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# Policy Constraints in Advocating Ecological Sanitation Systems in Developing Countries

## Case of biogas recovery from blackwater in Kuching, Sarawak of Malaysia

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The passage towards the completion of this research was rather challenging but interesting. As the nature of the research encompasses a series of complex and interrelated aspects, drawing valuable conclusions from the findings was not an easy task.

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# Abstract

Ecological sanitation (EcoSan) is an emerging wastewater treatment approach that is likely to be more economical and ecologically sustainable as compared to the conventional "end of pipe" sewer approach. The challenge of advocating such a system is often associated with how the system is incorporated into governmental policy and how this policy is translated into actual implementation.

This research was designed to assess these challenges in advocating ecological sanitation by deriving underlying policy constraints based on the case of Kuching City, Malaysia. Kuching is a typical developing city which does not currently have a centralised sewerage system and insufficiently treated domestic sewage has contributed significantly to river pollution within the city.

This research identified that in a highly hierarchical decision making government, the most prevalent pre-decision constraints are related to the challenge of effective and accurate dissemination of the ecological sanitation concept and benefits to decision makers. The variation of background and personal interests of the different actors involved is likely to cause differential translation of the EcoSan concept through a multi-level hierarchy. In addition, the lack of a transparent criteria-based decision making process might also hinder the acceptability of ecological sanitation.

Post-decision constraints are related to the lack of a formal policy making process, leading to ineffective dissemination and translation of policy goals into actual implementation actions. Differential perceptions, interpretation and awareness, an incoherent legal and institutional framework and a lack of technical capacity are also underlying constraints towards the successful incorporation of ecological sanitation.

# Executive Summary


### *Introduction*

Ecological sanitation (EcoSan) is an emerging wastewater treatment approach that is likely to be more economical and ecologically sustainable as compared to the conventional "end of pipe" sewer approach. The principles of the approach is to tackle wastewater management in a holistic and more economical manner, incorporating ecological considerations into the system design by promoting conservation and recycling of resources (energy and nutrient) while significantly lowering of cost of installation (mainly through the savings from avoidance of sewers) and operation.

The challenge of advocating such system is often associated with how the system is incorporated into governmental policy and how these are translated into actual implementations.

### *Research objectives*

This research was designed to assess these challenges in advocating ecological sanitation by deriving underlining policy constraints based on the case of Kuching City, Malaysia. The main objective of this qualitative research is to develop an understanding and insights into how emerging wastewater treatment approach such as EcoSan are perceived and what are the dynamics and complexity of policy implications in developing countries such as Malaysia, based on experiences gained from the specific case study.

The research process was designed ultimately to reveal prevalent pre-decision and post-decision constraints that need to be considered for the incorporation of EcoSan. "Pre-decision" aspects are those related to pre-conditions and influential factors affecting the adoption of EcoSan approach into a coherent policy. "Post-decision" aspects are issues that should be considered after the decision to engage on EcoSan had been made. These aspects include the translation of policy to implementation, codification of approach into legal and institutional framework and the use of economic instruments.

The overall research methodology was based on an inductive, qualitative analysis of the existing situation through interviews and literature review. Through contextualising strategy, relationship connecting literature findings and interview findings are translated into the final findings of the research.

### *Case of Kuching*

Kuching is a typical developing city which do not currently has a centralised sewerage system and insufficiently treated domestic sewage had contributed significantly to the river pollution within the city.

The government is currently evaluating suitable approach to tackle this problem and ecological sanitation had been identified as one of the potential solution. The main objective of wastewater treatment and management in Kuching is to improve the water quality of Sarawak River to a standard that is suitable for recreational use.

A feasibility study focussing on the use of conventional approach for Kuching was completed. The State is also interested in assessing the feasibility of integrating ecological solutions with conventional urban wastewater solutions.

The upgrading of the existing septic sludge treatment plant to a biogas recovery facility that can receive blackwater from domestic sources is a major pre-condition for EcoSan integration.

### *Findings and conclusions*

The results obtained from this research indicated that some prevalent pre-decision and post-decision constraints must be addressed for the successful advocacy of EcoSan.

### *Pre-decision policy constraints*

This research identified that in a highly hierarchical decision making government, the most prevalent pre-decision constraints are related to the challenge of effective and accurate dissemination of the ecological sanitation concept and benefits to decision makers. The variation of background and personal interest of different actors involved is likely to cause differential translation of EcoSan concept through a multi-level hierarchy. The sensitivity of this multi-level interaction can lead to mis-interpretation or mis-presentation of information and ideas which are crucial in determining whether idea will be adapted to the overall policy.

Apart from the information conveyed, the policy decision of course also highly depends on many other factors which could reflect the political value of the government, personality and interest of politicians in a less formal way. This also depicts the lack of a transparent criteria-based decision making process might also hinder the acceptability of ecological sanitation and accountability of the decisions. Awareness and acceptability of different stakeholders involved can be enhanced through more interactive stakeholder engagement.

In addition, the lack of a transparent criteria-based decision making process might also hinder the acceptability of ecological sanitation.

### *Post-decision policy constraints*

Post-decision constraints are related to the lack of formal policy making process, leading to ineffective dissemination and translation of policy goals into actual implementation actions. Differential perceptions, interpretation and awareness, incoherent legal and institutional framework and lack of technical capacity are also underlining constraints towards the successful incorporation of ecological sanitation.

### *Validity and recommendations*

The findings in general did not contradict significantly with findings from other researches and studies reviewed in the literature process. The wide validity of the results however, depends to large extent on whether the samples interviewed were representative of the intended stakeholder's perspective. As the findings of the research are based on a small sample of interviewees to a large extent, the validity of the results from the interviews can be further improved if a more comprehensive survey, comprising of larger sample size with careful selection of representative samples are taken. In connection to this, the establishment of a multi-stakeholder consultation process would greatly enhance the wider understanding of the general perception of all on ecological sanitation concept.

Although Kuching possesses resemblance of a typical fast developing city in the developing countries, the political and social construct of Kuching may be unique in some elements, due to its past colonial history and current governance structure for example. The transferability of the results from this research may only be valid for certain generalised issues but the extent of transferability remains uncertain until more in-depth study and similar research in other cities are carried out.

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# 1. Introduction

Access to water resources and proper wastewater management were highlighted as major challenges towards sustainability in the World Summit on Sustainable Development held in Johannesburg, South Africa, August 2002.

The need for treating wastewater has traditionally being linked to hygiene, threats on human health such as preventing spreading of disease rather than for the purpose of protecting of water resources and the environment. While urbanisation and human development progresses, the need to address wastewater problem has become a necessity of healthy and comfort living.

In the recent years, environmental concerns such as degrading dissolved oxygen and the problem of eutrophication have been the driving force behind a technological development of sewage treatment with emphasize on biological removal of nutrient (especially nitrogen and phosphorus) and organic matter (Magid, 2001).

In recognition of the harmful health and environmental effects of discharging untreated wastewater to waterways, the need for reducing pollution from wastewater discharged is handled in the developed countries by the rapid expansion of centralised water borne wastewater treatment system for the past 2 decades. In many instances, the adoption of a centralised system is also considered a part of development process towards modernisation.

While this system is considered "conventional" today, majority of the population in the world still do not have access to proper sanitation. The fundamental constraint today widely recognised is the affordability to invest and maintain such system. It is estimated that only around 0.3 billion people (5% of total world population) has access to well-functioning flush toilets (conventional wastewater system) while almost 2.4 billion people (more than 30%) in the world do not even have access to basic sanitation (EcoSanRes, 2003).

In connection to the solutions for wastewater problem, conventional end-of-pipe treatment approach has been challenged with critics on its long term sustainability in recent years. Apart from the high capital investment, operating and maintenance cost that is unaffordable to most developing countries, the fertility loss of nutrient from soil into the waterways, the wasteful use of valuable water resources for transporting waste are all major criticisms being raised on the unsustainable approach in long term (GTZ GmbH, 2002).

## *1.1 The evolution of a new approach - EcoSan*

An emerging alternative approach - ecological sanitation approach, also known as "closing the loop" approach or "sewer-less" approach (referred as "EcoSan" hereafter in this report) is undergoing rapid development and pilot tested globally. EcoSan approach is especially interesting in developing countries where there is no existing centralized sewage system.

The principles of the approach is to tackle wastewater management in a holistic and more economical manner, incorporating ecological considerations into the system design by promoting conservation and recycling of resources (energy and nutrient) while significantly lowering of cost of installation (mainly through the savings from avoidance of sewers) and operation. Currently, there are various EcoSan technological options being developed globally, ranging from low-tech to high tech solutions.

The fundamental shift of approach to accommodate recycling is to source separate and treats waste at source as much as possible as opposed to conventional approach of mixing all waste streams for end of pipe treatment. The two main wastewater streams to be treated separately from domestic wastewater are the blackwater (from toilet bowls – feacal matter, urine and toilet paper) and greywater (from kitchen sinks, bath tubs etc.). In some cases, urine is separated from other fractions of the blackwater as well. These approaches will essentially reduces the costly sewers (usually costing up to 80-90% of total capital investment) and maximize reuse of resources via recovering energy and nutrients (EcoSanRes, 2003).

## *1.2 Challenges to a paradigm shift*

There are a lot of challenges facing the introduction of such new approach into an existing administrative system as well as the society as a whole. These challenges are often associated with the lack of a clear policy within all levels of the governmental system on the planning of wastewater system. According to a study, there is often no national policy being set for sanitation[1] and in other instances, a declared policy has been unclear, even contradictory in its aims and objectives (Elledge, 2003). Elledge (2003) argues that without a sound national sanitation policy, there is no focus for the planning of wastewater programmes and no sure basis for developing the multi-layered organisational structures needed to devolve responsibility for sanitation down to lower level of government. It is also believed that a sound policy is essential for the successful diffusion of a new approach from pilot project to large scale implementations (Elledge, 2003).

Considerations for policy implications not only include winning necessary political support for general directions of decision on approach (in this case, whether to opt for the ecological approach), but also many other components of successful policy formulation and implementation i.e. overcoming structural inertia that resist changes for new approach, adapting legal and institutional framework, carefully designed financing and management scheme, cost benefit assessment of available options based on local suitability and conditions, localization of technical options, implementation and evaluation of performance etc. Thus, reaching a coherent policy as the starting point for development of EcoSan is indeed a complex process.

Based on this background of introducing a radical change of approach to the wastewater management, this research is designed to analyse relevant fundamental constraints concerning policy implications of integrating the EcoSan approach into an existing urban wastewater planning system in cities within developing country context, which currently do not have an existing centralised wastewater management system. The research was based on a specific case study. The location of the case study chosen for this research is the City of Kuching, located in the State of Sarawak, Borneo part of Malaysia. The specific objectives and methodology used is described in the Section 2.

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[1] The word "sanitation" in this paper limits sanitation to domestic wastewater treatment aspect only, used interchangeably with the word "wastewater treatment".

# 2. Research objectives and methodology

This section delineates the research objectives as well as the methodology employed to address the research objectives. The problem background will be presented, followed by specific research questions to be answered while scope and limitations of the findings from the research are also elaborated.

## *2.1 Problem statement*

The overall problem setting of this research is based on exploring the dynamics and complexity of policy implications in promoting large scale application of EcoSan approach in countries of developing status. As mentioned in Section 1, the study will be based on a specific case study which the problem definition will be described below.

Domestic wastewater generated from Kuching is traditionally treated using septic tanks before ending up in open drains discharged directly which eventually end up in the main river – Sarawak River. Sarawak River flows through the urban centre of Kuching. The city currently has no centralized sewage treatment system. A river baseline study carried out in 2001 revealed that the level of organic pollution in Sarawak River is becoming critical and the bacteriological counts are very high. Poorly treated domestic sewage is evaluated as one of the main organic pollution sources (Povlsen, 2001, p. 109).

In response to avoid further deterioration of the river water quality, the Sarawak Government is in the midst of evaluating the best approach, or combination of approaches, for solving the pollution from domestic wastewater in Kuching. Apart from conventional centralized sewage treatment system, there is also considerable interest in integrating the ecological sanitation approach into the overall wastewater planning process where appropriate. A conventional centralised wastewater master plan covering most urban area draining to Sarawak River had been prepared while considerable interest in integrating EcoSan approach is leading to the preparation of an integrated wastewater framework plan, focussing on the options and benefits of such integration.

There are several existing technical pre-conditions that are favouring the introduction of EcoSan in Kuching. There is already separate piping of black and grey water today in majority of the households, which will essentially reduces cost of plumbing modifications at household level (Lynghus, 2003). A plan to upgrade an existing sludge treatment plant in Kuching into a biogas recovery facility for recovering energy and nutrients is in line with the direction towards the principles of EcoSan approach. Part of the domestic wastewater would be co-digested with other organic waste (e.g. food residue) to recover energy and fertiliser. Planning of pilot projects to demonstrate EcoSan principles are in the pipeline.

All these on-going activities add to the rationale for choosing this city as a case study. The analysis will be based on an evolving practical case, which can also be considered a "hot" topic. The results of this research might be useful for future wastewater policy making in Kuching and other cities with similar local setting.

The systematic incorporation of ecological principles into conventional wastewater management systems requires extensive evaluation of options, existing local conditions and followed by the formulation of a clear policy and strategy for implementation.

The key problem addressed in this research was therefore to analyse and determine underlining policy constraints that could hinder the decision making, integration and large scale application of ecological sanitation concept, based on analysis of the proposed EcoSan applications (blackwater management system).

## 2.2 Research objectives

The main objective of this qualitative research is to develop an understanding and insights into how emerging wastewater treatment approach such as EcoSan are perceived and what are the dynamics and complexity of policy implications in developing countries such as Malaysia, based on experiences gained from the specific case study.

The research process was designed ultimately to reveal a set of prevalent constraints that need to be considered for future policy formulations to incorporate EcoSan. The importance of having a clear policy, as setting the common direction (in this case to adopt EcoSan approach), is discussed later in section 3.3.3. The main policy implications included for considerations in this research can be categorized into "pre-decision" and "post-decision" aspects.

"Pre-decision" aspects are those related to pre-conditions and influential factors affecting the adoption of EcoSan approach into a coherent policy. Relevant aspects included in this research were:

- situation of awareness and status of existing policy process
- dynamics of communicating EcoSan idea within the local decision making process
- perception based analysis on issues such as the preferences, perceptions and acceptability conditions of EcoSan concept etc.

The above preconditions are based on the presumed functions of the government to ensure human activities (in this case wastewater discharge) do not harm the environment. In general, there are two general approaches to regulate pollution, either the government regulate polluters by providing particular treatment i.e. through own governmental operations using public fund e.g. sewage treatment system or to control pollution by setting discharge quality standards on individual without regulating what systems are in place as long as the requirements are achieved. For this research, the case of wastewater treatment is related to the first approach i.e. governmental function to provide wastewater system.

"Post" aspects are issues that should be considered after the decision to engage on EcoSan had been made. In order words, these aspects are mainly related to the follow up actions after the decision. The aspects included in this research include:

- Policy process and dissemination
- Codification of regulatory and institutional framework
- Application of economic (e.g. incentive) based instruments

It must be noted that in the case of public established sewage system, it is usually mandatory for public to use the system. Thus, the codification of EcoSan into the legal and institutional framework is fundamental to formalise the "must" while economic instruments together with awareness instruments are often supplementary for supporting behaviour changes.

***Regulatory and institutional framework***

The successful introduction of a new approach needs to be codified into the regulatory and institutional framework. The need and importance of reviewing legal and institutional framework for accommodating the new approach were also stressed in the recent Sustainable Urban Wastewater Management Seminar held in Kuching (Sarawak Development Institute, 2003). This may include codification of the option into existing or even the enactment of new legislations, guidelines and norms. The objective of this research is to review the existing legal and institutional framework relevant to domestic wastewater management, identify the potential aspects associated with revisions and subsequently deriving the potential constraints to these changes.

***Implications of economic based instruments***

The use of economic based instruments for managing environmental issues is frequently overlooked in the development of emerging solutions for waste management. In Malaysia, the use of economic based instruments to internalise socio-environmental impacts is indeed very rare. This research will explore potential economic instruments, especially incentive based scheme, that could be considered for the case to support behavioural change. For example, the renewable energy aspects leading to the reduction of greenhouse gas emission can be considered for climate change related trading mechanism such as the Clean Development Mechanism (CDM).

### 2.2.1 Research question

The research objectives lead to the formulation of the ultimate research question of this research:

**"What are the prevalent "pre-decision" and "post-decision" policy constraints for incorporating EcoSan principles into the overall wastewater management planning with reference to the proposed blackwater management system in the case of Kuching, Malaysia?"**

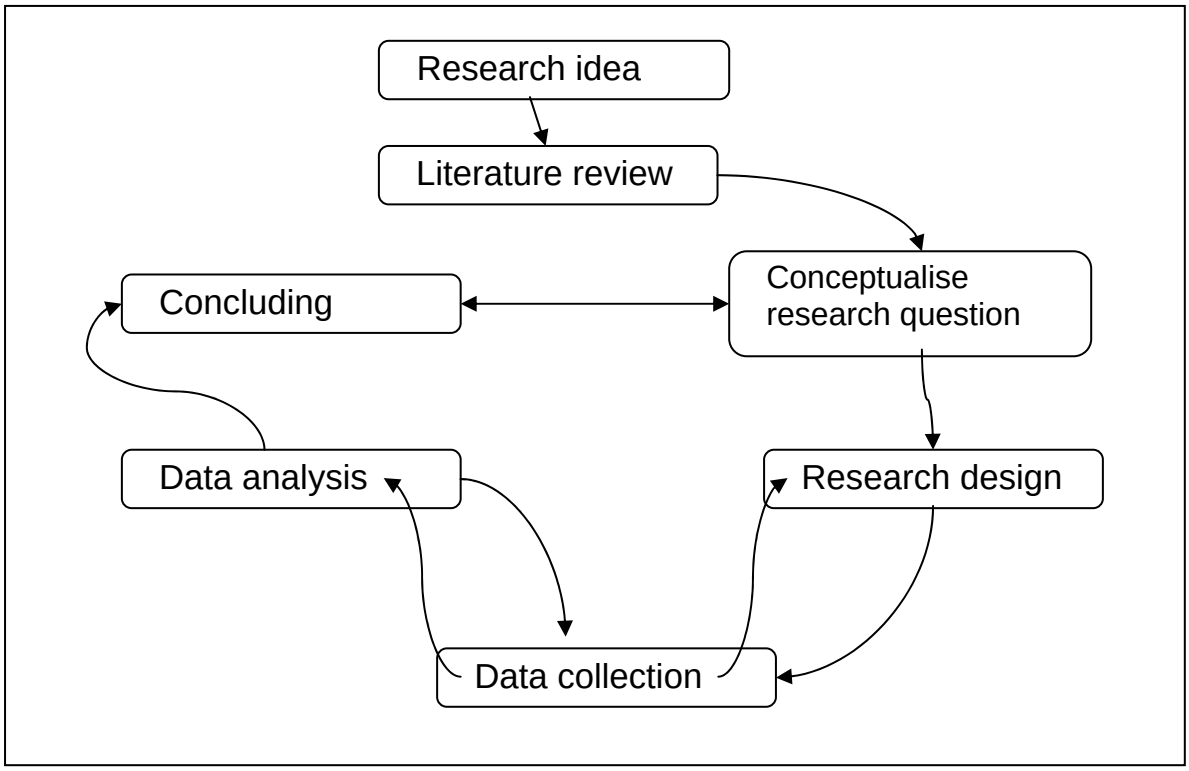
## *2.3 Research methodology*

The overall research strategy of this thesis was to address the research objectives via an inductive, qualitative analysis of the existing situation and potential constraints in relation to policy implications of integrating EcoSan approach, based on the case study selected.

The overall period of the research was about 3.5 months. A detail schedule of the research activities is attached in Appendix 1.

The research flow for this research can be illustrated in Figure 2-1:

*Figure 2-1 Research methodological flow*




The qualitative research was carried out with a combination of research methods:

- Literature review;
- Semi-structured interviews;
- Observations;
- Continuous comparison and validation of data and literature.

Due to the exploratory nature of this research, the scope and research question for this study was carried out based on "continuous revision" basis with the building up of knowledge and understanding.

Apart from exploring trends and facts from the specific case selected, the research also reviewed and drew relevant experiences from other cities in other countries that could be beneficial and used as case references for Kuching.

### 2.3.1 Literature review

The primary aims of the literature review carried out include:

- To establish researcher's knowledge and understanding of EcoSan and current status of development globally;
- To use these literature as basis for deriving the context and research focus;

- To establish related past and future research and experiences in the selected research focus;

- To develop understanding of situation and related work done for the case study selected which was beneficial for the research design;

- To ensure research findings from this thesis would add new knowledge or experiences.

The sources of literature search included:

- World wide web – websites and documents;

- Library – Books, journal;

- Conference and training material – related conferences material;

- Governmental authorities and projects – reports, legal documents, publication etc.;

- Newspaper.

