REFURBISH THE RUBBISH-LAND

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Abstract

Landfill nowadays is still considered as the cheapest solution in waste management especially for municipalities in developing countries. For these countries, roughly, it only requires an open space in particular location with several precondition, manual collecting mechanism (sometimes involving private partnerships), relatively low cost maintenance (mainly for the collecting instrument e.g.: trucks, containers, etc) and some very brief regulation for the waste management.

The technical requirements and regulations for a landfill has been developed from time to time and proved it has increased to high level of safety and effectiveness of a landfill operation, but in the end it only causes a high number of operational costs. Even furthermore in European Union level, one directive about Landfill (Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste) has been adapted and amended among the member countries only to result a so called "Modern Landfill" which characterized with strict controls of the potential impacts and sophisticated high cost technology. But this modern landfill still cannot cover the fact that the environmental impacts behind each landfill aren't 'disarmed' yet. Therefore recently there are even more and more landfills or 'ex-landfills' are putting under reclamation while as a substitute, some alternatives of waste management have been introduced and proved to be more environmental friendly.

There are many open landfill sites in Indonesia, which is mainly the general household rubbish, and most of the sites are used without any appropriate treatments and maintenances. Therefore nowadays, there are many concerns, issues, and problems following the existing landfills operation as well. And it will be even much more in the future regarding to the environmental pre-caution.

The objective of this paper firstly is to initate a way to prepare the transition of waste management in such developing country as Indonesia into non landfill approaches in context of landscape design and planning by creating development scenarios of reuse and reclamation the space within environmental, economical, social and time concern. Secondly, introducing new methods and technologies of municipal waste management as alternatives solutions particularly in sustainable ecologically ways for developing countries would be the inseparable complement of this paper.

Keywords: *landfill, reclamation, waste management, municipality, sustainable, environment, developing country, transition, integrated solid waste management system, recycling, composting, incineration, hazardous, pollution, remediation, public park, education, campaign, zero waste system, phase, long term, landscape design, landscape planning, public participation, production, horticulture*

Backgrounds

A landfill is a site for the disposal of waste materials by burial and is the oldest form of waste treatment. Historically, landfills have been the most common methods of organized waste disposal and remain so in many places around the world. Landfills may include internal waste disposal sites (where a producer of waste carries out their own waste disposal at the place of production) as well as sites used by many producers. Many landfills are also used for other waste management purposes, such as the temporary storage, consolidation and transfer, or processing of waste material (sorting, treatment, or recycling).

Landfill is classified into three categories based on the disposal waste type. First, hazardous waste landfill: waste disposal units constructed to specific design criteria and which receive wastes meeting the local definition of hazardous waste. These landfills are generally constructed to keep materials that present a serious hazard to human health, such as high-level radioactive waste, away from public access by double liners systems. They are restricted, by permit or law, to the types of waste that they may handle (chemical vs. radioactive, liquid vs. dry).

Second, sanitary landfills: also called modern, engineered or secure landfills, these usually have physical barriers such as liners and leachate collection systems, and procedures to protect the public from exposure to the disposed wastes. The term sanitary landfill normally refers to those where municipal solid waste is disposed of, as well as other

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wastes high in organic material. In some countries, all landfills are sanitary landfills. Landfill nowadays is still considered as the cheapest solution in waste management especially for municipalities in developing countries.

Third, inert waste landfill: waste disposal units that receive wastes which are chemically and physically stable and do not undergo decomposition, such as sand, bricks, concrete or gravel. Dumps: also simply called landfills, dumps are landfills that are not engineered with the special protective measures required by sanitary landfills. They are most common in rural, remote, and developing areas. Many jurisdictions prohibit the use of non-sanitary landfills for the disposal of municipal solid waste. Other jurisdictions that do allow dumps may require them to be constructed according to some engineering standard to mitigate the risk for environmental contamination, such as by limiting the slope, requiring compaction, or ensuring that the cell is high enough above the groundwater table (source: www.wikipedia.org).

Among the EU countries, one directive has been set up to give the requirements and standards applicable to landfilling activities in order to minimize the impacts. The directive provides that:

1. all landfills are classified in three categories, according to the type of waste they receive,
2. operators demonstrate that they and their staff are technically competent in managing the site and have made adequate financial provisions to cover the maintenance and after-care requirements of the site,
3. operators comply with higher engineering and operating standards and the more onerous conditions set out in the landfill permits e.g. for landfill gas, water and leachate management,
4. certain hazardous and other waste, including liquids, will be prohibited from landfills,
5. pre-treatment of waste prior to landfilling will become a requirement, and
6. operators of existing landfills must, by certain date, submit site conditioning plans for all existing sites, in order to comply with the requirements set out by the LD (Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste).

