Mineral Resources Limited at Bibiani Mines. Pp 6-10.
2. Maples S., 2005. Introduction to GIS Mapping and Arcgis 9.2 Software. Yale University GIS Library: 1-25
3. Mensah A.A., Duncan E.E. and Annku M.F., 2010. Enhanced land documentation for farmland compensation a case study of Umat lands, postulated challenges and solutions. EJISDC 42(5), 1-9.
4. Stemn E and Bilintoh T.M., 2015. Municipal solid waste landfill site selection in the Sekondi-Takoradi metropolis of Ghana using fuzzy logic in a GIS environment. Journal of Environment and Waste Management Vol. 2(2), 071-078.