The research literature for this study was divided into two main categories

- Wastewater issue and wastewater policy related

- Concept and experiences of EcoSan globally

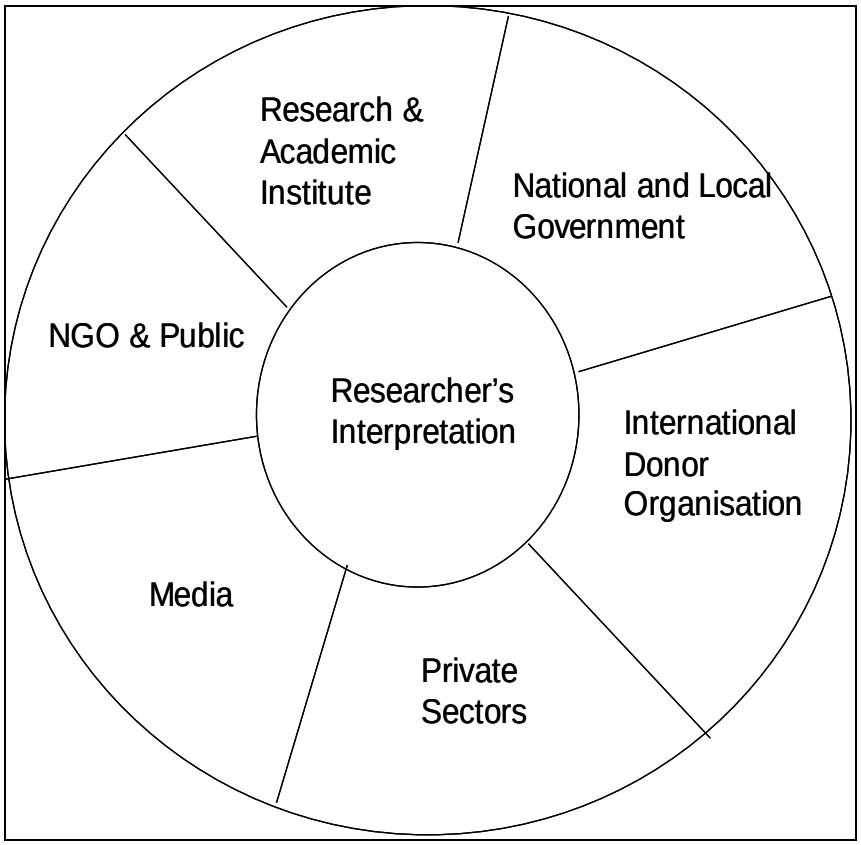
### 2.3.2 Data collection - Multi-stakeholder analysis

Policy making process is no doubt a government's key role. However, the involvement of actors from other organisation fields in the policy making has been widely promoted globally, which is also conforming to the principles of good governance and sustainable development.

Due to the diverse nature of organisation fields that would most probably be affected by the integration of this new approach, the research data will be based on triangulation strategy, which means to collect information from a diverse range of stakeholders and settings using a variety of nature. The involvement of stakeholders with different position and interests will ensure the findings to be more comprehensive and representative of the society (see Figure 2-2). This choice is firmly supported by the view that case study should preferably be multi-perspective analyses, which consider the voice of many actors, including e.g. the powerless (Feagin, Orum & Sjoberg, 1991).

The selection of representative stakeholders was a dynamic process, which was revised throughout the research period when new information and knowledge was gathered. The initial list was established based on information obtained from the key environment authority in Kuching as well as the researcher's past experiences in the system. A list of selected stakeholders interviewed is attached as Appendix 2.

*Figure 2-2 Organisation fields involved in the multi-stakeholder analysis*




Additional empirical data was collected on top of data and information abstracted from literature review was based on perceptions and observations from open-end interviews. A clear introduction of the background, objectives, scope and main components of the research was given prior to each interview. This was to facilitate the discussion to the right context.

The interviews were semi-structured with a set of standard questions prepared for each interview. The types of questions used include:

- direct questions to elicit answers;
- attitude questions to elicit feelings and opinion;
- knowledge questions to elicit knowledge of service;
- open-ended question to generate unrestricted questions;
- closed questions such as pre-coded questions to elicit fixed answer;
- ranking question to generate preference and opinion.

Most of the questions were open-ended, designed to build a relationship for engaging interviewees to express their personal views and relating to their daily life. The proportion of stakeholder distribution for the interviews is illustrated in Table 2-1.

*Table 2-1 Proportion of stakeholder distribution interviewed*

| Stakeholder type | Number of interviews |
|---|---|
| International organisations | 3 |
| Government agencies | 6 |
| Business organisations | 5 |
| Non-Government Org. | 3 |
| Media | 1 |
| Research / acadermicians | 2 |
| General public | 2 |
| Total | 22 |

A standard list of questions used in the interviews is attached as Appendix 3.

### 2.3.3 Data analysis

The general approach of data analysis was based on contextualising strategy, in which the researcher continuously explored relationships that connects literature findings with statements and events into a coherent whole.

Data obtained from the interviews was in many cases subjective and indirect in nature. The interpretation by the researcher was required to derive relevant findings. These findings are compared and contrasted with analysis and interpretation of collected documents and information to further establish mutually supporting findings, leading to justifiable conclusions.

The identification of prevalent constraints was based on the results obtained from the analysis, which can be referred as using the "gap-analysis" approach, to define what the missing links and requirement for integrating EcoSan approach as are perceived by the organisation field studied.

Data are presented in various forms, from text description to tables, figures for illustration of trends.

## *2.4 Scope and limitations*

### 2.4.1 Scope of research components

The planning and implementation of wastewater treatment system is usually a provision of public services provided by the local government. Policy aspects related to the decisions of such extensive infrastructure system can comprises of many different considerations that usually requires extensive evaluation including technical, socio-economic, environmental and political value judgement. It is very difficult to arrive at straight forward and unambiguous solutions and the planning process is always characterised by the search of acceptable compromise solutions through adequate evaluation methodology (Refsgaard, 2001). Due to the complexity involved, the scope of policy implications for this research was limited to the following:

- General perception and acceptability of EcoSan approach;

- Legal framework;
- Institutional framework;
- Economic instruments framework.

In relation to the scope of organisation field, it was decided to focus on various levels of stakeholders, including international, national, regional and local levels.

In order to further narrow down the scope, this research will specifically focus on dealing with the blackwater part of the domestic wastewater. Other organic waste streams that could be integrated to the biogas production, other components of wastewater such as greywater, stormwater are not included in the research.

The output from the analysis will be concentrated in identifying the policy related constraints useful for initiation of further research and evaluation process. The results will not be sufficiently detail to the extent of deriving actual legal and institutional amendments but it does set the "boundaries" and "concerns" regarding the way forward if EcoSan principle is to be implemented on a wider scale.

### 2.4.2 Validity and generalisability

In terms of external validity and generalisability, the findings for implementation of ecological sanitation concepts can comprise of many complex issues which in many cases are inter-related. However, the outset of this research is based on the research strategy of case study approach. Thus, the scope of this research is set to reflect specifically the case study within the geographical boundary and local conditions of the City of Kuching. In other words, the case study approach as expected, should provided poor basis for scientific generalisation (Dalhamar, 2002). However, setting this limitation of scope is necessary to ensure the analysis was detail enough to provide some insights to the issue addressed.

In terms of internal validity, the selection of stakeholders for interviews maybe a source of threat to the validity as it was based on consulting key stakeholders as well as the researcher's own experience. This limitation can be minimized by keeping an open list i.e. a continuous identification process. Verifications of information gathered by continuous comparison of interview findings and documentation findings were a way to reduce subjectivity of results.

In summary, the findings can only be representative for the case studied but inconclusive for all cities in developing countries. In fact, policy research is often very case specific, due to the different settings such as political, socio-cultural background of the country administration. However, the experiences gained from this research may provide some general trends which are common for many countries with similar development phase and social background.

# 3. Literature review

This section presents summaries of literature review as described in Section 2.3.1. As mentioned earlier, the findings were useful as setting the context for carrying out the policy analysis. The summary is presented in two main sub-sections. The first sub-section covers the theoretical background of the governmental functions and the provisions of wastewater treatment as pre-conditions for continuous development. This is followed by discussion of the role of policy, related complexity and its related management instruments such as legal, institutional and incentive based system. Experiences from other countries are also presented as a result of the literature review.

The second sub-section presents the concept of EcoSan, outlining the rationale and status of this concept development. This sub-section will also delineates relevant experiences and information from other countries, setting references for the scope chosen for this study i.e. emerging blackwater treatment system with biogas recovery.

All and all, the literature review provided a sound knowledge basis for the researcher to enable the design and execution of this research.

## *3.1 Theoretical problems associated with domestic wastewater*

The definition of terms used in wastewater types differs from country to country. Domestic wastewater is usually including all wastewater generated from household activities. This includes:

- Blackwater - wastewater from the toilet consist both faeces, urine and toilet paper;
- Greywater - wastewater from other sources in the house including all sinks, bathroom etc.

For cities with centralised, conventional wastewater treatment system (end of pipe solution), the domestic waste is mixed with other streams to form the total urban wastewater which commonly consists of a mixture of domestic wastewater, effluents from commercial and industrial establishments, and urban runoff. Industrial wastewater is often pre-treated individually to an acceptable standard before allowed to be discharged to the centralised wastewater treatment system. In contrast, for cities or towns without centralised system, domestic wastewater is usually treated separately onsite with septic tanks or discharged untreated.

Traditionally, domestic wastewater discharge is not a major concern especially for sparsely populated area. However, the rapid urbanisation phenomenon worldwide has causes an increase in population density and activities. Consequently this resulted in increasing stresses on the natural environment. The discharge of insufficiently treated wastewater is threatening the quality of the environment to the extent that it is no longer acceptable to dispose wastewater without concern of environment (Refsgaard, 2001).

There are several main concerns of untreated domestic wastewater discharge:

- Threaten and degrade water resources supply;
- Disease spreading and health risk;
- Eutrophication – damage to ecological system;

- Loss of amenity and tourism.

It is well recognised that transfer of nutrients from terrestrial to aquatic ecosystem causes on one hand, eutrophication in water bodies and on the other hand nutrient deficiency in agricultural land. These problems are tremendously increasing particularly in developing world, where there is hardly any provision to interrupt the nutrients discharge into water body and, in return, loss of nutrients from agricultural land is compensated only with hardly affordable commercial fertiliser in order to feed a rapidly growing population.

It is estimated that around 2.4 billion people of the world need to gain access to effective and sustainable wastewater system. There are approximately 1 billion people (mainly developed countries) currently served by sewage systems and only 30% of those have advanced end of pipe treatment (Matsui, 2002). These figures highlight the importance and urgency to address wastewater issue. The United Nations World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002 articulated the target of halving proportion of people without sanitation by 2015 (EcoSanRes, 2003).

This following section explores the fundamental roles, trends and relation of public sector's (referred as government hereafter) involvement in providing wastewater treatment as a common public services.

## *3.2 The functional role of government in wastewater*

As prologue in section 3.1, the impact of insufficiently treated domestic wastewater is no longer accepted in the context of sustaining the overall societal requirement. This leads to the need to review the overall functional framework of government in a society.

Larsen (1999) divided the basic functions of government into 3 main categories:

- Maintaining basic societal order e.g. judicial system;

- Ensuring societal reproduction e.g. assuring health and well-being of citizens through health, education, social services;

- Ensuring physical preconditions for continuous development e.g. providing drainage, wastewater, solid waste services.

The provision of wastewater management system is historically being a governmental task. Provision of wastewater treatment related to the last two functions i.e. while ensuring societal reproduction (to ensure health of public is protected from disease from treating wastewater discharged), the government should also ensure the natural resources e.g. water resources are protected from wastewater pollution. The provision is to ensure the by-products i.e. wastewater in this case do not hinder the normal development process i.e. do not inhibit human development and continuous material production (Larsen, 1999).

As mentioned in Section 2.2, this function can be implemented by government either through regulating individual polluter e.g. specifying requirement for developer or household to have certain system that meets permissible discharge standards or providing the establishment i.e. sewage treatment system through public funds i.e. own operations within public sector domain. Own operation only depicts that the responsibility lies on the local government to ensure the provisions, but the actual operational activities could be contracted out to private companies which was carried out widely in many countries (Larsen and Martens, 2002, p. 22).

In fact, outsourcing of wastewater management through concession is an increasing practice all over the world. This move is mainly based on the theoretical expectation that private companies are more cost-efficient in implementing the task but the contracting process is not as straight forward as expected (Larsen, 1999). In many cases, contracting services to private firms did not resulted in better and more efficient services.

Due to this trend in contracting out public services, the management focus has been placed a lot on improving the concession conditions such as setting of service goals and monitoring scheme to ensure objectives are met. However, there are a lot of constraints in this development as shown in country like Denmark, Malaysia etc. Typical constraints are the difficulty in quantification of service performances as well as the difference in organisation objectives i.e. private sectors are business profit oriented (Larsen, 1999).

The above discussion has made it clear about government's functional role in providing wastewater management to the public i.e. as a public task. The following section will discuss the role of policy as the basis and departure point in practising this role.

## *3.3 The role and dynamics of wastewater management policy*

The word "policy" is used widely but not very often defined. A policy, as defined by Pal (2001) is a course of action or inaction chosen by public authorities to address a given problem or interrelated set of problems, towards certain directions. "Policy is a theoretical construct. It is a course of action, yes, but action that is anchored in both a set of values regarding appropriate public goals and a set of beliefs about the best way of achieving those goals"(Pal, 2001). Elledge (2003) on the other hand defines policy as a set of procedures, rules and allocation mechanisms that provide the basis for programmes and services. He further denotes that policies are important for setting priorities and often allocation of resources for their implementations.

The idea of public policy assumes that an issue is no longer a private affair. The "disciplined application of intellect to public problems" reduces to one question: what are we going to do about the problem in view? In the case of this research, the problem of pollution to the river water by insufficiently treated domestic wastewater becomes the focus of the formulation of wastewater or sanitation policy. Inevitably, wastewater policy is usually closely related to the environmental policy.

Policy formulation process is an inherent task of public authorities. However, the process itself could be complex and in many case there seems to be no formal procedures. The formulation is influenced by many factors, and it can be assumed that stakeholders from different discipline e.g. social scientists, political scientists, economists, environmental scientists, lawyers, sociologists will ask questions structured by their disciplinary approach to social inquiry and their own assumptions about the sources of social order. Scholars rooted in the natural sciences may sometimes ask quite different questions about how people should behave with respect to the environment: global warming might seem different as a political, economic or meteorological issue (Pal, 2001).

Refsgaard (2001) stated that there are usually conflicts due to multiple criteria and multiple users present in her research on multi-criteria decision making in wastewater planning. The policy cycle or policy formulation usually consisted of a series of evaluation against a set of criteria, which usually reflects the political priorities. The derivation of a policy decision, and subsequently policy design has to take into account a series of conflict analysis characterised by technical, socio-economic, environment and political value judgements. Thus, in the

planning process, it is very difficult to arrive at a straightforward and unambiguous solution. This also means the final decisions will usually be characterised by an acceptable compromise solutions through an adequate evaluation methodology (Refsgaard, 2001).

The objectives stated in a policy can be achieved through different means or instruments. Different types of instruments will be discussed in the following section.

### 3.3.1 Types of policy instruments

Instruments for policy implementation can be categorised into three main groups (Lindquist, 2003):

1. Regulatory – instruments specifying what various actors are allowed to do or not allowed to do and how certain activities should be conducted. E.g. bans, permits, standards etc.;

2. Economic – instruments to create positive or negative incentives for certain activities by adjusting the financial conditions surrounding those activities. E.g. Environmental charges, subsidy, marketable permits etc.;

3. Informative – instruments based on the assumption that actors are not rational due to lack of knowledge or awareness, aimed at compensating this deficiency by providing better information. E.g. public awareness activities, eco-labelling etc.

Larsen and Martens (2002) depicts similar categories of instruments (termed "measures" in their publication) for achieving urban environmental management goals. In addition to the above categories, a category termed "own operation" is also mentioned. "Own operation" refers to governmental operational actions, typically relevant to major infrastructural activities such as sewage treatment.

In the context of wastewater provisions, the regulatory instruments and own operation i.e. provision of infrastructure for treatment are related to ensuring the "must" is met while economic and informative instruments are used to encourage the change, usually behavioural related.

It is interesting that Elledge (2003) also denotes four categories of policy instruments i.e. regulatory measures, economic measures, information and education, assignment of rights and responsibilities for providing services. The last instrument is supporting the term "Own operation" as depicted Larsen and Martens (2002), which is related to the responsibility of providing services.

The use of regulatory instruments can also be described as the "command and control" approach. This approach has proved essential but faces various implementation barriers especially when it comes to enforcement. Other critical challenges for a smooth implementation of a legal framework include the inconsistency and sometimes contradictory provisions among various legislations. This often leads to overlaps and gaps among institutions (Larsen and Martens, 2002, p. 30).

Managing environmental quality along a path of rapid economic growth is challenging and in some cases a contradicting task. Many policy makers are frustrated due to the lack of necessary instruments other than regulatory measures. Another policy instrument - economic based instrument on the other hand, offers policy makers advantages over command and control approach by means of encouraging behavioural change. This approach also offers the raising

of revenue for environmental protection efforts. However, the use of economic instruments is limited in developing countries. The main limiting factor, according to Panayotou, is the difficulty in transferring experiences from developed countries to developing countries due to different needs (Panayotou, 1998). In some cases, economic based instruments might not be effective due to limited factual importance.

### 3.3.2 Policy advocacy for emerging technologies

For the case of wastewater treatment, innovations of technological solutions to treat wastewater has evolved in a continuous fashion over the past decades.

The objectives of innovation are based on many driving factors. These could include more stringent standards, cost-efficiency, affordability, and environmental sustainability etc. These factors are leading to the development of new principles such as ecological sanitation. Details of this emerging concept will be discussed in Section 3.3.

However, emerging technologies such as ecological sanitation which is likely to offer major public benefits, social and environment is facing problem in wider diffusion due to it's immaturity in development. Thus, policy considerations should take into consideration of promising innovative technologies in order to compete with conventional, or so called "legacy" technologies. This is similar to policy implications for other basic utility such as electricity, in which energy production with less environmental impacts (if done properly), such as renewable technologies. Policy on technical innovation in this case must establish kind and degree of support that government should offer to innovative electricity technologies (Goldemberg and Johansson, 2002).

### 3.3.3 Experiences of policy implications from other countries

#### 3.3.3.1 General environmental policy

Since the heightening of awareness and debate on the need of immediate action to attain sustainable development at the Rio Earth Summit[2] in 1992, the consideration of environment has been incorporated into development policy in many countries (Mamit, 2000). Environmental and economic development is inextricably linked and thus environmental goals have to be integrated into economic policy. The increasing emphasis on environment has also lead to the development of comprehensive environmental policy and strategy in many developed countries. Development of environmental policy has been extensive especially in members countries within the European Union (EU). For example, policy of prohibiting the landfilling of organic waste has been implemented through EU legislations (directives). This policy will indirectly motivate separate collection and treatment of organic waste, and eventually favouring the development of treatment system such as organic waste recovery for biogas and nutrients (Hsiao, 2001).

In contrast, dedicated environmental policies in developing countries are very new or still lacking. Country such as Malaysia has only in 2002 established its "National Policy on the Environment" (Ministry of science, technology and the environment of Malaysia 2002).

There are two main principles found in environmental policy today, the "polluter pays principle" and "common cost principle". The "polluter pays principle" claims the polluter to be responsible for the damage to environment while the "common cost principles" places the environmental burden towards public purse (Erdmenger & Schreckenberger, 1998).

[2] Also known as the United Nation Conference on Environment and Development (UNCED) held in June 1992.

#### 3.3.3.2 Wastewater and sanitation policy

As discussed in Section 1.2, well declared wastewater or sanitation policy is often not in placed, unclear or contradictory in many countries. Most water related policies are mainly based on water supply, not wastewater. The lack of policy for planning and implementation seems to be the root cause of the failures in expanding sanitation coverage especially in developing and third world countries (Elledge, 2003).

Elledge (2003) highlighted four main aspects how sanitation policies can improve sanitation coverage and programme quality:

- Encourages access to and use of sustainable services;
- Stimulate local action by including local initiatives in overall strategy;
- Setting scene for more sustainable and effective programmes;
- Help shape incentives.

In the case examples of sanitation policy illustrated by Elledge (2003), there are wide variations in national policies between countries. He indicated that sanitation is often addressed in an ad hoc manner and as an afterthought. There seems no explicit sanitation policy that supports emerging sanitation techniques such as ecological sanitation. West Bengal and Kerala are two countries that have established large and innovative programmes.

It was suggested that South Africa and Uganda probably offer best examples of well written national policies. In the case of South Africa, subsidiary policy to the National Sanitation Policy (2001) has also been drafted. An example of such policy (South Africa) is attached in Appendix 4.

Experiences from EcoSan implementation in the Southeast of China (Guangxi Province) also indicated that political will and policy support are important aspects for success. It was identified from the experience that the main activator was policy support. Favourable policies, support from related sectors had inspired the stakeholders involved (Shuimin, 2001).

Policy and strategy development has lead to new approach towards the issue of sanitation which are more cost efficient and environmental orientated. For example, new strategy such as recipient strategy[3] is promoted as opposed to household strategy[4]. Recipient strategy accepts varying treatment levels between households while household strategy reflects property rights and wastewater regulations. Refsgaard (2001, p. 101-126) shown in her research that a recipient strategy is clearly better from allocative efficiency point (reduction of 25% total cost per household based on a set pollution reduction) of view than household strategy but there seems to be many constraints for policy to change from household strategy to recipient strategy. These include the high transaction costs involved, distributional effect of a change and redistribution of rights.

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[3] Where an emission recipient is set for all households in common that emits to a specific recipient.