Due to this regulation strictness, highly cost technology and management and negative environmental impacts that carried by implementation of it, landfill is not anymore popular option for waste management. But on the other hand, landfill implementation in most of developing countries is still considered as a 'cheap and easy' way of dealing with waste management particularly for municipality solid waste. Landfills in most of developing countries particularly in Indonesia are basically categorized as sanitary landfill but in fact, the treatment method, management and maintenance procedures are still as minimal as for dump sites. This brings high possibilities of landfill failures and malfunctions followed by numbers of negative environmental impacts.

Therefore there are numbers of landfill reclamation cases particularly in western countries and also numbers of alternatives in waste management that has been introduced and implemented with a relatively successful result. These landfill reclamations has been developed within a multidiscipline effort, practical and theoretical, among scientists, engineers, planners, landscape architects and regulators. Especially for landscape architects, their contribution has been increased because of the ability to work with huge open spaces, which landfill usually is, and the using of plants for passive reclamation method.

Such a method as phytoremediation is often suggested with landscape architects as the main contributor for the landfill reclamation. Phytoremediation is the use of plants for remediation of soils, sediments, and water. Phytoremediation processes include either direct uptake of contaminants by plants and the resulting accumulation, biodegradation, or volatilization of those contaminants and enhancement of the biodegradation process in root zone, which is referred to as the rhizosphere. The evapotranspiration processes of plants can also be used to reduce infiltration of surface water, serving as natural barriers or caps.

The future for phytoremediation holds promise in the overall remediation marketplace as the trend toward more passive remedial technologies and recognition of the importance of natural processes continues. There will be growth in three areas: the types of vegetation used for phytoremediation, expanded applications of phytoremediation and integration of phytoremediation with natural processe, engineered systems and landscape architectural design and site planning.

The advantages of phytoremediation are the low cost of the technology (it is generally about one-fifth of the cost of more conventional technologies), environmental compatibility, and public acceptance. Phytoremediation can also be used as a single treatment technology, or it can be coupled with more aggressive conventional technologies such as excavation and treatment/disposal, or less aggressive technologies such as natural attenuation. In addition, phytoremediation can be integrated with landscape design practices such that a remediation system can be positive addition to the property. Phytoremediation is a long term remedial technology at most sites, with treatment times on the order of

several years (Carman, 2001).several years (Carman, 2001).

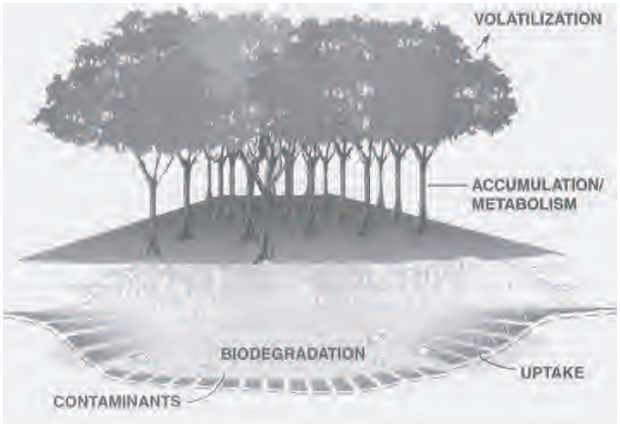

***Image 1**: Phytoremediation Processes (source: Kirkwood Ed., 2001)*

The last character of phytoremediation mentioned above will be a disadvantage for most developed countries because of their rushed need of the healed spaces for further development. But on the other hand for most of the developing this long term process would be the right approach for dealing with landfills regarding the needs of preparation for the substitute waste management, technology improvement, regulation and operational set up, new uses design and planning, and conditioning of the society and regulator behaviours.

Method of inquiry

The method that will be used for completing this paper are studying all the possible methods and theories for landfill reclamation and remediation, executing the comparison from the case studies and examples, giving the conclusion which process and technique suits better within condition of developing countries particularly in frame work of sustainable landscape design and planning, analyzing the existing condition of the selected site for case study from the updated data and information provided by the local government and institutions, and then in the end implementing the design and planning principles within the selected case study.