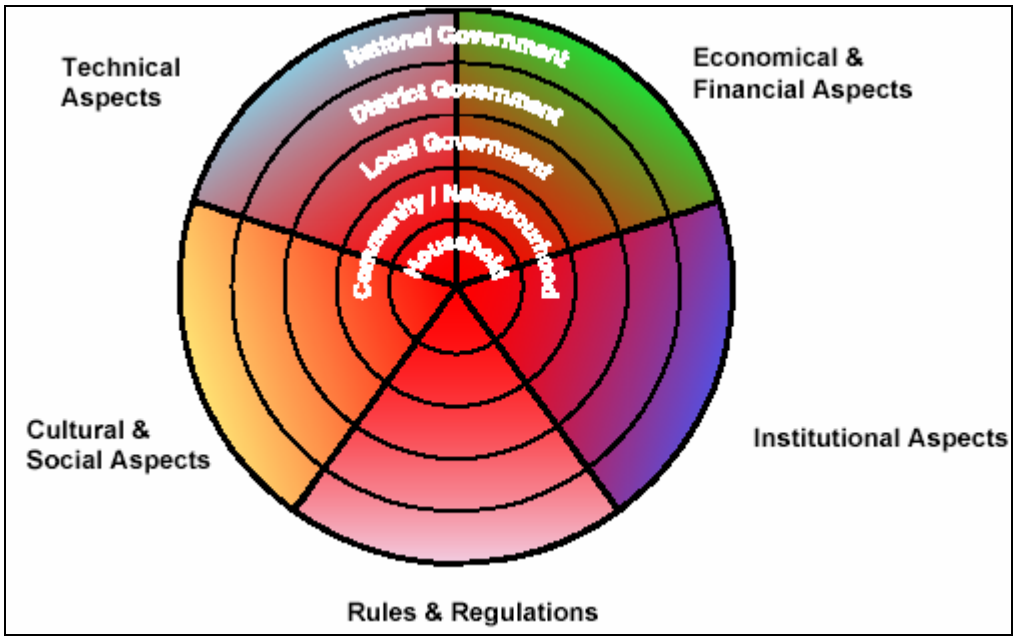
[4] Based on institutional status quo, with same reduction requirement for each individual household irrespective of the costs involved.

### 3.3.3.3 Bellagio Principles for Sustainable Environmental Sanitation

Another principle developed which is related to sustainability of sanitation policy (ecological sanitation) is the "Bellagio Principles for Sustainable Environmental Sanitation" (hereafter referred as "Bellagio principles"). The principle stresses the importance of human dignity, quality of life and environmental security should be the centre of sanitation system and decision making should involve participation of all stakeholders, especially the consumers and providers of services. Bellagio principles also denotes "waste" to be considered as a resource and it's management should be holistic and form part of integrated water resources, nutrient flows and waste management processes. The principle suggested sanitation problems should be solved to the minimum practical size.

Based on the Bellagio principle, the need to secure stakeholder involvement leads to the development of "Household Centred Environmental Sanitation (HCES) model" in 1999. HCES is an approach that place house hold as the focal point of environmental sanitation planning. The principle includes circular system of resource management as well as solving as close as possible to where they originate. Successful implementation of the HCES approach requires the dissemination of information and assistance to those responsible for improving environmental services, such as municipal officials, urban planners, and policy makers responsible for creating an enabling environment. The different aspects can be illustrated in Figure 3-1 (Kalbermatten, Morel, Saywell, & Schertenleib, 2003).

*Figure 3-1 Household centred environmental sanitation (HCES) approach based on Bellagio principle*




*(Source: Kalbermatten et al., 2003)*

### 3.3.3.4 Policy constraints

Follow up and implementations seem to be a major challenge. The major constraint identified by Elledge (2003) is how national policy is translated and implemented at lowest level of government. The constraints include lack of technical, managerial and financial capacity to address sanitation need. This is also illustrated for cases of India, Nepal etc. (Elledge, 2003). It is highlighted that for large countries, policies for lower level such as provincial, county, municipal, community etc. need to be established.

Kalbermatten et al. (2003) also identified inadequate resources as major constraints towards improvement of sanitation. In addition, they further highlighted the following issues as typical barriers towards better sanitation services:

- lack of political will;
- poor policy at all levels;
- poor institutional framework;
- inappropriate approaches;
- ineffective promotion and low public awareness.

Experiences of specific policy instruments are discussed in the following sections.

#### 3.3.3.5 Legal and institutional framework

Laws and regulations codified for the implementation of appropriate wastewater policy have been highlighted as important pre-conditions for achieving the objectives of the policy in many occasions and researches. This also applies to the introduction of emerging technologies such as ecological sanitation. For example, in the 2nd International Symposium on ecological sanitation held in Lübeck, Germany (7-11 April, 2003), it was stressed as one of the ten recommendations for action from the symposium that regulatory framework should be adjusted with the aim of authorising and promoting a closed loop with new innovative technologies and management concepts[5].

Elledge (2003) describes legal framework as a major aspect of legitimacy for sanitation policy. He further highlighted that without a legal framework to guide policy implementation, sanitation programme and projects run the risk of violating societal norms and failing to address the policy objectives.

Regulations for sanitation can cover a wide range of topics, including the practices of service providers, design standards, tariffs, discharge standards, environmental protection and contracts (Elledge, 2003).

An amendment of regulatory framework that supports ecological based sanitation system has been shown in country like Finland. The amendments of the Finnish Environmental Protection Act (FEPA) were carried in 2000 to improve wastewater treatment in rural area (Mattila, 2003). The amended FEPA follows the following principles:

- environmental damages must be prevented beforehand;
- environmental damages must be minimised;
- people must exercise caution in their actions;
- BAT (Best Available Technology) must be applied;
- BEP (Best Environmental Practices) must be applied;
- the one causing environmental damages must also pay for the rehabilitation.

Based on the amendments in the Regional Environmental Protection Act (REPA), a decree (or discharge standards) was prepared to specify the effluent treatment requirement. Although the REPA does not specify type of technologies, but municipalities are given the right to issue

[5] Refers to ecological sanitation technologies.

local ordinances on these matters based on local circumstances. This gives the municipality power to refuse the use of septic tanks in area which is sensitive to groundwater pollution.

Other laws enacted or amended include the Finnish Water Supply Act, Land Use and Building Act, Act on Solid Waste and Health Care Act. An interesting observation is that the Land Use and Building Act require household to have written operational and maintenance manual (Mattila, 2003).

In Denmark, some examples of imposing conditions in various associated legislations for supporting the reuse and recycling of animal manure (biogas production and bio-fertiliser distribution to field) are listed below:

- 6-9 months' slurry storage capacity required;
- Restrictions on manure application on land ('harmony rules');
- No organic waste in landfills;
- Tax on waste when incinerated but not if recycled;
- Power companies obliged to purchase electricity based on biogas at prices according to law.

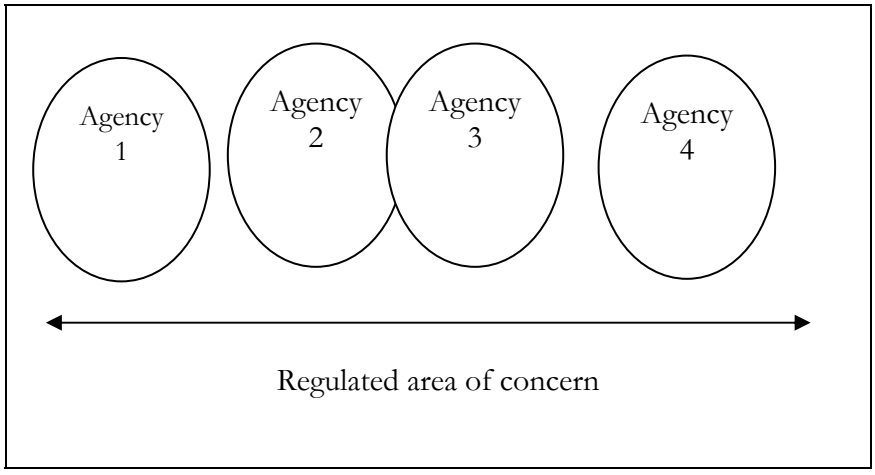
These conditions formed firm basis for supporting the actual implementation.

### *Unambiguous institutional framework*

Institutional organisation denotes the way in which the management tasks are distributed among the agencies involved. It refers to the institutional structure of the system and is defined by competence norms, which are norms describing the mandates and duties of each agency.

Based on experiences from many developed countries, especially in Europe, environmental problems had been dealt with in an ad hoc manner initially. After certain time frame, this had lead to a lot of institutions with similar or overlapping tasks and in some case, gaps in between what was needed (Larsen and Martens, 2002). This can be illustrated in Figure 3-2 below:

*Figure 3-2 Gaps and overlaps in an incoherent institutional framework*



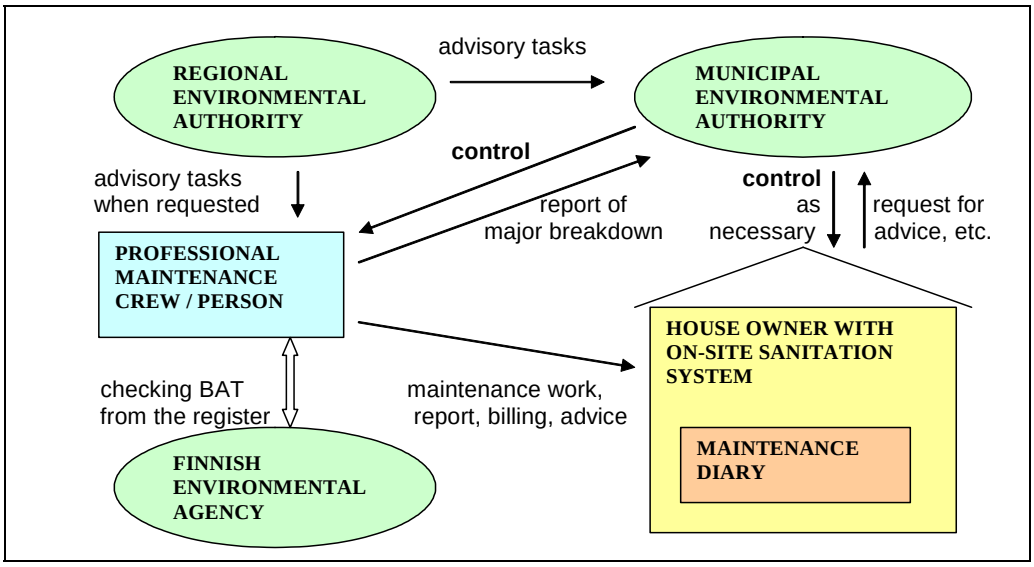

*(Source: Larsen and Martens, 2002)*

Overlaps and gaps among stakeholders involved in particular functions can be major barriers to effective implementation. It would possibly lead to the lack of coherency, lack of clarity,

lack of accountability and most importantly, lack of coordination (Larsen and Martens, 2003). Unclear institutional framework as an important issue in sanitation policy was also highlighted by Elledge (2003). He indicated that responsibility for sanitation is divided among a number of ministries, based on their involvement in urban affairs, housing and public services, environmental protection and local governmental administration. This could lead to confusing mix of institutional activities, sometimes resulting in overlapping authorities or in a situation where no organisation is clearly defined responsible.

Mattila (2003) indicated that the legislative framework is sufficient and it is more a question of common will and appropriate management solutions than inadequate tools. In other words, appropriate institutional framework must be carefully designed and be in place as well. A proposed institutional arrangement introduced in Finland for controlling on-site sanitation is illustrated in Figure 3-3 below.

*Figure 3-3 Proposed control system for on-site sanitation in Finland*




*(Source: Mattila, 2003)*

### 3.3.3.6 Use of economic instruments

Economic instruments, also referred as market based instruments, are often introduced as complimentary instruments for regulatory approach. Economic instruments can include user charges, subsidies, incentives, fines etc. The application of economic instruments applies to some aspects of wastewater management. For example, user charge can be charges paid by households in exchange for the removal of human excreta and wastewater. Subsidies are allocation of cash or kind to support the development of infrastructure.

There are many economic instruments being introduced especially within the European Union to improve environmental performance. The following cases are some examples of economic instruments as applied to cases which have relation to the EcoSan principles (to be discussed in Section 3.4). This includes issue such as the recovery of biogas from wastewater as a form of renewable energy.

In Denmark, incentives were made through providing basic economic preconditions via government investment grants of 20 - 40 % of investment costs for facilities treatment organic manure from pig farms and industrial effluents. Biogas and heat from biogas are exempted from energy tax. State production grant of DKK 0.27 per kWh electricity produced. Low interest rate, long-term (20 years) loans are provided (Gregersen, 1999).

In Sweden for example, the production cost of biogas is about 5 times higher than natural gas. Thus, government subsidy and tax incentives are used to ensure the market competitiveness of biogas in the market (Hsiao, 2001).

In Czech Republic, the use of biogas and biodiesel is encouraged by providing discounted Value Added Tax (VAT) of 5% (European Environmental Agency, 2000).

In relation to wastewater discharge, pollution charges are introduced to encourage better treatment system. For example in Lithuania, wastewater charges are based on the following pollutants:

*Table 3-1 Wastewater charges in Lithuania*

| **Pollutant** | **Charges* (RM/ton)** |
|---|---|
| BOD | 400 |
| Suspended Solid | 20 |
| Nitrogen | 400 |

* converted from Euro based on 1 Euro equivalent to approximately 4 RM
*(Source: EEA, 2000)*

### 3.3.4 Command and control (regulatory) vs economic instruments

A comparison of regulatory tools and economic instruments can be summarised below:

*Table 3-2 Comparison of regulatory approach and economic instrument based approach*

| **Type of innovation** | **Regulatory based** | **Economic instrument based** |
|---|---|---|
| Compliance investment | Direct impact | Should reduce investment required to deliver overall compliance across industry |
| Cost saving investment | No incentive to go beyond compliance investments | Increases number of investments which are cost effective |
| Long term process innovation | If regulations are frequently reviewed – could be "technology forcing" | Incentive to innovate particularly if a tax is increasing year on year |

*(Source: Erdmenger & Schreckenberger, 1998)*

As illustrated in Table 3-2, the use of economic instruments has the advantage of stimulating innovation and uptake of clean technology compared to "command and control" regulatory based approach. For the case of this research, the stimulation of technological research using EcoSan principles could be considered "clean technology" for sustainable wastewater solutions.

## 3.4 Emerging trends of Ecological Sanitation (EcoSan)

### 3.4.1 Principles and problem of end-of-pipe solution (treat and dispose)

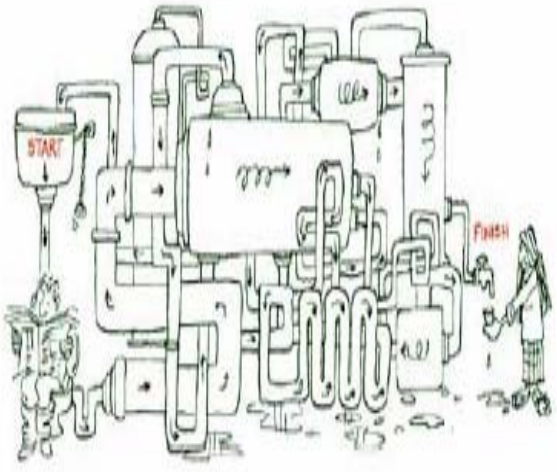
The fundamental principle of the conventional wastewater system is based on the "end-of pipe" solution i.e. flushing wastewater away from the sources, treat and dispose eventually. It is often refereed as sanitation process, basically related to pathogens and health. This approach usually comprises a sewer network (piping) to collect and transport wastewater, a centralised wastewater treatment plant consist of various unit operations. These operations form the linear treatment phases i.e. primary, secondary and tertiary. All these stages involve intensive material and equipment i.e. large tanks, pumps and many other components. The business and market for this approach is well established worldwide.

There are several challenges being questioned on this approach, all related to the long term sustainability and feasibility for poorer people. The main concerns include:

- Disease and health concern
- Affordability
- Ecological sustainability
- Loss of amenity

In relation to health concern, although sewers can transport wastewater away, inadequate treatment and disposal at the end of pipe will release pathogens to downstream environment. Increasing incidents of sewer leakage, especially old sewers also create risks and threat to public health and environment. It was estimated that 6,000 children die each day from diseases related to inadequate sanitation and hygiene (WEHAB, 2002). The importance of health aspects and potential problem of centralised sewage system are best reflected from the recent outbreak of the Severe Acute Respiratory Syndrome (SARS) especially in Asia. According to Hong Kong specialist, SARS has spread like wildfire in some of Hong Kong's densely populated housing estates, with more than 300 cases in one housing block blamed on a faulty sewage system. (Health, Welfare and Food Bureau, Hong Kong Special Administrative Region, 2003).

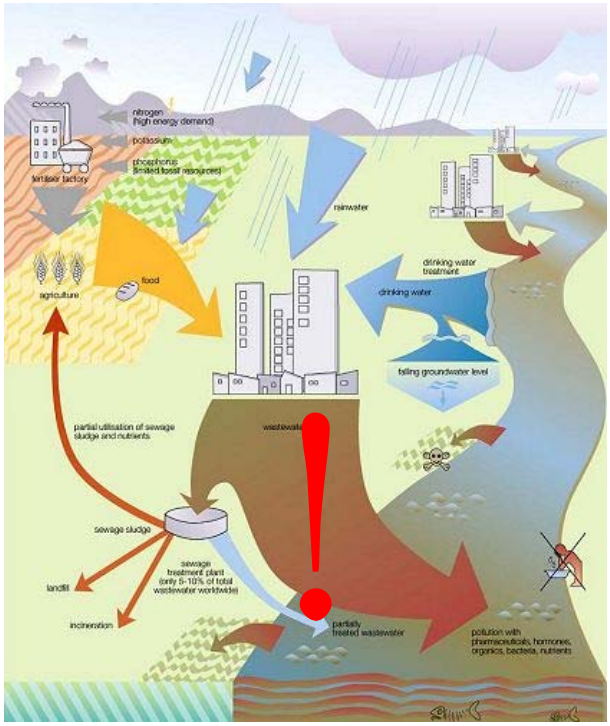
*Figure 3-4 Is end of pipe engineering solution mindless?*




Source: Narain S. (2002) *The Flush Toilet is Mindless*

When it comes to affordability, wastewater collection and treatment tend to be two to three times more expensive than the costs to extract, treat, and distribute tap water. In addition, the costs to operate and maintain sewage collection and treatment systems are often higher than the annual depreciation of the capital investment in the infrastructure. Treatment plants consume a lot of energy, generate large quantities of excess sludge that must be disposed of or used, and require relatively sophisticated equipment that demands well-trained operators and engineers (Figure 3-4).

*Figure 3-5 Linear loss of nutrient and wasteful use of clean water. (Source: GTZ, 2002)*

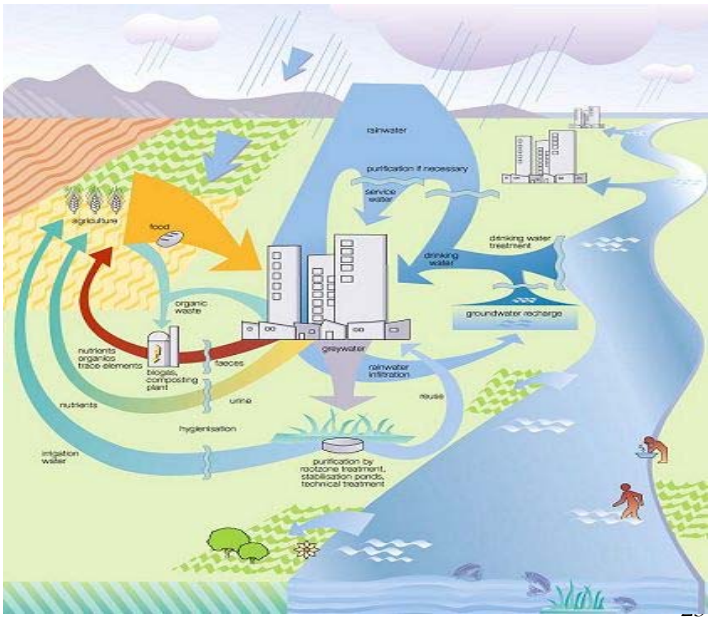



As indicated in Section 3.1.2, the logic of the conventional approach on resource use is also questionable. In the developed world, waste management systems have originally been designed to ensure a high local hygienic standard and have been developed to maturity without primary concern for recycling. It basically utilizes clean water for transporting waste while the linear loss of nutrient (which potentially can be recycle) to the waterways is becoming a big problem in many cities (Figure 3-5). Advance tertiary treatment of the conventional wastewater system is designed to ***remove*** the nutrients before final discharge. However, this application is complex and the use if limited globally. It was estimated that of 540 major European Union cities, only 79 have advanced tertiary treatment (European Commission, 2001). The main nutrient losses include both nitrogen and phosphorus. Phosphorus is a finite resource. It was estimated that close to a quarter of mined Phosphorus (250 Metric Tonnes) ended up in the aquatic environment since 1950 (Gumbo, Savenjie & Kelderman, 2002). These "loss" opportunities for better use of water resources and nutrients are the two main arguments for developing alternative approaches.

## 3.4.2 Principles and logic of EcoSan (closing the loop)

The main principle of this approach is to shift from disposal to recovery the system include the containment, sanitisation and recovery of "waste"water which is more ecologically (environmentally) and economically (affordability) sounded. It stresses a systematic closure of material flow which will help to neutralise the depletion of resources due to human activities.

*Figure 3-6 Closing the loop approach – EcoSan (Source: GTZ, 2002)*



wastewater in principle can be comparable to the closing of material loop of material in waste management.

The EcoSan principle also in general supports the "Proximity Principle", which highlights the preference of treating waste as close to the source of generation as possible (except for EcoSan system that include off site centralised treatment facilities such as biogas plant for blackwater treatment). This principle is also the basic support for decentralisation of wastewater treatment system.

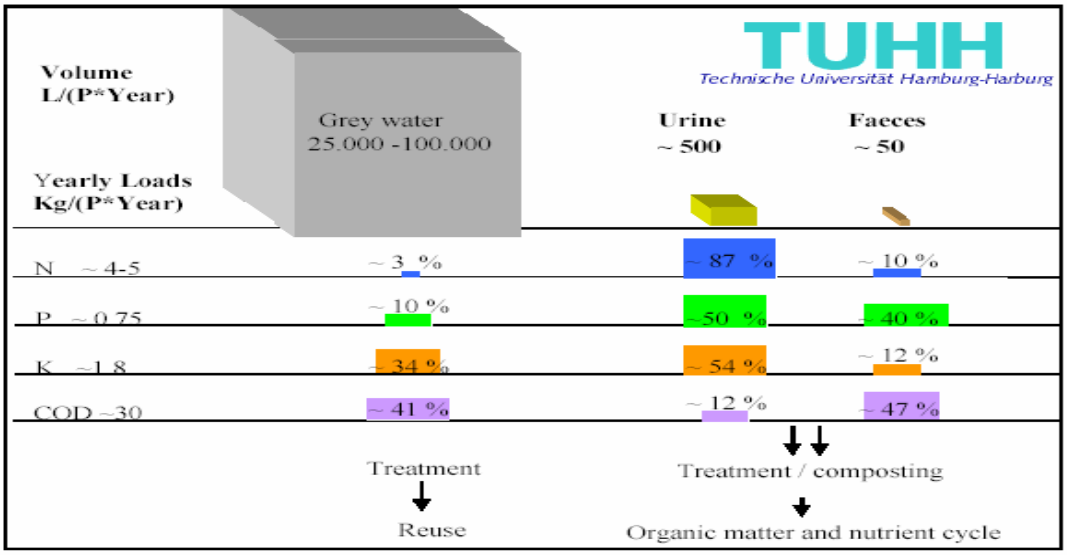
The process of closing the water and nutrient loop also implies the need to source separation. There are strong arguments why source separation of domestic wastewater makes perfect sense. This can be illustrated in Figure 3-7. If the primary material for recycling is nutrient, Figure 3-7 shows that around 80-90% of the nutrients (Nitrogen and Phosphorus) are contained in the blackwater (faeces and urine) while the volume of blackwater is much less than the total wastewater volume as treated in the mixed (conventional) system (Gajurel, Li & Otterpohl, 2002). On the other hand, the sanitation process is also mainly targeted for pathogens in blackwater. Thus, it makes sense from the point of nutrient recovery as well as sizing of treatment system to treat black and greywater separately.

There are several orientations of source-separation systems developed from the EcoSan principles today that are being tested worldwide. The degree of separation is closely related to the desired end-treatment intended. For domestic separation, there are three basic different kinds of source separation:

- Separate collection of blackwater and greywater;
- Separate collection of urine, faeces and greywater;
- Separate urine from other wastewater stream (mix of faeces and greywater).

Source separation usually requires physical alterations of toilet system, plumbing and building structures. The separated wastewater fractions can be treated locally or brought to centralised treatment facility. The last option on the list above is usually an alternative for area with an existing centralised wastewater sewerage system.

*Figure 3-7 Breakdown of pollution loading for domestic wastewater*




*(Source: Gajurel, et al., 2002)*

The following sections will describe findings about the status and trends of blackwater treatment system. As the scope of this research is set to explore only the blackwater system, greywater treatment will not be elaborated in this research.

### 3.4.3 Blackwater management system

Source separated blackwater is interesting because apart from the high organic and pathogenic content, the separated blackwater collects more than 75% phosphorus, 90% of nitrogen and phoshorus that can be recovered (Johansson & Lennartsson, 1999). Based on the EcoSan principles, the design of blackwater treatment system needs to take account of lowering the capital and operating cost while promoting recycling of nutrients.

There are several configurations of blackwater systems been developed and demonstrated globally. The system considerations include collection, transportation and end-treatment.

An important design criterion for all 3 system considerations is the volume of water used for flushing in the toilet bowl, which will determine the solid content of the blackwater. Lowering the water use can greatly reduce the tank volume; transportation cost and most probably favours the end treatment process (Johansson & Lennartsson, 1999).

For this reason, the use of low-flush toilet with urine separation is shown in countries like Sweden and other countries. Vacuum toilets with and without urine separation are also used in several housing area in countries such as Germany and Norway. The blackwater is collected in storage tanks and either dewatered and composted locally or transported to treatment facility elsewhere (Johansson & Lennartsson, 1999).

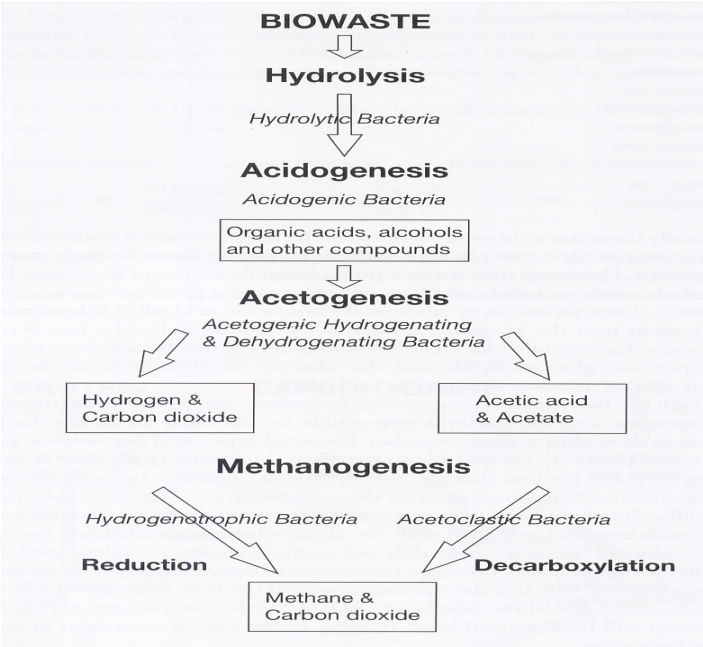
#### 3.4.3.1 Composting vs anaerobic digestion

Typical treatment processes include liquid composting and anaerobic digestion. In terms of energy requirement, composting is an energy consuming process requiring around 50-75 kwh of electricity per tonne of waste while anaerobic digestion on the other hand, is a net-energy producing process, with around 75-150 kwh of electricity produced per tonne of waste (IEA, 2001).

For the option of anaerobic digestion, there is the possibility of integrating blackwater for treatment in biogas facility, which encourages the recovering of energy and nutrients. This could be done on-site or in large centralised facility. According to Johansson & Lennartsson (1999), all these systems described above are relatively new, and there are very limited experiences with large scale systems. Small scale systems are demonstrated in a school in Kvicksund, Sweden and dormitory in Aas, Norway. On-site biogas recovery and bio-fertiliser generation is demonstrated in the model project "Wohnen & Arbeiten" in Vauban, Freiburg (Lange and Panesar, 2003) and Flintenbreite "Eco-village" in Lübeck, Germany. (Oldenburg and Wendland, 2003).

All the existing systems are installed in countries with seasonal and cold climate. There are no experiences of full scale demonstration of such blackwater treatment system being tested in tropical or sub-tropical climate conditions. Apart from the proposed system in Kuching, Malaysia (tropical climate), another project of similar nature is proposed and planned in Havana, Cuba (sub-tropical), which will include the implementation of blackwater treatment system for 16 apartments. Vacuum toilets will be installed and the blackwater will be collected separately and co-digested on site in biogas reactor (Agriculture University of Norway, 2002).

## 3.4.4 Integrating biogas recovery with wastewater management




### 3.4.4.1 The principles of anaerobic digestion

Biogas recovery from waste, which utilises the concept of anaerobic digestion (AD), is not a new technique. The principle reactions of AD can be best illustrated in the following figure:

*Figure 3-8 Process of biogas production via anaerobic digestion (Source: Evans, 2001, p. 94)*

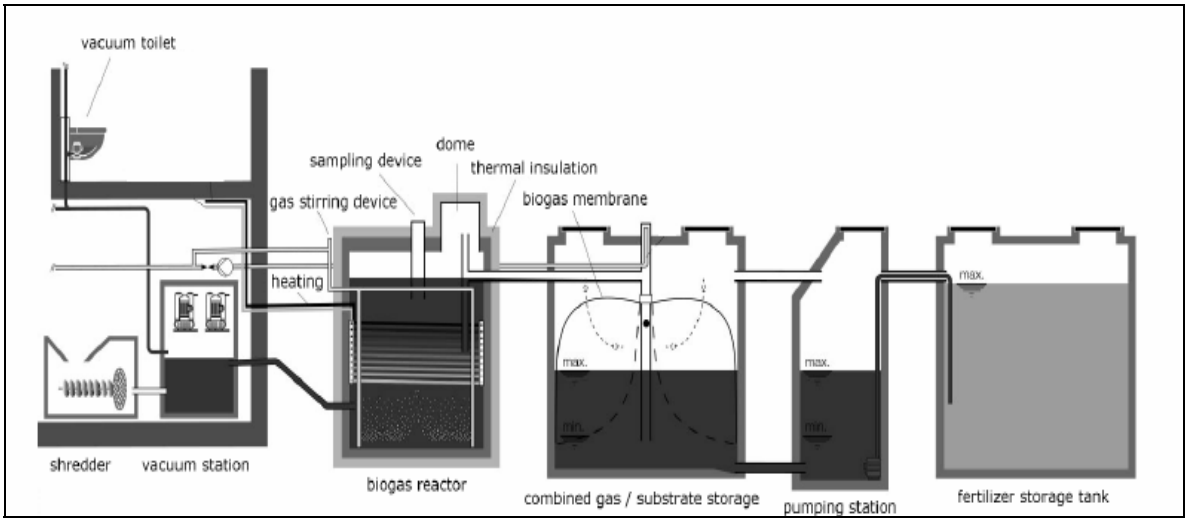
As illustrated, the biodegradable waste is degraded through a series of bacteria based digestion process eventually producing a gas mixture of biogas comprising approximately 50-60% methane ($CH_4$) and 30-40% carbon dioxide ($CO_2$). Apart from the biogas, residual digestate and process liquor are also produced and these could be further processed into valuable nutrient additives or soil conditioner. There are several different process configurations which could have different process temperature, loading, moisture content etc. Technical details of these options would not be elaborated in this study.

### 3.4.4.2 Status and experience of biogas recovery system

International Energy Agency (2001) estimated that there are around 125 industrial sized AD plants (with total installed capacity of 5 million tonnes and electricity generating potential of 500 MW) in the world today and another 35 are under construction. The principle feedstocks (waste treated) are mainly municipal solid waste, organic industrial waste, agriculture waste such as manure and sewage sludge from wastewater treatment plant. Experiences of co-digestion of blackwater with other organic waste are however limited, especially for those of significant size.

There are however several existing demonstration projects that are designed to treat blackwater and household organic waste on site with biogas recovery. Examples of such system are demonstrated especially in Germany and Norway. The first biogas plant for an apartment building in Germany was built in Vauban of Freiburg, Germany (Lange and Panesar, 2003). The system consists of a concrete digester for treating black water and organic household waste, a post treatment with an internal plastic bag gas storage and a storage tank for the fertilizer. The biogas plant is connected to the internal gas system of the house; it will provide cooking gas for the 16 households. The plant is almost ready – only the automatic regulation of the gas pressure and the feeding device for organic household waste need modification and adjustments. (see Figure 3-9). In Norway, on site treatment of blackwater for 24 student apartments is designed to produced fertilizer slurry (Jenssen, 2001).

*Figure 3-9 The Biogas-Bio-Fertilizer-Module in Vauban, Freiburg of Germany*




*(Source: Lange and Panesar, 2003)*

In summary, AD seems to be a well developed technique for treating organic waste including sewage sludge. There are pilot projects integrating blackwater and household organic waste in decentralised AD digestors but there are no full scale existing systems that are designed to treat blackwater in large centralised facility based on EcoSan principles as the case proposed in Kuching, Malaysia.

### 3.4.5 End use of biogas – experiences from other countries

Approximately 90% of the energy from AD process is retained in the form of methane in the biogas produced (IEA, 2001). Thus, the quality of biogas i.e. the methane content and content of other undesirable trace compounds such as hydrogen sulphide, is of prime importance when it comes to deciding the utilisation options. For AD process with pure organic waste feedstock, the quality of biogas is more consistent and clean compared to biogas from landfill for example.

There are several different utilisation methods of biogas today. In general, biogas can be used in all applications designed for natural gas as there are great similarities between them. The technologies involved for different utilisation differs from high technological implications such as upgrading of gas quality for vehicle fuel to simple modification of equipment and direct use for combined heat and power production, cooking and lighting (IEA, 2001).

Apart from being a renewable fuel, upgraded biogas can bring other benefits when compared to other fossil fuels such as coal, oil. These include:

- Higher efficiency;
- Usually cheaper;
- Lower sound by methane powered engines;
- Lower fume emissions e.g. reduce nitrogen dioxide by up to 95% (Sydgas, nd.).

The use of biogas is certainly increasing in many countries. In country like Sweden, biogas energy already increased to about 15% (15 TWh) of natural gas derived energy. The integration of upgraded biogas into the natural gas grid which serves 55,000 customers is a very interesting system development. This integration increases the application and market of

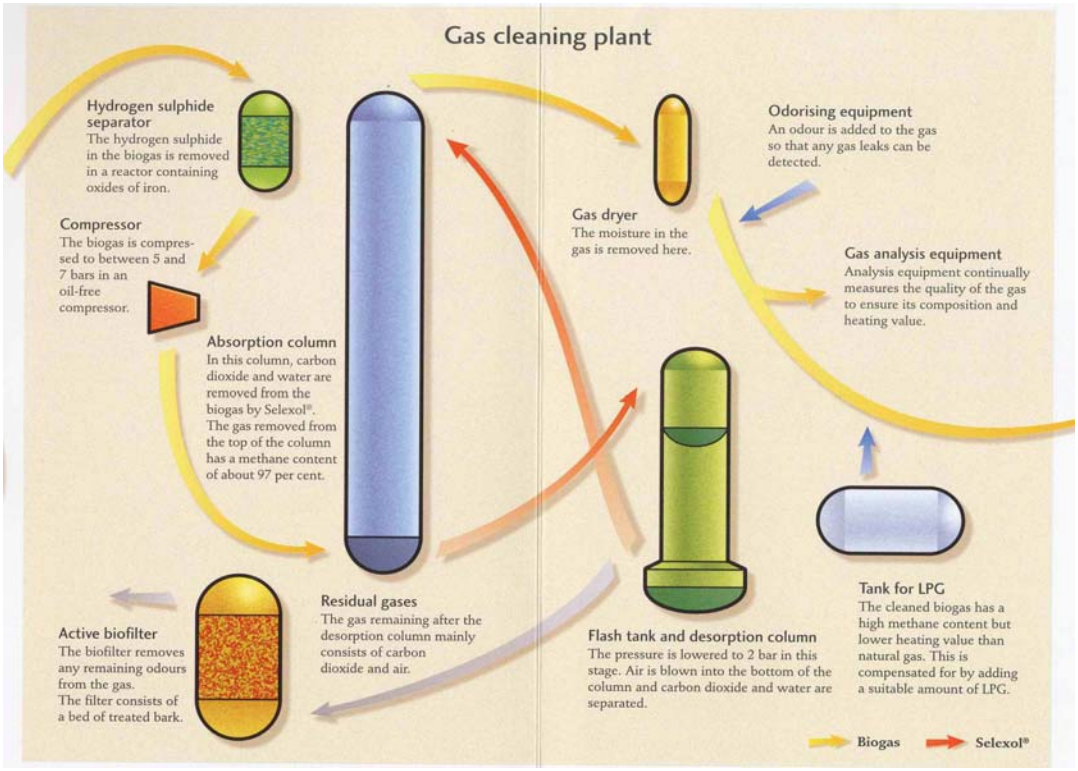
the biogas and manages to reduce the problem of supply reliability as natural gas can act as a backup to the biogas customers. (Sydgas, nd.)

### 3.4.5.1 Upgrading of biogas for vehicle fuel

The upgrading of biogas to similar quality to natural gas for vehicle fuel is carried out in several countries such as Sweden, Switzerland, Netherland and Czech Republic. (Eklund, Ivarsson, Jensen, Jönsson, Polman and Schyl, 2003). The upgrading or cleaning process is mainly to remove the carbon dioxide and other contaminants presence in the biogas. There are various techniques of upgrading process. An example of biogas cleaning process can be illustrated in Figure 3-10.

The investment for such an upgrading facility, with a capacity of 200m$^3$/h, is around 8.5 mil SEK[6] (approx. MYR 4 million) in Sweden. Annual operational cost for such a plant is around 5-7% of the investment cost. This corresponds to an upgrading cost of MYR 0.05-0.10 per kwh (USD 0.013 to 0.025) of almost pure methane contented biogas (Ivarsson, 2003). In view of the local economical conditions in Malaysia, both the investment and operational cost are expected to be lower.

*Figure 3-10 Upgrading process of biogas*




*(Source: Sydkraft AB, nd.)*

[6] Approximately USD 1 million at reported time

*Figure 3-11 Upgraded biogas filling station in Eslöv, Sweden (Source: Own picture from study tour, 2003)*

The supply of upgraded biogas as vehicle fuel is distributed through the establishment of a series of filling stations accessible by users. In Sweden for example, there are now more than 10 biogas filling stations built (Figure 3-11).

According to Eklund et al. (2003), the cost of upgrading and the lack of standards and regulations concerning the integration of upgraded biogas to natural gas grid are the most challenging constraints. The lack of economic support for the use of biogas for electricity production has delayed the diffusion of the use of biogas.

***Status of Natural Gas as Vehicle fuel in Malaysia***

Although the use of natural gas as vehicle fuel constitutes very small portion of the total gas used, the use of natural gas as vehicle fuel has increased 10 times over the last ten years in Malaysia. It is estimated approximately 5000 vehicles today, mainly taxis, are running on natural gas powered vehicles (NGV) in Malaysia (Hydrocarbon Asia, 2002).

The expansion of NGV is spearheaded by Malaysian state oil company Petronas. Petronas currently has 21 natural gas refuelling stations and it expected to have 162 compressed gas refilling stations across the country by 2006. Lee Giok Seng, manager of operations and services for Petronas NGV, said the company is extending its natural gas vehicle programme (NGV) beyond Kuala Lumpur to cut air pollution and reduce dependency on petroleum products.

He said that although natural gas offered environmental benefits, the main driving forces to expand its use in transport were economic and the need to reduce dependency upon petroleum.

He said the price of natural gas at the pump had been steady since 1992 at 56.5 Malaysian cents per litre equivalent, while as of January 2002 gasoline cost 130 cents per litre and diesel 70.1 cents.

***Environmental gains from substituting diesel***

In general, substituting fossil fuel such as diesel with upgraded biogas would bring various environmental gains. An example of such gains is illustrated below:

*Table 3-3 Environmental gains of a public bus switching from diesel to gas*

| Emissions (kg) | Diesel | Natural/Biogas | Reduction |
|---|---|---|---|
| Nitrogen oxides | 2000 | 800 | 60% |
| Carbon monoxide | 1200 | 120 | 90% |
| Hydrocarbons NMHC* | 325 | 65 | 80% |
| Particles | 42 | 17 | 60% |

*Source: Sydgas, nd.* * non-methane hydrocarbons

### 3.4.5.2 Combined heat and power production

Combining hot water recovery with electricity generation seems to be an efficient use of the biogas, which can yield conversion efficiency up to 85%. Electrical conversion efficiency is about 30% for internal combustion engine running on biogas.

New approach includes the use of combined cycle power plants consisting of gas turbines, steam turbines and waste heat recovery boilers all working together to produce electicity. In future, the use of fuel cells might be able to further improve the cost effectiveness of biogas utilisation.

Heat recovery is particularly useful for cold climate countries and the use would be different for tropical countries like Malaysia.

### 3.4.5.3 Biogas for cooking

Biogas can also be used for direct cooking and this is in fact a traditional practice of converting animal dung to biogas for cooking in countries like India and China. Today, focus is more placed on technological improvements of the application, development of distribution structure for large scale biogas plants. Development of biogas cooking system at village scale has been demonstrated in many countries. For example, the EcoSan pilot project carried out in Guangxi Province has shown the feasibility of such approach. (see Figure 3-12)


*Figure 3-12 Biogas for modern cooking in Guangxi Province, China*

*(Source: Own illustration, 2001)*

### 3.4.6 Organic fertiliser as substitute of chemical fertiliser

The residues after the anaerobic digestion process comprise of solid (known as digestate) and liquid (process liquor) products. The digestate (dry) and process liquor (wet) usually needs refining before they can be used for horticulture or agriculture. The application of this material could be spread as stabilised compost or slurry. The liquid fraction contains about two third of the nutrients in the wastes. Part of the liquor can be recycled into the process as inoculation. However, the distribution needs to be regulated on it's quality and rate of application (IEA, 2001).

# 4. Review of existing situation - Case of Kuching

This chapter sets out the background information regarding the current situation in Kuching, which was the case studied. The review includes general introduction to the city, overview of current wastewater management and future wastewater planning, overview of existing policies (environment and wastewater) at all levels, current legal and institutional framework and status of economic instruments application within the country.

## 4.1 Introduction to the city of Kuching

The city of Kuching, the State capital of Sarawak, is located in the South-west of Sarawak, Malaysia (see Figure 4-1). Sarawak, the largest State in terms of land area in Malaysia, is located on the North of Borneo Island, adjacent to Sabah, another State of Malaysia as well as sharing borders with Indonesia and Brunei. Sarawak, together with other 12 States formed the federation of Malaysia.

*Figure 4-1 Location of the City of Kuching, Malaysia*


Kuching achieved city status in the year of 1988 and the city is developing rapidly in terms of population growth and business development. The city is divided into North and South, administered by two city councils. The city has also expanded into the jurisdiction of a third municipal council and thus making the administration of the city even more complex when it comes to stakeholder involvement (to be discussed in section 4.5).

The population has grown about 65% between 1980 and 2000. The population of Kuching city is estimated to be around 400,000 while within the greater Kuching district in 2000 was approximately 496,000 (Department of Statistics, 2001).

The main economic activities of the city encompass mainly commercial businesses and increasing industrial development. Dominating industries include timber processing,

electronics and food processing industries. Agriculture activities such as livestock farming, plantations etc. can be found in the surrounding hinges of the urban centre.

The annual rainfall for Kuching varies between 3,000 and 5,000 mm. The wettest season is during the Northeast monsoon from November to March, with a peak rainfall in December to January typically higher than 400 mm per month. The temperature in the area ranges from about $22^0$C to $34^0$C (Polvsen, 2001).