As an inseparable addition, studying the alternatives 'environmental friendly' waste management methods and analyzing it for reaching conclusions of suitable and possible better methods of waste management for developing countries would be also the methods for complementing the paper.

Information Sources

Key data for this paper are mainly printed and online literatures in theme of alternative methods for waste management, sustainable landscape architecture practices, local environmental issues, landfill reclamation and remediation performing by landscape architect and examples of worldwide landfill (reclamation) performances. Furthermore for the work on the selected case study in Metro, Lampung, Indonesia, series of basic data and information have been provided within cooperation with local government, landfill operational and management unit, and local environmentalist.

Design and Planning of Landfill Reclamation in Developing Countries – Case Study: Karang Rejo Landfill, Metro, Lampung, Indonesia

Metro city area is an urban area in Lampung province, Indonesia that continuously developing from the centre to the fringe supported by transportation and lighting facilities. In the urban fringe, the characteristic of an urban has not developed because the urban fringe came from the city sprawl which highly occurred since 2001 and has not been reached by urban facilities. Land use has not been implemented optimally as an urban area.

***Image 2**: View of Metro City Centre from the Top (source: Metro Government, 2007)*

Metro city is a region concentrated mainly on non agricultural activities such as trade, industry, service, settlement and education sector, thus it has fairly high intensity on public activities in urban area. Those public activities create some problems to be deal with. One of the problems is how to manage the public waste. This issue has to be taken care for present time and also for the future of Metro city.

Critical problem of city waste management in the mean time has moved to downstream which is Waste Dump Area or called *Tempat Pembuangan Akhir (TPA)*. This problem has always been a public discussion in media mass and mostly always ended up with blaming on the local government for its lack of attention and application of the waste dump area. The same situation happened in Metro's waste dump area which is located in Karang Rejo, Metro.

Karang Rejo Landfill has the size of approximately 7,8 hectares and located in Karang Rejo District, Metro city. It is adjacent with Pekalongan Sub-district in Regency of Lampung Timur and situated around 7 kilometres from the city centre. To approach the location, private or public transportation could be used.

***Image 3**: Karang Rejo Landfill, Metro (source: Metro Government, 2007)*

Waste volume on 2005 reaches approximately 127 m3 per day which 90,86 m3 is anorganic waste and 35,45 m3 organic waste while up to November 2006 increased to approximately 177 m3 per day which 125,05 m3 anorganic waste and 49,78 m3 organic waste or equal with 38,40 % increase. The measurement of the waste volume has been done by approximately cubical volume because there is still no weighing bridge in Metro waste dump area. The waste came from settlements, traditional markets and commercial areas, main protocol streets, industries, and public spaces.

***Image 4**: Karang Rejo Landfill Site Plan (source: Metro Government, 2007)*

Waste management in Karang Rejo waste dump area is still processing with Open Dumping System which is dumping the waste to a hole in the ground and the pushing it with heavy machine to the edge of the hole. Waste reuse has been done still in traditional way which is mining the old waste dump landfill to produce compost manure. Waste has been separately located by creating waste zones.

Selected Principles for Landfill Reclamation

1. *Identification of the hazardous materials and the impacts*

   Identification of the hazardous materials and further environmental impacts could be realized by cooperation between Pemerintah Kota Metro (Metro City Government) as the regulator with the researcher from local university or non-governmental organization. Site survey, material sampling, and surrounding neighborhood investigation are the possible ways for this phase.

2. *Selection of the appropriate remediation methods*

   Phytoremediation could be the appropriate land remediation method but it needs a long-term implementation. Using the local and productive plants could be the solution deal with the operational and maintenance cost. For the early periods, using plants that can benefit without being consumed, due to the possible hazardous, could be the best strategy.

   Rubber tree (Hevea brasiliensis) and oil palm tree (Elaeis guineensis), which are already popular as high commodities in Lampung region, could become suitable plant for phytoremediation phase. Other horticultural plants that can be consumed and more productive, such as: corn (Zea mays), coconut tree (Cocos nucifera), coffee plant (Coffea robusta), can be fully planted further on the next phase.

   Composting could be a helpful addition to this phase regarding to its possibility to gain benefits with the waste as the main resource but it needs a proper operational plan. The composting operational that present on site now only appears in basic facilities. It needs more waste selection and treatment with sufficient techniques in order to gain more benefits from it.