Kuching City is located on relatively flat terrain along the surrounding rivers and streams and large parts of the city are founded on unstable ground (peat swamp or soft clay). Kuching is situated along both sides of the Sarawak River, approximately 40 km from the river mouth which drains towards the South China Sea (Lynghus, 2003).

In Kuching, several small river tributaries discharge to Sarawak River and a total of 21 drainage sub-catchement areas in Kuching are discharging into the part of Sg. Sarawak, which is flowing through Kuching. In 1997, a gated barrage was constructed through the Sejingkat Isthmus and the river was blocked by causeways in order to regulate the tidal influence on the river. (Polvsen, 2001)

## *4.2 Current domestic wastewater treatment and environment*

Currently, there is no centralised sewage treatment system in Kuching. Most houses in Kuching have two wastewater outlet systems, separating the wastewater into black water (from toilets) and grey water (from bath-rooms, kitchens, cleaning and others).

The blackwater from individual households are mostly treated in individual septic tanks. In some areas (especially new housing estates, commercial buildings etc.) black water is discharged to a collection system for treatment in communal Imhoff Tanks or prefabricated primary treatment packages. It is estimated that there are approximately 65,000 septic tanks in Kuching (Lynghus, 2003). The discharge from septic tanks is directed to storm water canals, which drains to the nearest natural water course.

Septic tanks are generally not very efficient with limited organic matter removal and almost no nutrients are removed prior to discharge, even with the most efficient type of septic tanks (Polvsen, 2001). In addition, the septic tanks in Kuching are generally not functioning due to the lack of desludging. As a consequence, blackwater is discharged almost untreated to the drainage system. A study carried out on the effectiveness of various septic tanks in use in Kuching City South was carried out in 1996 by the Kuching City South Council. The study revealed that conventional septic tanks are not effective and do not comply with discharge limit allowed by the regulation. The study further confirmed the direct relationship of the lack of desludging and poor discharge quality. This included high organic pollutants and bacteria counts (Kuching South City Council, 1996).

The poor water quality of the river draining through the city, especially the tributaries and its relation with poorly treated sewage discharge has also been documented in many other different studies and reports.

A river management study, known as the "Sungai Sarawak Environmental Control and River Management Study" was carried out by the Government of Sarawak in 1997. The study established some basis of pollution level in Sarawak River. The river baseline study carried out by the Natural Resources and Environment Board through the Sustainable Urban Development project in 2001 is probably the most comprehensive study that documented pollution from urban activities and pollution in Sarawak River. The report documented that

the tributaries of Sg. Sarawak situated in Kuching City and the part of Sg. Sarawak, which is flowing through Kuching, is significantly polluted. (see Figure 4-2)

*Figure 4-2 Pollution of river tributaries mainly due to poorly treated sewage*

The major issues are serious pollution with faecal derived coliform bacteria, which is posing a health risk and pollution with organic matters and nutrients, leading to oxygen deficiency, deleterious impact on bottom fauna and offensive odours. The main source of the pollution is raw and insufficiently treated sewage and wastewater, which is discharged to the open drains in the city (Polvsen, 2001). This compliments the findings of the study carried out by Kuching South City Council mentioned earlier.

An estimation of pollution loading was made and it can be clearly shown in below that organic pollution from households, especially due to the poorly treated sewage, is indeed a major problem.

*Figure 4-3 Pollution loading based on different sectors in Kuching*

| | Households (kg/day) | Foodoutlets (kg/day) | Industries (kg/day) |
|---|---|---|---|
| BOD | 5900-9700 | 650 | 15 |
| COD | 19900-26000 | 800 | 40 |
| TSS | 5400-8000 | 260 | 60 |
| Tot-N | 2600-3400 | 30 | 5 |
| Tot-P | 500-600 | 10 | 3 |
| Oil & grease | 200-350 | 60 | 2 |

*(Source : Polvsen, 2001)*

## 4.3 A review of existing related policies

A review on relevant policies was carried out to generate an overview of the existing governmental direction in wastewater as well as relevant policies that would have a bearing on related aspects of EcoSan application. Such areas include the recovery of biogas as renewable energy source, reduction of greenhouse emission as contribution to climate change commitment, the application of organic based fertiliser etc.

### 4.3.1 National policies

#### 4.3.1.1 Overall development policies

On the national level, the National Vision Policy denotes the need to pursuit an environmentally sustainable development for reinforce long term growth. Other widely known policies where environment and natural resource management are incorporated in are the 8th

Malaysia Plan (2001-2005) and the Third Outline Perspective Plan (2001-2010). These plans specifically mentioned Malaysia Government's commitment towards international obligations in the protection of environment and conservation of natural resources.

#### 4.3.1.2 National environmental policy

The Ministry of Science, Technology and Environment have recently (March 2003) published the Malaysian "National Policy on the Environment" which was approved by the parliamentary cabinet in October 2002. The environmental policy places the management and conservation of environment in the context of sustainable development.

This policy statement sets out the principles and strategies necessary to ensure the environment remains productive, both ecologically and economically. This lead to the overall strategy of integrating environmental dimensions into development activities and in all related decision making process.

The National Policy on the Environment also spells out eight mutually supporting principles that attempts to harmonise economic development goals with environmental imperatives. Interestingly, these principles specifically outline the need to integrate environmental dimensions in the planning and implementation of policies, objectives and mandates of all sectors to protect the environment. Strengthening private sectors involvement, ensuring highest commitment and accountability, active participation in regional and global international efforts to protect the environment are some other aspects that are interesting for this research (MOSTE, 2002).

In fact, this general policy direction seems to support the use of EcoSan principles, which promotes ecologically sustainable environment through sustainable sanitation practices.

#### 4.3.1.3 National wastewater policy

There are no explicit wastewater policies that specify the direction of domestic wastewater treatment in the country. Efforts to improve wastewater systems have been initiated in Peninsula Malaysia but the overall direction is not clear in relation to the approach. Legislation has been enacted in 1993 and a consortium was established to implement technical improvements. This would be discussed further in section 4.3.3.

However, it must be noted the planning and implementation of environmental related issues (such as wastewater treatment) in peninsula Malaysia might not apply to State of Sarawak as Sarawak has its own sets of environmental legislations and sovereign rights towards the protection and conservation of its environment under the federal constitution.

#### 4.3.1.4 National energy policy

On a national level, policy related to energy development is likely to have bearings on the recovery of energy from wastewater as one of the EcoSan solutions. The environmental objective incorporated in the current Malaysia National Energy Policy (Ministry of Energy, Communication and Multimedia, 2003) includes:

*"To minimize the negative impacts of energy production, transportation, conversion, utilization and consumption on the environment."*

This policy supports energy production that has lower overall environmental impacts, which might be the case of energy recovery from the biogas recovery system. This is also supported by the encouragement for the use of alternatives to fossil fuels and increasing investment on clean and renewable sources of energy which is stipulated in the National Policy on the Environment.

The production and use of biogas also fits into the goal of Malaysian Government's decision to intensify the development of renewable energy (RE) as the fifth fuel (after oil, gas, coal and hydro) resource under the country's Fuel Diversification Policy, as stipulated in the objectives of the Third Outline Perspective Plan for 2001-2010 (OPP3) and the 8th Malaysia Plan. Policy statements in the Plan require the development of regulatory framework and implementation mechanisms before programmes related to renewable energy can be incorporated.

This policy recognises the need to ensure the long term reliability and security of energy supply as well as the commitment towards international conventions on climate changes. The energy sector contributed approximately 68% of the total carbon dioxide emissions in Malaysia (Loh, 2003).

According to Dr. Hassan Ibrahim, the chief executive officer of the Malaysia Energy Centre[7], the Government of Malaysia is trying to spur the growth of renewable energy through the Small Renewable Energy Programme[8] (SREP).

#### 4.3.1.5 Incentives for renewable energy development

Under the Malaysian 2003 Budget announced in September 2002, incentives for the use of RE resources were reviewed. Companies which generate energy using biomass are given the following incentives after the review until end of 2005 (Danida, 2003):

a) Pioneer Status with tax exemption of 70% of statutory income for 5 years or Investment tax Allowance of 60% on the qualifying capital expenditure incurred within a period of 5 years with the allowance deducted for each year of assessment to be set off against 70% of statutory income; and
b) Import duty and sales tax exemption on equipment used in the project and are not produced locally. Equipment purchased from local manufacturers is given sales tax exemption.
c) The scope of the existing incentives be extended to cover hydro power not exceeding 10 MW and solar power.

The 2003 Budget also provides for additional incentive to companies which incur capital expenditure investing in energy efficient equipment for own consumption. The incentives were as follows:

i) Accelerated Capital Allowance on related equipment to be fully written off within 3 years;
ii) Import duty and sales tax exemption for equipment used in energy conservation which are not produced locally. Equipment purchased from local manufacturers is given sales tax exemption;

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[7] Malaysia Energy Centre (PTM), non profit organization undertaking research and policy advise to government

[8] Power production less than 10 MW with utilization of all types of Renewable Energy, including biomass, biogas, municipal waste, solar, mini-hydro and wind.

iii) To serve as a greater incentive, the 2003 Budget proposes to reduce the write-off period from 3 years to only one.

#### 4.3.1.6 Small Renewable Energy Programme (SREP)

Small power generation plants which utilise Renewable Energy can apply to sell electricity to the utility through the distribution grid system. Project developers are required to negotiate directly with the relevant utility on all aspects relating to the Renewable Electricity Purchase Agreement, including the selling price on a "willing-seller, willing buyer" and "take and pay" basis. The Renewable Energy electricity producers will be given a licence for a period of 21 years, which will be effective from the date of commissioning of the plant. Under this Small Renewable Energy Power Programme, the utilization of all types of Renewable Energy, including biomass, biogas, municipal waste, solar, mini-hydro and wind, are allowed (Loh, 2003).

Maximum capacity of a small Renewable Energy plant designed for sale of power to the grid must be 10 MW. A power plant can be more than 10 MW in size, but the maximum capacity that will be allowed for power export to the distribution grid must not be more than 10 MW (Loh, 2003).

There are about 30 SREP projects approved but the most prohibitive aspects are due to it's high investment cost. There are no specific price incentives for renewable energy, which was capped at a ceiling of RM 0.17[9] per kilowatt hour (Loh, 2003).

PTM indicated that raising the price of renewable energy as well as mandatory for power providers to produce a certain percentage of renewable energy as part of licensing conditions would help to increase the viability of renewable energy projects. It also promotes the development of renewable and co-generation as much as possible. However, these advices are yet to be transcribed into written policies by the government.

#### 4.3.1.7 Clean Development Mechanism (CDM)

Clean Development Mechanism (CDM) is a market-based scheme to assist developed countries in meeting their green house gas (GHG) emissions target without harming national economies. CDM enable parties involved to trade parts of their assigned amount of carbon credits generated from CDM projects.

The Government of Malaysia recently ratified the Kyoto Protocol in order to contribute towards the protection of the global atmosphere and in order to harvest the benefits from participating in the CDM. This is in line with the National Policy on the Environment which stipulates the proactive approach to regional and global environmental issues.

Relevant policy and institutions have been established for the implementation. There are four main criteria that a project needs at least one to be fulfilled in order to be eligible for CDM consideration (Varming, 2003):

1. must support sustainable development;

2. must fulfil international criteria – voluntary, measurable and additional;

3. must be a cooperation of Annex 1 countries and Malaysia;

[9] Equivalent to approximately USD 0.04 per kwh.

4. must have elements of technology transfer or technological improvement.

Malaysia has also signed an agreement with Denmark to identify and help develop CDM-approved projects. The Ministry of Science, Technology and Environment is appointed as the Designated National Authority (DNA) which will be the focal point for the approval of CDM projects. There are three projects (all biomass energy recovery) prepared and awaiting approval from relevant approving committee (Varming, 2003).

#### 4.3.1.8 Tax incentives for natural gas vehicles (NGV)

As part of the National Energy Policy, the use of natural gas vehicles are encouraged with sets of incentives (attached in Appendix 5). This might be relevant if biogas is to be considered for upgrading into fuel suitable for vehicle use as in the case of Sweden, Holland and Switzerland.

### 4.3.2 Regional and local policies

Regional level policies refer to those formulated at State level while local level refers to city or municipal level policies. As mentioned in section 4.3.1.3, although certain decisions such as concessions of wastewater treatment management is not applicable to the State of Sarawak, certain policies are still adopted by the State directly or as a basis for formulating State based directions.

#### 4.3.2.1 State environmental policy

Currently, there is no written State environmental policy in Sarawak. The state policy is mainly reflected and dictated through various provisions in the various legislations enacted (Mamit, 2000). In fact, the conservation of natural resources has already been included in the Natural Resources Ordinance enacted in 1949, 50 years ago. Details of state legislation will be discussed later in section 4.4.

According to Mamit (2000), the environmental protection in Sarawak is way ahead of other states in the country due to the strong political commitment. Despite the lack of a clearly written policy, environmental related issues are frequently discussed in the state legislative assembly[10] and the state cabinet[11], which are two main high level forums where decisions on strategy and directions are made. This also depicts the hierarchial nature of the existing government, indicating the policy making lies closely with political leaders and state administrative elite (Shariff, 2001).

The State's environmental direction is in line with the need of acquiring sustainable development as adopted from the Rio Summit in 1992. This can be reflected from the vision and mission statement of the overall State environmental board – Natural Resources and Environment Board (NREB). However, the environmental quality management in Sarawak has been governed by concern and need in an adhoc basis (Mamit, 2000). This can be reflected with the budding of subject specific ordinances and bylaws enacted.

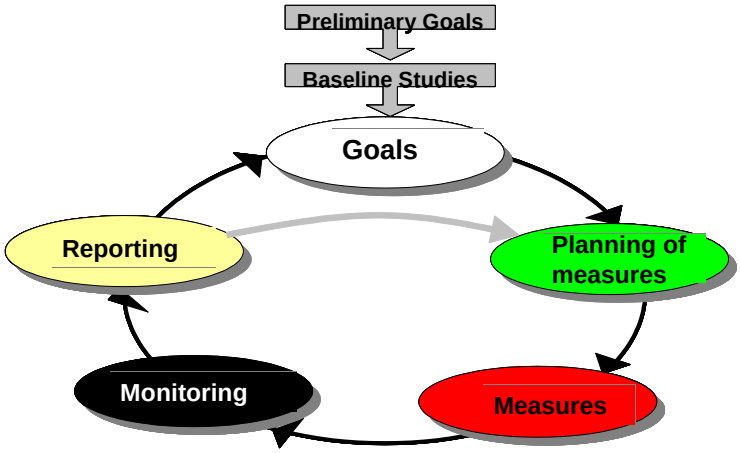
The State of Sarawak, due to influence of external advises and assistance to some level, has recognised the importance of establishing a systematic environmental management system. With support from the Danish Cooperation for Environment and Development

[10] Held twice every year, an official forum where various legislations are discussed, debated and passed.

[11] More frequent meetings of all State level ministers.

(DANCED)[12], the State has taken the step to develop a systematic environmental planning approach, known as the Urban Environmental Management System (UEMS) since 1999. The adoption of the UEMS framework (Figure 4-4) has the objective of providing necessary information and support for decision makers to devise informed decisions.

*Figure 4-4 Urban Environmental Management System Framework developed in Kuching*




*(Source: Larsen and Martens, 2002)*

The UEMS framework is currently being implemented with Kuching City as the point of departure. The two areas of concern include river water quality and solid waste management, both which have some relations to the topic of this research. The measures referred in the framework include regulatory and incentive based approaches.

### 4.3.2.2 Local policy – Kuching

Local policy is mainly associated with unique or specific issues concerning the city of Kuching. Although there are no clear, official written policies, implementations of various efforts related to environment are continuous.

An important initiative, which was already initiated in 1994 in Sarawak, is the Healthy City Programme. The programme is based on the conduction of annual Inter Agency Conferences with participation from a large number of institutions involved in urban planning and development at both state and local levels. Through the programme, broad vision for city like Kuching was formulated as the guiding policy. The main elements of the vision are to develop Kuching into a clean, healthy and safe city for sustainable living.

An "Integrated Waste Management System" (IWMS) strategy was adopted by the State as a general approach towards waste management. IWMS strategy was conceptualised in 1998 through a comprehensive study administered by the State Planning Unit. The strategy is to approach various environmental issues e.g. wastewater, solid waste, septic sludge, hazardous waste etc. Following the framework of IWMS, a series of investments and activities had been carried out, including the establishment of a septic sludge treatment plant.

[12] Incorporated into the Danish International Development Agency (DANIDA) since November 2002.

In terms of physical projects and studies, the State Planning Unit of Sarawak has approved a number of environmental projects to form part of the 8th Malaysia Plan for the State of Sarawak and which will be implemented in the course of the next five years.

The latest motivation that might compliment the integration of EcoSan principle is the declaration of Kuching as a "garden city". The "garden city" concept is in line with the natural dimensions of EcoSan principles. EcoSan solutions can constitute an aesthetic enrichment of an area and a substantial contribution to sustainable settlement development and the safeguarding of water as a resource. Strategically, this form of wastewater treatment can stimulate a comprehensive improvement of the urban landscape (Beneke and Seggern, 2003).

The Kuching North City Hall has also formulated its environmental policy as part of the accreditation to the international recognised Environmental Management System ISO 14001. The policy entails the commitment of the council to preserve environment from pollution and building towards a beautiful, cultured, well planned and healthy city (DBKU, 2003). Some of the interesting aspects of this environmental policy that can support EcoSan principles (more environmentally sustainable system) include the recognition of the need to understand the changing environmental needs, engaging in best practices in environmental activities and services, the adoption of reuse and recycling concept and finally the aim of sustainable urban development.

## *4.4 Current regulatory framework*

### 4.4.1 Overall environmental regulatory framework

At the national level, neither the word "pollution" nor "environment" was found in the Malaysian Constitution. However, the Constitution does provide sufficient basis for federal government of Malaysia to enact laws and regulations for the prevention, abatement, control of pollution and enhancement of environment (Abdullah, Hasan & Komoo, 1998).

The overall environmental management in the country is governed by the Environmental Quality Act, 1974 (EQA). The EQA serves as the main regulatory framework while a series of subsidiary regulations are enacted for more specific governance.

At the State level, according to the federal constitutions, the State of Sarawak and Sabah located on Borneo are allowed to enact State based legislation to regulate environment, in particular on the use of natural resources.

In 1993, the Natural Resources Ordinance 1949 was revised and amended, resulting the enactment of the Natural Resources and Environmental Ordinance, 1993 (NREO), which is the key regulatory basis of environmental related issues in Sarawak today. The Natural Resource and Environment Board (NREB) was established in 1994 to execute the NREO. Since then, a series of subsidiary rules were enacted for specific regulated issue e.g. pollution of livestock farming.

Environmental issues are also incorporated in various state and local based legislations, commonly related to public health, river management, water supply and so forth. The process seems to be based on ad hoc responses. The rapid enactment of the Natural Resources and Environment (Control of open burning) Order, 1997, was a direct response to the severe haze experienced in South-East Asia in 1997.

### 4.4.2 Regulatory framework concerning blackwater management

There is much relevant existing legislation that is related to the control of blackwater (toilet waste) management but none of them seem to be explicitly for only the management of blackwater or wastewater from domestic sources. Elements of pollution control from households are included in several laws on different administrative level in ad hoc basis, and thus the overall regulatory framework does not seems to be systematic or coherent. Aspects related are addressed seem to relate to public health and cleanliness and less emphasis on the environmental degradation as such.

Relevant legislations identified for the case of Kuching include:

*Table 4-1 Legislations concerning domestic wastewater management*

| **Level** | **Main and subsidiary legislations identified** |
|---|---|
| National | Environmental Quality Act, 1974 |
| | Environmental Quality (Sewage and Industrial Effluent) Regulation, 1978 |
| | Sewage Services Act (not in force in Sarawak) |
| State and Local | Natural Resources and Environment Ordinance, 1993 |
| | Draft Natural Resources and Environment (Water Pollution Control) Rules, 2002 |
| | Sarawak Electric Supply Act, 1997 |
| | Electrical Inspectorate Act, 1984 |
| | Local Authorities Ordinance,1996 |
| | Local Authorities (Cleanliness) By-laws,1999 |
| | Local Authorities (Compulsory Desludging of Septic Tanks) By-Laws, 1998 |
| | Building Ordinance, 1994 |
| | Building By-Laws,1994 |
| | Sarawak River Ordinance, 1993 |
| | Sarawak River Cleanliness Bylaws, 1993 |
| | Water Ordinance, 1994 |
| | **Guidelines, Standards and Codes** |
| National | Guidelines for developers – on the design and installation of sewerage systems. First Edition, January 1995 |
| | Guidelines for developers – Vol. 5 Septic Tanks. 2nd Edition, January 1999. |
| | Malaysian Standard MS 1228:1991. Code of practice for design and installation of sewerage systems, 1991. |
| Local | Kuching City South Council: Guidelines for health and sanitary plumbing requirements (n.d). |

The National (Environmental Quality Act 1974 - EQA) and State (Natural Resources and Environment Ordinance 1993- NREO) environmental legislation depicts the overall regulatory basis for the case of blackwater management.

On the national level, the Environmental Quality (Sewage and industrial effluent) Regulations 1979 made under the EQA specifies the permissible effluent discharge standards. The Sewage Services Act 1993 was enacted with the objectives of regulating sewerage services but it is not in force in the State of Sarawak (Chong, 2003).

There are several State laws that regulate the pollution of inland waters from sources of pollution. The regulations are based on the 3 types of measures: Prior approvals (such as Environmental impact assessment), Rules and Orders (Larsen, 2003).

These measures are included in the NREO, Sarawak Rivers Ordinance 1993 - SRO (implemented through the Sarawak Rivers (Cleanliness) Regulations 1993- SRC) and Local Authorities Ordinance 1996 - LAO (implemented mainly through the Local Authorities (Cleanliness) Bylaws 1999- LAC). The objectives and coverage of these regulations seems to vary, for example, the SRC is only enforceable for gazetted rivers while the LAC is relevant for cleanliness of the environment e.g. public drains.

Provisions of the requirement of sanitary facility for buildings are included in the Building Ordinance 1994. Comprehensive requirements and guidelines are available for the building, plumbing, drainage requirement, including a series of acceptable types of sewage treatment system (Sarawak Government, 1997).

The most explicit legislation that is related to blackwater management in Kuching is the Local Authorities (Compulsory desludging of septic tanks) By-laws, 1998. The by-laws came into force in Kuching in November 2002. The by-laws depicts the operational and maintenance requirement of septic tanks.

The large number of ordinances makes execution and coordination efforts difficult. It was observed that despite the extent of overlaying legislation, there are some gaps in the framework which need to be addressed prior to the commencement of a dedicated sewage treatment solution (Sarawak Government, 1997).

This was supported from the main findings from a legal and institutional analysis carried out by the Sustainable Urban Development Project in 2002 (Larsen, 2002). The findings led to recommendations of simplifying the regulatory system and ensuring the coherency of these regulations.

## *4.5 Current institutional framework*

The institutional framework concerning the management of wastewater in Kuching encompasses a wide range of stakeholders from different organisational levels. Stakeholders include government, businesses with direct relation to the issue as well as general society which are affected.

Despite the lack of clarity in the regulatory and institutional framework, the provision of wastewater treatment system in Sarawak is regarded as a public task. This is particularly evident with the government's adoption of the IWMS, implementation of feasibility studies related to wastewater treatment options. Thus, State and city based governmental agencies forms the core of the organisation field as a whole as the function of wastewater management provision remains as a public task.

Strategic task in Sarawak[13], as described by Hartoft-Nielsen and Nielsen (2001), is led by the State Cabinet, through which all jurisdictional and major budgetary decisions are made. In the context of this research, strategic task here refers to the function to establish a wastewater management system. Other agencies involves in the establishment function include State

[13] Refers to major planning and decision making functions.

Planning Authority (SPA), State Planning Unit (SPU), local councils and Drainage and Irrigation Department (DID).

SPA plays an important role in land-use and development planning while SPU acts as an overall coordination body under the special project section. The local councils, through the provisions in the LAO, are involved in the establishment and operation of the system. The Drainage and Irrigation Department (DID) is also involved when it comes to issue related to urban drainage system. The local councils will have to consult DID before proceeding with the implementation of any drainage works (Larsen, 2003).

Agencies having a role in protecting the environment from wastewater pollution include the National Department of Environment, Ministry of Environment and Public Health, Natural Resources and Environment Board, Sarawak Rivers Board and local councils. Most of the agencies mentioned above have the function to control of environmental degradation due to human activities and the local authorities have the function to ensure the cleanliness of the environment. These control functions are implemented through regulations, rules and bylaws. Examples can include setting discharge effluent quality standards, specifying standards and guidelines for permitted treatment system etc.

As a result of the incoherency in legal framework, the institutional set up is equally complex and unclear. Gaps and overlaps exist and these may lead to cases of inaction (Larsen, 2002). The distribution of tasks in some occasions is not officially recorded, which lead to much confusion to other stakeholders, especially the affected e.g. public.

The key governmental agencies of importance in the management of blackwater identified are listed below:

*Table 4-2 Major relevant government agencies to wastewater management in Kuching*

| **Committee and agencies** | **Areas of responsibility** |
|---|---|
| State Cabinet | Major policy and budgetary decision making group, consisting of State top administrators and ministerial level personnel. |
| State Planning Authority | Land use planning, formulate policies and plans for all development and re-development projects. |
| State Planning Unit | Overall coordination of the integrated waste management system strategy for Sarawak. Special project unit coordinates wastewater master planning. |
| Ministry of Environment and Public Health | Administration and coordination of local councils. Involves in policy development for issues related to environment and public health. |
| Natural Resources and Environmental Board | Overall environmental authority of the State, draws policy directions and strategies on issues related to environment and natural resources. Approval authorities for prior approval projects e.g. Environmental Impact Assessment. |
| Sarawak Rivers Board | Responsible for ensuring the navigability of gazetted rivers, including functions to ensure cleanliness of the river. |
| Drainage and Irrigation Department | Flood protection, urban drainage planning, design and implementation. Relevant to projects that affects drainage of the city. |
| Local councils | Establishment and operational level organisation, involves in direct dealing with public on issues such as cleanliness of drains, desludging of septic tanks, approval of building structural plans etc. |

Non-governmental stakeholder participation and consultation in governmental policy decision in Kuching today is limited. Related stakeholders, either directly or indirectly affected by governmental decisions include private companies involved or affected by the services e.g. contractor for septic sludge treatment, research and academic institutions, non-governmental organisation, general public of the society etc.

In relation to the private sector involvement in the blackwater management system, a private company is contracted as operator of the proposed biogas plant. Developers and contractors of housing projects would also be relevant due to their role in complying with the sanitary requirement e.g. septic tanks as sewage treatment system today when constructing houses.

## *4.6 Future wastewater planning*

The issue of pollution due to domestic wastewater is included as a major component to be solved in the IWMS as discussed in section 4.3.2.2. The main objective of wastewater treatment and management in Kuching is to improve the water quality of Sarawak River to a standard that is suitable for recreational use.

### 4.6.1 Conventional wastewater treatment system

A feasibility study (termed as "conventional sewerage study" hereafter) of a wastewater management system focussing on the use of conventional approach for Kuching was completed in March 2003. The study encompasses a master plan for a conventional centralised sewage system for Kuching City, covering around 60% land coverage of the city discharging into Sarawak River. The study was based on a "zone" approach, which the city area was divided into 4 main zones (Lynghus, 2003).

The cost estimation from this study can be illustrated below:

*Table 4-3 Capital cost estimation of conventional sewerage proposal in Kuching, 2003*

| **Description** | **Cost estimated (RM)-millions** | **Cost estimated (USD) - millions** | **% total cost** |
|---|---|---|---|
| Sewers and pumping stations | 1,650 | 434 | 65 |
| Connection fees, engineering etc. | 630 | 166 | 25 |
| Sludge and wastewater treatment plants | 270 | 71 | 10 |
| Total | 901,65 | 671 | 100 |

*(Source: Lynghus, 2003)*

It can be observed that the majority (80-90%) of investment cost for this type of conventional approach lies with the establishment of the sewer network and heavy plumbing requirements while only 10% goes for the wastewater treatment facilities. This costing proportion is consistent with cost breakdown of typical centralised wastewater treatment system mentioned in section 1.1. The operational and maintenance cost estimated at RM 70 million (USD 19 million) per year.

### 4.6.2 Integrating alternative solutions

The State is also interested in assessing the feasibility of integrating ecological solutions with conventional urban wastewater solutions. It is expected that the overall costs of the integrated wastewater management system can be reduced when compared to an entire conventional wastewater management system. The rationale for this is based on the fact that an integrated approach to wastewater management systems will aim for the adoption of the most feasible solution for the specific locations. By doing so, it is possible to optimise the cost-efficiency and environmental performances of the system, taking into account the local composition of economic activities and physical and demographic conditions (Lynghus, 2003).

A number of examples on possible cost savings (for the blackwater) can be mentioned (Lynghus, 2003). The benefits can include:

- A major portion of the pipes (like large and deep trunk sewers) can be avoided by using non-piped methods or local treatment methods, cost sav-ings can be achieved;
- Large trunk sewers, pumping stations and other major structures can be avoided and the need for heavy constructions and special foundations can be reduced considerably;
- The introduction of low flush toilets and other water saving measures will result in a decrease in water consumption. This will lead to cost savings at the water works.

The disadvantages can include:

- Existing toilets have to be replaced with low flush toilets, vacuum toilets or similar in each dwelling in ecologically sanitized areas to secure reduced water consumption;
- A large number of treatment facilities could raise the cost for operation and maintenance for such facilities.

Nonetheless, ecological sanitation is devised to treat organic wastewater. Therefore, the use of ecological sanitation is primarily more appropriate for housing estates and other areas with a similar composition and quality of wastewater. For business districts and other areas with a complex mixture of sources and wastewater, implementation of ecological sanitation are less attractive compared to conventional sewerage systems. Specific wastewater streams from industries and commercial activities that may contain higher heavy metal content or other hazardous material need to be treated differently.

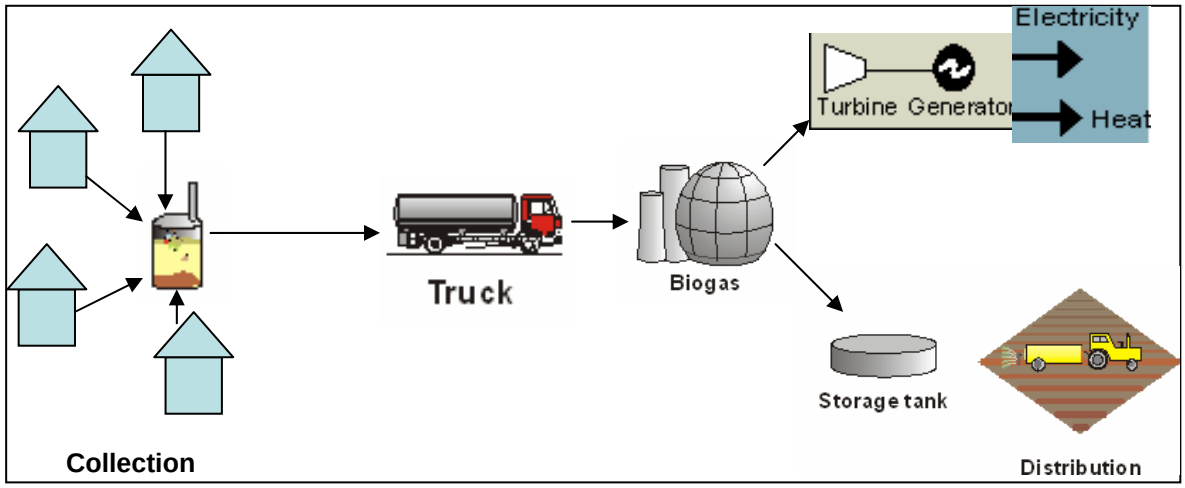
### 4.6.3 The proposed blackwater management system in Kuching

The existing septic sludge treatment plant is currently treating septic tank sludge from Kuching by drying, stabilising and landfilling. The plant has a maximum daily treatment capacity of 350 $m^3$ of aged sludge (Peter, 2003).

On 10 April 2003, a Memoradum of Understanding was signed between the operator and a Danish company on the possible upgrading of the facility to a biogas and organic fertiliser production plant. Evaluation of economic and environmental aspects for treating the septic sludge and other organic wastes for biogas production is currently in progress and it was proposed to utilise the existing facilities at the plant as much as possible (Peter, 2003).

Upgrading of the facility will allow recycling of the received septic tank sludge and at the same time allow the plant to receive other environmental deteriorating residues for recycling. Such residues include organic wastes from abattoirs and wet markets, oil and grease from food outlets, livestock waste etc. With the implementation of this facility, the blackwater from most households in Kuching can be transported to the facility for recycling, while the greywater is managed on site using for example constructed wetlands in suitable areas. This is the proposed ecological sanitation integration for the wastewater system in Kuching. (See Figure 4-5)

*Figure 4-5 Proposed blackwater management system in Kuching using EcoSan principles*




*(Source: Own illustration)*

The proposed biogas plant is estimated to produce 1 to 2.5 million $m^3$ of biogas per year. The average methane ($CH_4$) concentration is estimated to be approximately 60% depending on the quality of the waste input (Peter, 2003). Providing that average of 1.8 million $m^3$ biogas is produced per year, this will corresponds to approximately 1.1 million $m^3$ of $CH_4$ being produced per year.

Applying the average of 6 kwh/$m^3$ of biogas[14], the anticipated energy output from the biogas plant would be about 11 Gwh per year. Equivalent tonnage of oil can be calculated based on standard calculation figures by Hsiao (2001)[15], this is equivalent to about 1.2 million tonnes of oil. Comparing to the size of other plants, the plants mentioned in section 3.4.5.1 in Eslöv, Sweden generates approximately 7 Gwh per year.

[14] Source: NREB. This calorific value is probably higher depending on the quality of waste input.

[15] 1000 $m^3$ of biogas = 666 tonnes of oil.

# 5. Findings and discussions on policy constraints

The main findings and discussions from the research will be presented and discussed in this section. As mentioned in section 2.3.3, the derivation of results are based on compiling interview data, complimenting and comparing information collected from literature (section 3 and 4) and data from interviews and observations. The delineation of the findings on "pre-decision' and "post-decision" policy constraints will be presented based on the several aspects of policy development focussed in this study. The section starts with findings on constraints on general policy formulation for the integration of the EcoSan principles with reference to the proposed blackwater management system. The analysis is followed by discussions on constraints related to codification of regulatory and institutional framework as well as constraints related to application of economic instruments.

## *5.1 Policy formulation*

The delineation of constraints related to policy formulation can be categorised into the following aspects:

*Table 5-1 "Pre" and "Post" policy formulation constraints*

| **"Pre-decision" aspects** | **"Post-decision" aspects** |
|---|---|
| Differential translation and interpretation of actual idea in decision making process<br>Lack of transparent criteria-based decision making process | Unclear policy formulation process |
| Differential perception of wastewater treatment criteria and EcoSan concept<br>- perception on criteria<br>- social cultural aspect<br>- resistance to change | Follow up on decisions<br>- differential interpretation<br>- "gap" between policy intention and actual implementation |
| Diverse awareness and interpretation of "policy" | Lack of dissemination of policy |

Details of the above findings will be discussed in the following sections.

### 5.1.1 Differential translation of concept in decision making

As discussed in section 4.5, the task of establishing wastewater system is recognised as a public task in Kuching. Thus, it is important to analyse how EcoSan principles are introduced into the formal policy decision making process. The incorporation of EcoSan into the formal decision process can be considered a prelude for acceptance prior to formal policy incorporation of EcoSan.

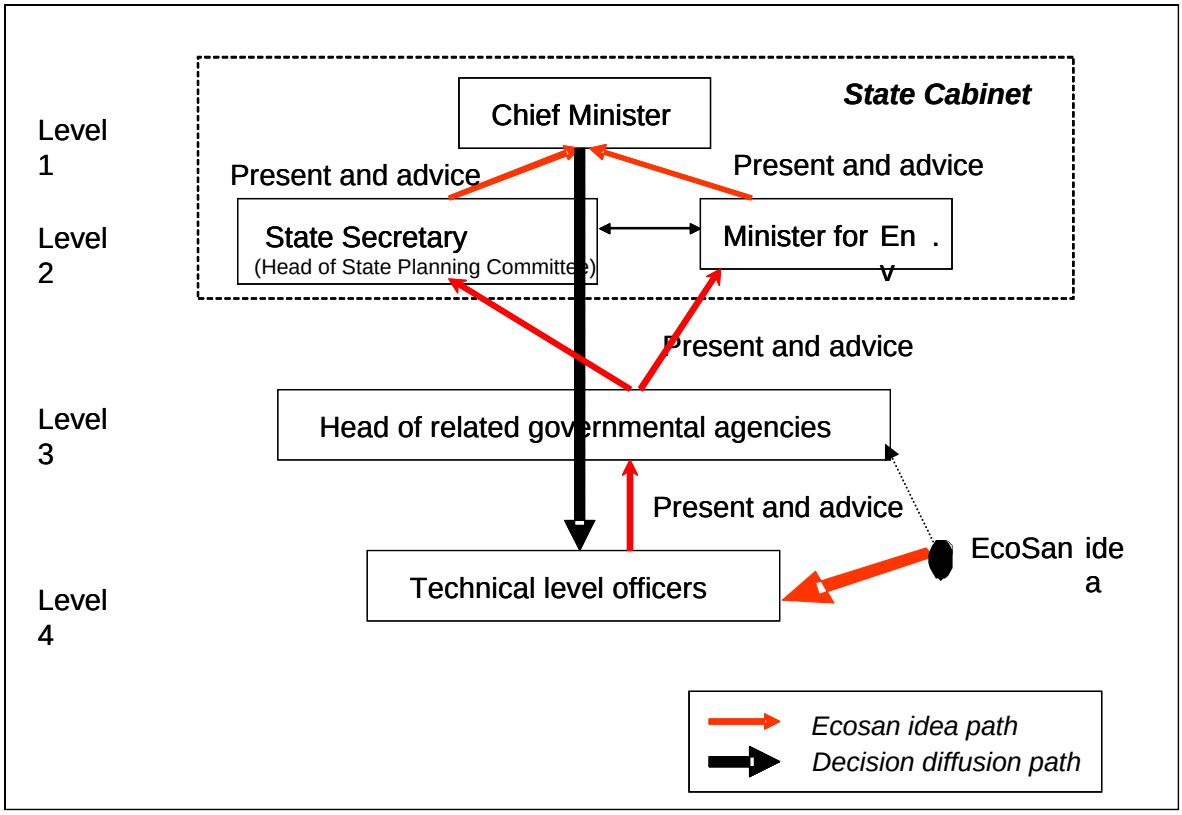
The hierarchical nature or top-down structure of policy making is evident for the case of Kuching (Hartoff-Nielsen and Nielsen, 2001, p.79). Thus, political advocacy involving top politicians and top administrative elites[16] would be crucial for the incorporation of EcoSan principles to the overall wastewater policy making.

Political inspiration and motivations in Kuching on the incorporation of EcoSan had been influenced by external donor agencies via international environmental assistance programme

[16] Defined by Hartoff-Nielsen and Nielsen (2001) as "top decision makers of the State administration (thus Kuching) i.e. including the State Secretary, State Financial Secretary and the State Attorney General apart from the Ministers".

to a large extent. However, this influence is not a direct, straight forward process. The introduction of the concept into the formal decision making structure can be illustrated in Figure 5-1.

*Figure 5-1 Decision making pathway of the EcoSan approach*




*(Source: Own illustration)*

As illustrated in Figure 5-1, the administration can be divided at least to 4 major levels. The most influential top decision maker is the Chief Minister of the State which together with ministers and top State administrative elites forms the State Cabinet (Level 1&2). The EcoSan principles was observed to be mainly advocated through the technical level officers (Level 4) via direct projects[17] involvement while head of related agencies (Level 3) was also involved through various study tours, seminars and meetings. The dissemination of detail principles and benefits from technical officers (Level 4) to Level 2 was carried out through Level 3 (head of agencies to present to ministers or top administrative elites). A State Planning Committee is also established (consisting of Level 2&3 personnel), headed by the State Secretary and attended by heads of department to discuss strategic governmental issues such as wastewater planning.

Politicians and top administrative elites in Kuching were also exposed to the EcoSan concept through study tours, seminars and meetings. Currently, the EcoSan idea had been presented to Level 1 and 2 but no formal decision has been made on whether to adopt EcoSan principles. Level 2 and Level 3 are requested to evaluate the practicality of EcoSan approach prior to any decision (Chong, 2003).

[17] Refers to the Danish International Development Assistance/Sarawak Government "Sustainable Urban Development Project" (1999-2002) and "Implementation of an Urban Environmental Management System Project"(2003-2006).

As described above, the multi-level hierarchical system involves a lengthy information pathway, involving different actors with different training background and personal interest. The main potential constraint identified here is the likeliness of differential translation of EcoSan from Level 4 to Level 1. In other words, the decision and thus diffusion of EcoSan concept highly depends on how the information is being translated across the different levels of actors. Mis-interpretation or mis-presentation along the multi-level dissemination of information and ideas can be crucial in determining whether idea will be adapted to the overall policy. This importance is also highlighted by Shariff (2001, p. 120) in which he denotes that *"…the interaction between the top civil servants and political leaders determines which public policies and values are articulated, formulated, expressed, enforced and implemented."*

Apart from the information conveyed, the policy decision of course also highly depends on many other factors which could reflect the political value of the government, personality and interest of politicians in a less formal way. This also leads to the argument that the lack of a transparent criteria-based decision making process might also hinder the acceptability of ecological sanitation. Some of these issues will be discussed further below.

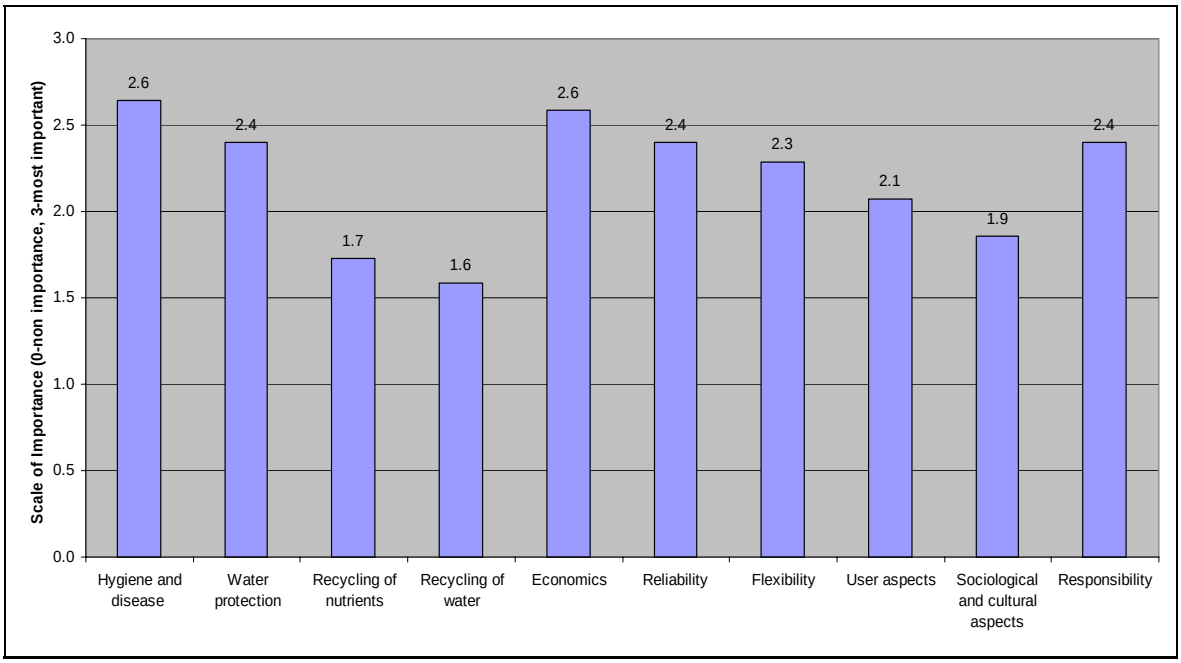
### 5.1.2 Perceptions on wastewater treatment criteria and EcoSan

The next "pre-decision" aspects concerned the shown preferences of wastewater treatment and perception on the EcoSan. There are two perception elements obtained from the interviews.