   The present contribution of waste pickers or scavengers could be improved more effective and efficient by providing appropriate training and equipment, especially for working safety. They, who are usually homeless, poor, and working irregularly, could be given a temporary housing to ensure their live.

   Since the Karang Rejo Landfill is still demanded and used, the strategy of remediation should be generated as a living system. It should be a continuous and intensive process divided into several

phases, so then the transition or preparation of another waste management system can be done successfully.

3. *Design of after-uses with consideration of time and fund*

   Designing and planning for the after-uses of the ex-landfill are integrated with the phytoremediation and composting process and implemented into several time-based phases of development plan. The time period of each development plan consider the length of phytoremediation plant's life and the assumption of sufficient fund that has been gained to start the next phases.

   Multiple functions for after-uses can create a dynamic place and more opportunities. Beside of creating more defined uses such as Reclamation Centre Building, Workshop Building, Composting Facilities, Front Office Building, Temporary Housing Building, Parking Lots and so on, designing more open spaces that can be used for temporary exhibitions and public spaces is also included in the idea of multiplicity. The exhibitions are ranging from flower and garden exhibition from the local florist, second-hand market, until the exhibition of "home-made" mulch production.

   Education theme could be a unique character, attached to the after-uses, especially regarding to sustainability development. It creates another opportunity to have more activities, creativities, publications and investments. Ideas, such as Green School which could be held in the open spaces or inside the Reclamation Centre Building and workshop for the scavengers, are to be offered on this particular theme.

4. *Integration of strategically further development*

   The integration of further development of post Karang Rejo Landfill reclamation to Metro city development is the "finishing touch" of this process. It should give its contribution to the city such as financial or educational. Firstly from the work of phytoremediation using horticulture plants could produce extra benefits for the city or at least it can provide enough funds for self operation. Secondly from garden exhibitions, "Green School", and second-hand market could gain the educative benefits and public participation in sustainable environment development particularly in landfill reclamation. And finally from the incorporation of the waste-pickers and scavengers by providing rather settled works in the reclamation process, trainings and temporary settlement could create a new job opportunity for the society. And parallel with the working phases of landfill reclamation, Metro city government should start to develop other methods in waste management, such as waste recycling, etc. and the preparation of the new engineered sanitary to be later on work as an integrated system of waste management. Public participation and cooperation with the private sectors should be intensively encouraged by the city government. By doing so, the transition process of waste management system, particularly in an ongoing landfill operation, could be generated successfully in favour of sustainable development.

Working Phases in Landfill Reclamation

The whole landfill site is being looked as if it is a puzzle board. A puzzle is process of arranging and combining pieces by pieces of separated parts to finally creating a fully integrated picturesque image. The process normally starts from one side and ends in other side. For the reclamation process, "the puzzle" consists of time and zone separation defining as working phases.

The work of Karang Rejo Landfill Reclamation consists of three phases within 10 - 15 years period:

- Phase 1: Pioneering the Working and Living Environment
- Phase 2: Expanding the Intensive Horticultural Planting
- Phase 3: Establishing the Landfill Park

The Karang Rejo Landfill Reclamation process in each phase consists of:

- Remediation process: phytoremediation
- Education process: public participation
- Production process: composting mulch and horticultural product

The development of each phase will be as independence as possible regarding to maintenance and operating resources. The funds could be raised from:

- the investment of private companies
- the production of horticultural fields, such as: rubber, oil, and corps
- the service fees from the users
- and the support from the local government

Conclusion

The key word of the Karang Rejo Landfill Reclamation process that has been explained above is TRANSITION. This means the process includes:

- transition of an ongoing landfill to a self-maintained and productive public park
- transition of public opinion about waste from waste as useless matter into waste as a resource and part of life cycle
- transition of the use un-regulated landfill to the use an integrated waste management methods

By looking the whole process as a transition, the reclamation process itself will:

- compromise the ongoing operation of the existing landfill
- spare the time needed by the preparation of the local government for adopting and establishing other methods in waste management,
- grow naturally without any radical and costly change of the land
- not designing a fixed functional object but more creating spaces for improvisation, innovation and creativity
- gain the public awareness about landfill and other waste management methods step by step
- encourage the learning process about environment and its sustainability

Outlook

This paper is expected to iniate a combination of planning and design method which means from planning method will contribute frame works and guidelines for the process of implementing the principles in larger context development areas while design method will contribute the 'try out' of the principles in the context of the selected case study site, within cooperation with local government, landfill operational and management unit, and local environmentalist.

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