#### 5.1.2.1 Wastewater treatment system criteria

First, the interviewees were asked to provide their views on the relative importance of a set of criteria provided that are important for domestic wastewater treatment system (see Figure 5-2 for list). The list of criteria includes the main principles of EcoSan such as the recycling of nutrient, water etc. The results obtained are indicated in Figure 5-2 below:

*Figure 5-2 Average results on perception of criteria for appropriate wastewater treatment system based on sectors*



The average results indicated that EcoSan principles of recycling of nutrients and water are considered least important as compared to the other criteria. However, the importance of economics was ranked as one of most important criteria, which may favour the advocacy of EcoSan system which is very likely to be more affordable. Other criteria ranked as most important is hygiene and disease control while the rest of the criteria are more a less about the same level except the socio-cultural aspects. The diverging preferences of criteria based on the different stakeholder sectors can be presented in Table 5-2.

*Table 5-2 Average results on perception of criteria for selecting appropriate wastewater treatment system based on sectors*

| | Int. Org. | Govern. | Bizness | NGO | Acemd | Media | Public | Total Avg. |
|---|---|---|---|---|---|---|---|---|
| Hygiene and disease | 3 | 3 | 3 | 2.5 | 3 | 2 | 2 | 2.6 |
| Water protection | 3 | 2.8 | 3 | 2.5 | 2.5 | 2 | 1 | 2.4 |
| Recycling of nutrients | 1.5 | 1.6 | 2.5 | 2 | 2 | 1 | 1.5 | 1.7 |
| Recycling of water | 1.5 | 1.6 | 2.5 | 1.5 | 2 | 1 | 1 | 1.6 |
| Economics | 2.5 | 2.6 | 2.5 | 2 | 2.5 | 3 | 3 | 2.6 |
| Reliability | 2 | 1.8 | 2 | 3 | 3 | 3 | 2 | 2.4 |
| Flexibility | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2.3 |
| User aspects | 1.5 | 2 | 2.5 | 2 | 2.5 | 1 | 3 | 2.1 |
| Sociological and cultural aspects | 2 | 2 | 2 | 2 | 2.5 | 1 | 1.5 | 1.9 |
| Responsibility | 2 | 1.8 | 2.5 | 3 | 2.5 | 2 | 3 | 2.4 |

### *Socio-cultural acceptance*

Kuching is a multi-cultural and multi-religious society. The main population group consists of Dayaks[18], Chinese, Malays and other groups. A number of main religions are also represented in Kuching, such as Islam, Christianity, Buddhism, Hinduism and other religions. Thus, socio-cultural aspect plays very important role in policy and decision making in Sarawak.

It is interesting to note that socio-cultural aspects are considered the 3rd least importance (refer to Figure 5-3) among the interviewees (mainly Level 3-4 and non governmental) while it seems to carry a higher bearing for Level 1 and 2 administrators due to political reasons i.e. politicians place voter's interest high on the agenda. This can be evident from the recent decisions to abandon an "Ecological Park" project[19] due to the doubtfulness on potential "odour" problem which may attract complaints from adjacent residents. Another "Pig Farming Area" project, aiming to congregate pig farms scattered around the town was also also abandoned due to religious issues and complaints from public (Chong, 2003).

The above examples illustrate the potential constraints of differential value between lower level officers and decision makers when it comes to introducing EcoSan concept. This also corresponds to Shariff's (2001) argument that "*problems may surface when politicians and bureaucrats try to cooperate in the policy process because they differ not merely over what should be done but also over who should decide and how. Bureaucrats are orientated towards problem solving while politicians seek to ensure policies meet popular demands.*"

Ethnic and religious societies each have their traditions and habits, which may or may not correspond fully with the concept of EcoSan Therefore, adaptation of ecological sanitation methods will require local acceptance among the households and users of the system. (Lynghus, 2003).

[18] Consisting of several different indigenous ethnic groups, predominantly Iban and Bidayuh in Kuching area.

[19] The objective of the project was to demonstrate the use of ecological method to treat river water and reduce pollution.

Cultural and religious sensitivity in the application of EcoSan principles could be a major barrier. Varying existing toiletry habits in the society, handling or waste on-site, application of fertiliser co-digested with pig manure etc. all have direct cultural and religious acceptability implications. These issues should be studied further.

#### 5.1.2.2 Perception on Ecosan principles and proposed blackwater system

Secondly, the interviewees were asked about their general perceptions on the EcoSan principles and the proposed blackwater management system (Section 4.6.3). Their understanding of the system was enhanced with introduction and explanation of the system by the researcher. The following opinions were documented (Figure 5-3):

*Figure 5-3 Highlights of perception statements from personal interviews*

- Good idea, need political will and major change management;
- Good initiative, but public must be made aware of the benefits;
- Good for environment, reduce pollution to river, doing "something" good while nutrients can be recycled;
- Likely to face resistance from public;
- Shall be cheaper but sceptical about problems like odour;
- Need to assess appropriateness, maybe only applicable in certain areas and certain sources of waste;
- Pilot projects are needed to demonstrate and prove the system;
- Should be codified in the regulation and guidelines.

There seemed to be diverging views on the EcoSan application in Kuching as can be depicted from the comments recorded in Figure 5-3. However, there appeared no strong opposition on the idea but rather some reservations and conditions to be met for the success of the system.

These diverging views can indicate the possible constraint of acceptability to be overcome due to the lack of knowledge, understanding and confidence on the EcoSan idea.

### 5.1.3 Awareness and interpretation of existing policy

The issue addressed here is whether stakeholders are aware of any existing policies concerning domestic wastewater. This awareness can indicate the status of "pre-conditions" necessary for formulating policy advocating EcoSan principles. The term "blackwater" seems to be a less common term known and thus the interviewees were only asked about their knowledge on specific policies concerning "blackwater" if they did demonstrate acquaintance with the term. The results based on the interviews are illustrated in Table 5-3.

There are several indications that can be derived from the above results. It can be shown that 50% of the respondents were not sure about the existence of any existing policy related to wastewater. As for those who are aware, more than 50% stated that there are no existing policies.

Table 5-3 Results on awareness of existing policy related to wastewater:

| **Stakeholder type** | **Number of responses indicating awareness of any existing wastewater policy** | | |
|---|---|---|---|
| | Yes | No | Not sure |
| Int. Org. & Government | 2 | 3 | 3 |
| Business Org. | 1 | 0 | 2 |
| NGO/Media/Academic/Public | 1 | 3 | 4 |
| **Total**[20] | **4** | **6** | **10** |

In agreement with discussions in section 3.3, the interpretation of the word "policy" seems to diverge among the interviewees. Many related policy directly to legislations while some referred directly to infrastructural or technical plans. This can be illustrated with the following responses recorded during the interviews (Table 5-4).

*Table 5-4 Diverging interpretations of the term "policy"*

| **Stakeholder categories** | **Diverging views on the interpretation of "policy"** |
|---|---|
| Int. Org. & Government | …no specific written policy related to wastewater<br>…wastewater master plan considered as policy<br>…refers to environmental policy<br>…refers to compulsory desludging regulations<br>…feasibility study to evaluate options<br>…government sets water quality standard of river |
| Business Org. | …government's integrated waste management system, which include wastewater management<br>…federal guidelines sets minimum standard of development involving more than 30 houses must have centralised treatment system. |
| NGO/Media/Academic/Public | …not clear, not written<br>…requirement of a septic tank, not sure<br>…compulsory desludging |

The diverging interpretations of "policy" suggested that the use of written policy for documenting decisions is not a common practice in Kuching. Policy decisions from decision makers seemed to be translated directly into sets of incoherent actions. The lack of a formal policy formulation process will be further discussed in section 5.1.4.1.

The lack of awareness on policy seems to be a potential fundamental constraint for setting clear and coherent policy in the future, which applies to the incorporation of EcoSan principles for example. This finding can be supported by similar findings by Hartoff-Nielsen and Nielsen (2001) which shown that the UEMS idea (as a non traditional, new approach) was also translated differently among stakeholders at different levels. Similarly, translation of policy to implementation plans or reality will present as a major barrier towards coherency of actions.

[20] The total number of answers here is less than the numbers tabulated in Table 2.1 because not all interviewees (some are not familiar with Malaysian situation and thus not representative of the target group) were asked on this questions.

### 5.1.4 "Post-decision" policy formulation constraints

#### 5.1.4.1 Is the policy process clear and acceptable?

As discussed in the above section, there seems to be a general lack of awareness and different interpretation of the term "policy". The next issue addressed is whether the policy formulation process is well recognised as well as problems related to current policy process from the opinion of the interviewees. The following opinions and comments were recorded from the interviews:

*Table 5-5 Opinions and comments on current policy process*

| Stakeholder categories | Opinions and comments on current policy process |
|---|---|
| Int. Org. & Government | …no (clear) policy making process (4)<br>…not specific, not clear (2)<br>…project orientated, ad hoc basis, often only address specific issue (2)<br>…policy proposals from individual agencies may lead to contradiction<br>…different interpretation of content of policy<br>…lack of proper communication of policy<br>…different procedures to adopt and implement in different States<br>…sometimes based on vested interest of certain parties<br>…most policy are reactive, often too late<br>…top down approach |
| Business Org. | …different opinion among stakeholders<br>…public awareness level very low<br>…sometimes policy changes too frequent<br>…should include externalities into consideration<br>…existing policy driven by economic considerations |
| NGO/Media/Acadermic/Public | …lack of stakeholder engagement (5)<br>…poor dissemination of policy (3)<br>…lack of political commitment and conflicting personal interest (2)<br>…too many policies, overlaps creates inconsistency<br>…written policy is not consistent with reality<br>…unclear responsibility<br>…policy should facilitate flexibility due to different local conditions<br>…lack of transparency, leading to public uncertainty |

*N.b. (number) refers to number of same or similar opinions by different interviewees*

Based on the findings and observations from this research, there appears to be no formal, at least well recognised methodology or procedures for developing explicit policy in Kuching or Sarawak. This is supported by the fact that 67% of the governmental respondents expressed that they do not know of any procedure for policy making process (refer to Table 5-5).

The second issue raised was the lack of comprehensiveness and clarity in the existing policies. Most policies are reactive, often project of specific issue oriented. This also resembles the fragmented regulatory and institutional framework as discussed in sections 4.4 and 4.5. In order words, the fragmented components can be visualised as like pieces of puzzles, which are put into place but there are no visualisation of the overall picture. The lack of coherency in policies, opinions often leads to contradictory, overlapping phenomenon. In relation to this, some respondents had expressed that the Urban Environmental Management System (refer to section 4.3.2.1) can be the overall coordinating framework when it comes to environmental issues. The UEMS would also have potential to provide more informed policy formulation.

Lack of transparency and stakeholder engagement in governance was highlighted especially by non governmental stakeholders i.e. NGO, acadermia, media and public (refer to Table 5-5).

Participation in policy and planning also has direct connection to many comments related to the lack of dissemination and awareness. This is an important constraint to be considered in the case of incorporating EcoSan principles i.e. decentralisation of wastewater treatment, recycling of nutrients etc. since the approach requires much more user involvement.

The high bearing of economic consideration in policy making process can be both an advantage as well as disadvantage to the advocacy of EcoSan principles. The advantage is that EcoSan principles maybe preferable since it is likely to be less costly but on the other hand, the disadvantages might be that environmental issues i.e. externalities will not have a lot of weight in the decision making. For example, the potential benefits of renewable energy and less environmental degrading organic fertiliser will likely to give any bearing on the policy on blackwater management.

#### 5.1.4.2 Translation from policy to implementations

The decision path is foreseen as a top-down flow which the decision will be triggered down through the various levels if the decision of adopting the EcoSan principle is adopted.

So far, the shown of interest by government on EcoSan is evident with the commissioning of the Integrated Wastewater Framework Plan to investigate the practicality of EcoSan integration, study tours for ministers and heads of department (Level 2 and 3) to see developed EcoSan system, initiation of pilot projects to test the EcoSan concept (Chong, 2003).

The shown of interest and commitment to formulate policies and incorporating EcoSan principles can be reflected through the following quotes:

> *"…the State Government is committed to formulate and implement appropriate policies and strategies to mitigate the adverse impacts of waste, whether solid or liquid on our environment."*
>
> Opening Speech by Minister for Environment and Public Health, Sarawak,
> at the Seminar on Sustainable Urban Wastewater Management, Sarawak Development Institute 10-11 June 2003

> *"…apart from using the conventional method of Centralised Sewage Treatment System, the State should consider using more natural and environmental friendly method such as Ecological Sanitation which had been proven successful and cost effective…."*
>
> Minister for Environment and Public Health, Sarawak,
> 6th May 2003, Sarawak Tribune

Despite the explicit commitment to consider EcoSan principle as shown above, the reality "gap" of political commitment follow up implementation is identified as a potential constraint. This is supported by the comments expressed by both governmental and non-governmental stakeholders in Table 5-6 may indicate barrier to the successful diffusion of EcoSan.

Most expressions from the interviews indicated that there are usually diverging interpretations and implementation of "policies" set by the government. This is to some extent due to the lack of knowledge about the policy which is related to the lack of proper dissemination, but also due to the lack of commitment (as expressed in Table 5-5, environmental considerations are very new in policy planning) and lack of strategy to implement the policy.

*Table 5-6 Comments on the reality "gap" between policy*

| Stakeholder categories | Opinions and comments on current policy process |
|---|---|
| Int. Org. & Government | …lack of accurate information for political masters to formulate policy<br>…seems to be a gap between political masters and implementing agencies<br>…policy proposals from individual agencies may lead to contradiction<br>…different interpretation of content of policy<br>…environmental considerations very new |
| Business Org. | …sometimes policy changes too frequent<br>…should include externalities into consideration |
| NGO/Media/Academic/Public | …lack of political commitment and conflicting personal interest (2)<br>…unclear responsibility<br>…policy should facilitate flexibility due to different local conditions<br>…lack of transparency, leading to public uncertainty |

The success of diffusion will very much on how the above commitment by the Minister for is translated into concrete policies or strategies to the lower level. There were also concerns on the lack of follow up actions and lack of clarity in responsibility to implement the policy. These constraints seemed to compliment with Elledge's (2003) argument about the common problem in which national policy is not translated and implemented at lowest level of government. The constraints include lack of technical, managerial and financial capacity to address sanitation need. Douglas and Ooi (1999) also determine that political commitments are engaged to a varying degree from stakeholders at different levels, to some extent due to the lack of multi-stakeholder engagement.

#### 5.1.4.3 Dissemination of policy

The lack of proper communication or dissemination of policies was expressed by stakeholders from both governmental and non governmental stakeholders. Elements of policies are usually expressed in fragmented manner in different occasions and media e.g. in development plans, minutes of meeting, resolutions from state assembly etc. A good example to illustrate this is the lack of awareness and level of adoption of the "National Policy on Environment" (refer to section 4.3.1.2) observed during the interviews. Many stakeholders had never heard about the policy and some indicated that they were aware but didn't know how to get access to the policy.

Similar results from other study can compliment the general lack of dissemination of governmental actions A number of river cleanliness campaign had been carried out by different agencies. Based on a survey carried out as part of the Sarawak River Environmental Control and River Management Study, at least 55% of the respondents were not aware of any of those campaigns. In terms of participation in the awareness campaign, only 15% had taken part (Sarawak Government, 1997). These illustrate the possibilities of lack in effective communication channel between governmental driven awareness campaigns and general target group i.e. public.

## 5.2 Codification of regulatory and institutional frameworks

As discussed in section 3.3.3.5, codification of EcoSan into the legal and institutional framework is a major aspect of legitimacy to ensure a legal basis, as well as to ensure regulatory principles are clear and societal norms are not violated. The legalisation of a new approach such as EcoSan however, seemed to be a complex issue and can take different point of departure. This section will not covered comprehensive legal analysis and detail legal

discussion, but rather, depicts some of the identified general constraints to adopt the EcoSan into the legal framework.

In the context of provision of wastewater system as discussed earlier, codification can include:

- Strategic functions
- Implementation functions

Strategic functions could include those related to setting the principles e.g. for the case of EcoSan, including resource conservation, resource recycling of nutrients and energy and so forth. The functions of regulating emission standards are also included in this category.

Implementation functions are those related to the provision to establish a treatment system (own operation for the case of public task). Related amendments can include the requirement of public to use the public established system, specification of standards and guidelines incorporating EcoSan principles. For the case of the proposed blackwater treatment system, example of codification is required in the building standards, emptying frequency.

Section 4.4 depicts that the current regulatory framework in Kuching is fragmented and lack of coherency in general. This also leads to the argument that most regulations in placed in Kuching today are not codified for strategic tasks but rather on implementation tasks. (Jensen and Larsen, 2002). This is evident since much legislation is related to control of pollution from wastewater but there is no explicit wastewater related regulation framework as such. Based on the interviews and literature review, the following potential constraints seemed to be crucial for successful implementation of a legal framework that incorporates EcoSan:

- Low awareness and familiarity with legal requirement;
- Lack of coherency and clarity in the overall legal system, leading to ambiguity;
- Political sensitivity;
- Lack of technical capacity;
- Lengthy and time consuming process.

Discussion of the above constraints is covered in the following sections

### 5.2.1 Low awareness of existing legal requirement

While almost 90% of the interviewees agreed that legal requirement is essential for the successful implementation of EcoSan, there seemed to be a general lack of awareness on the existing legislation related to wastewater. It was evident that many interviewees are aware of the existence of "some" regulations but most were not able to describe it. Environmental issues are considered "new" in the overall regulatory framework (Gau, 2003).

The lack of awareness also indicates similar problem of poor dissemination and communication of the legal requirement. It may also indicate that there is a lack of concern and intellectuality on legal issues among the stakeholders. This seemed to be related also to the weak enforcement and ignorance of regulation expressed by some interviewee. It is rather surprising to find out the lack of familiarity even within the actors of the governmental field.

The lack of awareness will be a fundamental constraint against the successful legalisation of EcoSan. If actors from various fields are not clearly following the legality, there would be very small chance that policy goals will be achieved.

### 5.2.2 Lack of coherency

Most interviewees suggested that there is either too much legislation in place or the legal system is sufficient. This corresponds to findings of both Dilling (2001) and Jensen and Larsen (2002) that the incoherency is mainly due to the "budding" of individual legislation originated to deal with isolated environmental issues. This seems to apply to case of water resources and water pollution. Thus, a possible constraint that may arise is that the codification of new issues may not fit into the existing framework without creating contradiction, uncertainty etc. for it to work.

It is justifiable that without a clear, commonly perceived policy goals and the lack of coherency in legal framework, there is no common basis or directions for different agencies involved to act. The leads to uncertainty in task distribution among the many agencies involved. Thus, the pre-condition of adapting the institutional framework is the same as for the legal framework, in which existing competence norms must be clarified and adjusted. The rationale of the all current mandates and duties should be reviewed and redistributed to fulfil the following criteria (Larsen and Martens, 2002):

- coherent and comprehensive;
- clear;
- accountable;
- co-ordinated.

Some interviewees suggested that there is a need to streamline the existing regulations to avoid overlaps and gaps. It seemed that overlaps and gaps can both contribute to inaction. Clarity in the distribution of the tasks and some degree of predictability of the actions that may be expected from other agencies are crucial for achieving efficiency and coherency in environmental management (Jensen and Larsen, 2002).

The problem with the lack of coherency of existing legislative framework can be illustrated through the different examples presented below. The first example is related to contradictory legislations with different level of specifications (see Figure 5-4)

The different level of regulatory area specified of can be a source of contradiction especially when the different legislations are implemented by different agencies. This creates uncertainties within the agencies involved as well as others that are affected by the rules.

*Figure 5-4 Contradictory regulations with different level of specifications*

***Discharge of effluent***

***Water Ordinance 1993 (gazetted Water Catchment Area)***
*Within 8 km from raw water intake point, it is prohibited to discharge treated effluent in higher concentrations than specified in Environmental Quality (Sewage and Industrial effluent) Regulations 1979.*

***Sarawak Rivers Ordinance 1993 (Sarawak Rivers (Cleanliness) Bylaws***
*Effluents shall not be discharged in concentrations higher than specified in Environmental Quality (Sewage and Industrial effluent) Regulations 1979, if it is likely to flow into a gazetted river.*

***EQA (EQ SO 8)***
*No persons shall discharge effluent containing substances in concentrations higher than specified in Environmental Quality (Sewage and Industrial effluent) Regulations 1979.*

The second example is related to inconsistency in interpretation of terms and definitions used in the various legislations. The review of existing regulations indicated that inconsistencies in terms and definitions are rather common in Sarawak and Malaysia. An example illustrating the same term – "sewage" used in the two main legislations with different definitions can be illustrated in Table 5-7.

*Table 5-7 Differential definitions of the word "Sewage" in various legislations*

| Level | Legislation/Guidelines | Definition |
|---|---|---|
| National | *Environmental Quality (Sewage and Industrial Effluents) Regulations ,1979* | "…any liquid waste or **wastewater discharge containing animal or vegetable matter** in suspension or solution, and **may include liquids containing chemicals in solution**;" |
| National | *Sewerage Services Act 1993* | "…any liquid waste or **wastewater containing human, animal or vegetable matter** in suspension or solution, and includes liquids containing chemicals in solution **but does not include industrial effluent**…" |

The differences above illustrated several interesting facts for discussion. The definition of "sewage" in the Environmental Quality (Sewage and Industrial) Regulations 1979 only refers to wastewater discharge from "animal or vegetable matter". In contrast, the definition of "sewage" in the Sewerage Services Act 1993 specifically include "human" in addition to animal or vegetable (refer to Table 5-7).

There are no explicit definition of the word "animal" in the Environmental Quality (Sewage and Industrial) Regulations 1979 and contrasting the definition with the Sewerage Services Act 1993, it seems like it can be argued whether the effluent discharge standards stipulated under the Environmental Quality (Sewage and Industrial) Regulations 1979 are applicable to blackwater which is of human origin. This also seems to illustrate the standards set in the Environmental Quality (Sewage and Industrial) Regulations 1979 (almost 24 years old) was probably targeted towards industrial and other commercial activities and sewage from household might not be a major concern that time.

A problem of this differentiation of definition might be a concern when it comes to enforcement and court cases related to the above legislation, particularly the Sewage Services Act 1993 which demands the effluent discharge standards stipulated under the Environmental Quality (Sewage and Industrial) Regulations 1979. This standard is also being referred to in many other relevant legal documents and guidelines also in Kuching. However, interestingly, the word "sewage" is hardly defined in any of the existing State or local legislations in Kuching.

On the other hand, the above observation also illustrates that the Sewerage Services Act 1993, have to be revised accordingly to incorporate industrial wastewater, if a conventional wastewater system of combining domestic and industrial wastewater treatment is going to be implemented.

### 5.2.3 Political sensitivity

This issue is related to the discussion in section 5.1.2.1 regarding meeting popular demand (maintaining voter's support). This constraint can to some extent restrict the modification of existing regulatory requirement (Gau, 2003).

### 5.2.4 Lack of technical capacity and clear institutional responsibility

The drafting of new environmental legislation or amendments to existing legislation requires a combination of legal, technical and social background of the issues. As mentioned by Gau (2003), environmental issues are relatively new in legislation in Sarawak and the local capacity of drafting environmental related legislation seems to be lacking (Martens, 2003). Today, there is no direct legal capacity within the environmental agency.

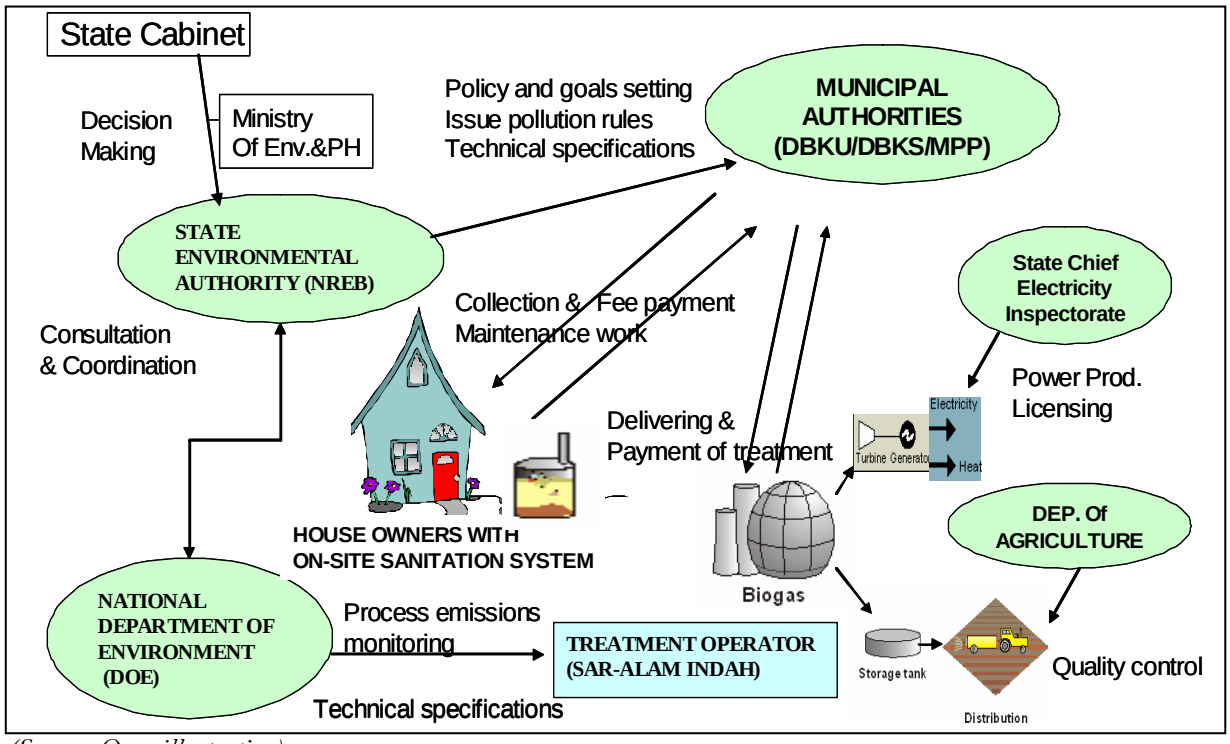
The lack of capacity can also contribute to the delay of codification. According to Gau (2003), the time required for drafting new legislation can range from 6 months to 2 years, depending on how "hot" the issue is within the political agenda.

When it comes to institutional arrangement, the planning and implementation of ecological sanitation approach has also differences compared to conventional centralised system. Instead of piping sewage, there is a need for alternative service system (logistics, maintenance etc.) which requires a well functioning scheme. In most cases, direct handling of recyclates e.g. composted material by households would be simply impossible or not preferable. This may well lead to the need of setting up a regular service enterprises, either public or private operated, to construct, manage and market recyclates from the EcoSan system. The demands for such schemes can contribute to income generation benefits for local population (GTZ, 2002).

As long as on-site sanitation means wastewater (especially black wastewater) treatment on the property, house owners themselves cannot be assumed responsibility for designing, constructing, operating and maintaining the treatment units. In many cases even the septic tanks have proven too difficult to them to take care of, not to speak of more complicated systems. In Finland for example, the Best Available Technology principle of the Finnish Environmental Protection Act requires that a person maintaining on-site sanitation systems must be a professional (Mattila, 2003).The professional performing the maintenance on the on-site system reports major needs for repairs and other bigger undertakings not only to the house owner but also to the municipal authority. The authority can then make a control visit to the properties time allowing.

This might also exposed another potential constraints related to the lack of local capacity. Constraint may also surface in on the distribution of responsibilities if it is not clearly differentiated. The findings from the interviews were compiled into a possible future institutional framework (see Figure 5-2). The distribution of tasks presented is of course preliminary and subjected to further investigation and legal review.

*Figure 5-5 Possible future regulation scheme for blackwater management system in Kuching*




*(Source: Own illustration)*

## 5.3 Application of economic instruments

Based on the interviews and literature, the following constraints are foreseen:

- Lack of awareness and political will;
- Lack of experiences and human capacity– CDM applications;
- Poor market conditions;
- Lack of relevant policy.

### 5.3.1 Lack of awareness and political will

Apart from potential constraints in quantifying the GHG reduction, the application of CDM also may suffer from potential problem of insufficient awareness and human capacity in the application process (Varming, 2003). Lack of political will on climate change issue and uncertainty on the actual adoption of national energy policy may also place this option to lower priority. This has also connection with the fact that the Kyoto Protocol has not gone into force yet and there is a lot of political uncertainty surrounding this issue.

### 5.3.2 Lack of experience and technical capacity - CDM applications

The potential of climate change savings is likely to be two-fold with the implementation of the project (Varming, 2003). The implementation of the system is likely to bring net GHG savings of which would otherwise be likely to be emitted to the atmosphere from the following sources:

1. Untreated or insufficiently treated wastewater
2. Use of biogas derived energy as alternative to fossil fuel

The calculation of the CDM credits, however, might be a possible constraint due to the lack of available data. For example, there are no emission data based on the electricity generation mix in Malaysia. These data are currently being collected by the Malaysian Energy Centre (Varming, 2003). The use of standard figures formulated from other countries or area may not be representative of the local situation or at least carries high uncertainties. In Sarawak, the total electricity mix comprises of relatively high (>30%) proportion of hydropower, which will lower the GHG emission savings due to the biogas project (Varming, 2003).

The commitment to the international treaty on climate change is relatively new for Malaysia. The lacking of local human capacity is inevitably a barrier for CDM projects. Currently, external assistance programme is in progress to build up local capacity to handle climate change issues, including the management of CDM application and implementations.

An attempt was made in this research with help from specialists in this field to determine the barriers of such assessment.

Domestic wastewater $CH_4$ emissions were estimated using the default IPCC methodology (IPCC 2000). It was assumed that 16.25 percent of wastewater $BOD_5$ will be anaerobically digested. This proportion of BOD was then multiplied by an emission factor of 0.6 kg CH4/kg $BOD_5$ (USEPA, 2003). For the case of Kuching, the data of BOD loading from Polvsen (2001) was used. The estimated BOD load from household was a significant range i.e. 5700-9700 kg/day (refer to Figure 4-3). Using an average of 8000 kg per day and predicting 60% of the BOD is contributed by blackwater (Polvsen, 2001), an estimation of 1750 tonnes of BOD would have been discharged due to blackwater annually[21]. Thus, applying the calculation[22] of $CH_4$ emission by applying the emission factor proposed by USEPA (2003) predicts a total of 170 tonnes of $CH_4$ or 3570 tonnes of $CO_2$ equivalent[23].

Again, one of the biggest uncertainties here is of course the use of standard emission figure used in the United States of America. It should also be noted that the biogas plant also receives organic waste from other sources e.g. pig farms, industrial which would otherwise contributes to GHG emissions as well. Localised data for this calculation is lacking and not calculated here.

The calculation of GHG emission reductions from electricity production can be based on different methodologies proposed by the CDM Executive Board for small-scale projects (Varming, 2003). For the production of biogas, the estimation in section 4.6.3 estimated that an average 1.8 million $m^3$ of biogas will be produced per year, equivalent to 11 Gwh of energy potential. This however, would have to be converted to GHG saving potentials as compared to the use of fossil fuel.

Due to the lack of data on electricity mix as mentioned above, a first approach can be based on the emissions from diesel generators. Here the reference gives a value of 0.8 kg CO2/kWh for larger diesel engines. Thus, applying this reference to the expected energy potential of 11 Gwh per year gives 8,800 tonnes of $CO_2$ savings per year.

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[21] Assuming all blackwater almost untreated today with the mal-functioning septic tanks.

[22] 1750000 kg BOD x 16.25% digestable x 0.6 kg $CH_4$/kg BOD.

[23] $CH_4$ having a global warming potential of 21 as compared to $CO_2$ of 1 (IPCC, 2000).

The above calculations illustrates that it is possible to calculate net GHG saving but a lot of data are missing and must be procured and uncertainty of data must be reduced. Potential challenges ahead would be to establish a recognised method for quantifying the emission reduction from the projects. Life cycle consideration of the EcoSan principles may also make the solution more preferable. This could be another policy implication – to ensure life-cycle of an investment to be considered in the cost benefit considerations.

### 5.3.3 Meeting market supply and demand

A key barrier identified for CDM projects is the matching of demand with supply under poor market conditions (Varming, 2003). In general, internalisation of external cost should be considered as well as the removal or reduction of subsidies on fossil fuels to encourage the general market for CDM projects.

### 5.3.4 Lack of relevant policy

Although there are some relevant existing policies that can encourage the use of economic instruments in the context of the proposed blackwater system, the research revealed that there is no current policy on the types of fertiliser used. It was rather surprising to find out about the lack of control over the application of any types of fertiliser today in Kuching (2nd Meeting on survey of potential user of organic fertiliser, 10th July 2003). Regulation only existed at the point of importing fertiliser. There are no specific directions specified from the government and the institutional task for regulating the use seems to be unclear.

A parallel survey on the potential user of organic fertiliser generated from the blackwater treatment system was carried out along side this research. The survey, up to 3rd September 2003, reported on preliminary indication of willingness of potential users (mostly oil palm plantations) to utilise organic fertiliser derived from the biogas plant in Kuching. The survey showed that almost all the existing plantations are utilising imported mineral based fertiliser.

Based on the interviews and observations (See Appendix 6) from the research, there are approximately 40% of the respondents shown interest in using organic fertiliser. However, the acceptance very much depends on the results from trial test.

Without any clear policies or regulations on the types of fertiliser (either chemical or organic) the selection of fertiliser seemed to be purely economically driven. The survey revealed that 50% of the respondents indicated their willingness to use, or at least try the organic fertiliser will be incentive driven (Appendix 6). 25% shown interest only if certain conditions such as automation of fertiliser distribution can be achieved. However, at this stage there are no indications of the government incorporating externalities such as environmental concerns into the pricing of fertiliser to make organic fertiliser more economically competitive.

This could be due to the resistance to change from current practices as well as other social related issues such as religious concern if pig waste is incorporated in the treatment process.

It was also observed that the awareness of the environmental benefits from using organic fertiliser as opposed to chemical fertiliser will be an important element to be ensured in the policy.

# 6. Conclusions and recommendations

This research is designed to elaborate various potential policy constraints that could arise from the advocacy of an emerging wastewater treatment approach – Ecological Sanitation. The results obtained from this research indicated that some prevalent pre-decision and post-decision constraints must be addressed for the successful advocacy of EcoSan.

This research identified that in a highly hierarchical decision making government, the most prevalent pre-decision constraints are related to the challenge of effective and accurate dissemination of the ecological sanitation concept and benefits to decision makers. The variation of background and personal interest of different actors involved is likely to cause differential translation of EcoSan concept through a multi-level hierarchy. The sensitivity of this multi-level interaction can lead to mis-interpretation or mis-presentation of information and ideas which are crucial in determining whether idea will be adapted to the overall policy.

Apart from the information conveyed, the policy decision of course also highly depends on many other factors which could reflect the political value of the government, personality and interest of politicians in a less formal way. This also depicts the lack of a transparent criteria-based decision making process might also hinder the acceptability of ecological sanitation and accountability of the decisions. Awareness and acceptability of different stakeholders involved can be enhanced through more interactive stakeholder engagement.

Post-decision constraints are related to the lack of formal policy making process, leading to ineffective dissemination and translation of policy goals into actual implementation actions. Differential perceptions, interpretation and awareness, incoherent legal and institutional framework and lack of technical capacity are also underlining constraints towards the successful incorporation of ecological sanitation.

The findings in general did not contradict with findings from other researches and studies reviewed in the literature process. It must be noted that although this research is based on the planning and implementation of the specific case of blackwater management system, the generalisation of the following results for other similar system such as for solid waste recycling should be reasonably valid.

The wide validity of the results however, depends to large extent on whether the samples interviewed were representative of the intended stakeholder's perspective. In general, it can be observed that there was a variation in terms of knowledge and awareness of the subject among the interviewees covered by this research. This is evident since the quantity and detail level of information obtained from individuals varied among the interviewees.

An example could be the results on perception of the importance of socio-cultural aspects. The result of this may be influenced by various factors such as the actual understanding of the implications of EcoSan, the representation of ethnic group and religion among the interviewees etc.

## *6.1 General recommendations and future research*

As the findings of the research are based on a small sample of interviewees to a large extent, the validity of the results from the interviews can be further improved if a more comprehensive survey, comprising of larger sample size with careful selection of representative samples are taken. In connection to this, the establishment of a multi-

stakeholder consultation process would greatly enhance the wider understanding of the general perception of all on ecological sanitation concept.

When it comes to a more detail understanding of higher level decision making process, further research and interaction with top-tier politicians would enhance the validity of the research objectives. However, accessibility to high level decision makers is not easy in general.

When it comes to recommendations for the advocacy of ecological sanitation, it is recommended that a thorough understanding of the existing political value to be established. Ecological sanitation can only solve mainly domestic wastewater treatment. Thus a comprehensive evaluation of suitability and integration to conventional wastewater treatment system would be needed.

It is also recommended that a formal policy making process is established, followed by formulation of a wastewater policy. Incorporation of EcoSan principles can be included in the wastewater policy if government decides to adopt the approach. Pilot projects to test EcoSan system are also recommended to test feasibility, develop local experiences and of course to build confidence of all stakeholders through "show-case" approaches.

Codification of legal and institutional framework requires a detailed analysis of the existing provisions within a specific area, and by the process of reorganising the existing provisions to eliminate any possible gap, overlap or inconsistency encountered. In general, capacity and awareness to undertake legal and institutional review need to be improved.

Detail study into possible use of economic instruments is also highly recommended. In general, capacity and awareness to design such instruments need to be improved.

Although Kuching possesses resemblance of a typical fast developing city in the developing countries, the political and social construct of Kuching may be unique in some elements, due to its past colonial history and current governance structure for example. The transferability of the results from this research may only be valid for certain generalised issues but the extent of transferability remains uncertain until more in-depth study and similar research in other cities are carried out.

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2nd Meeting on survey of potential organic waste generators and organic fertiliser user, 10th July 2003, 18th Floor Menara Pelita, Kuching, Malaysia.

Site visit meeting to JF Trading Farm, Sungai Pinang, 4th August 2003.

# Abbreviations

| | |
|---|---|
| AD | Anaerobic Digestion |
| BAT | Best Available Technology |
| BEP | Best Environmental Practices |
| BOD | Biochemical Oxygen Demand |
| CDM | Clean Development Mechanism |
| $CH_4$ | Methane |
| CMIP | Consolidated Municipal Infrastructure Programme |
| $CO_2$ | Carbon dioxide |
| COD | Chemical Oxygen Demand |
| CWS | Community Water Supply |
| DANCED | Danish Cooperation for Environment and Development |
| DANIDA | Danish International Development Agency |
| MBKS | Kuching South City Council |
| DBKU | Kuching North City Hall |
| DID | Drainage and Irrigation Department |
| DKK | Danish Kroner |
| DNA | Designated National Authority |
| DOE | Department of Evironment |
| EcoSan | Ecological Sanitation |
| EcoSanRes | Ecological Sanitation Research Project |
| EEA | European Environmental Agency |
| EQA | Environmental Quality Act |
| EU | European Union |
| FEPA | Finnish Environmental Protection Act |
| GHG | Greenhouse Gas |
| Gwh | Giga watt hour |
| GTZ | Deutche Geselleschaft für technische Zusammenarbeit |
| HCES | Household Centred Environmental Sanitation |
| IDP | Integrated Development Plan |
| IEA | International Energy Agency |
| IIIEE | International institute for industrial environmental economics |
| IPCC | International Panel for Climate Change |
| ISO | International Standard Organisation |
| IWMS | Integrated Waste Management System |
| K | Potassium |
| KCH | Kuching |
| kwh | Kilowatt hour |

| | |
|---|---|
| LAC | Local Authorities (Cleanliness) Bylaws |
| LAO | Local Authorities Ordinance |
| MNS | Malaysian Nature Society |
| MOSTE | Ministry of Science, Technology and Environment |
| MPP | Padawan Municipal Council |
| MS | Malaysian Standard |
| MW | Mega Watt |
| MYR | Malaysian Ringgit |
| N | Nitrogen |
| NGO | Non Governmental Organisation |
| NGV | Natural Gas Vehicles |
| NREB | Natural Resources & Environment Board |
| NREO | Natural Resources & Environment Board |
| OPP3 | Third Outline Perspective Plan |
| P | Phosphorous |
| PTM | Malaysia Energy Centre |
| PSTT | Provincial Sanitation Task Team |
| RE | Renewable Energy |
| REPA | Regional Environmental Protection Act |
| RM | Ringgit Malaysia |
| SARS | Severe Acute Respiratory Syndrome |
| SDI | Sarawak Development Institute |
| SEK | Swedish Kroner |
| SESCO | Sarawak Electricity Supply Corporation |
| SIDA | Swedish International Development Agency |
| SPA | State Planning Authority |
| SPU | State Planning Unit |
| SRC | Sarawak Rivers (Cleanliness) Bylaws |
| SREP | Small Renewable Energy Programme |
| SRO | Sarawak Rivers Ordinance |
| Tot-N | Total Nitrogen |
| Tot-P | Total Phosphorous |
| TSS | Total Suspended Solids |
| TWh | Tera-Watt hour |
| UEMS | Urban Environmental Management System |
| UNIMAS | University of Malaysia Sarawak |
| USD | US Dollars |
| USEPA | United States Environmental Protection Agency |
| VAT | Value Added Tax |

| | |
|---|---|
| WEHAB | Water and sanitation, Energy, Health, Agriculture and Biodiversity |
| WSDP | Water Services Development Plan |
| WSSD | World Summit on Sustainable Development |
| YB | Yang Berhormat (Honourable) |

# Appendix 1 Research schedule

| ***Timeline*** | ***Planned event / activities*** |
|---|---|
| 31 May- 1 June | Preparation of research plan and literature review |
| 2-4 June | Participation in training course on: Appropriate sanitation in the developing world organized by Agricultural University of Norway in Oslo |
| 5-9 June | Literature review and write up |
| 10 June | Depart for Malaysia |
| 11-15 June | Holiday and family matter |
| 16 June | Start up meeting with Malaysian advisors and counterparts |
| 17-22 June | Literature review, scope review, arrangement for interviews |
| 23 June | Attended 1st workgroup meeting on organic waste generators and potential fertiliser users survey held in NREB, Kuching |
| 24 June – 4 July | Interviews and meetings, summaries and write up |
| 5-7 July | Vacations |
| 10 July | Attended 2nd workgroup meeting on organic waste generators and potential fertiliser users survey held in NREB, Kuching |
| 8-15 July | Interviews and meeting, draft report write up |
| 15-23 July | Progress report and review of work |
| 24 July – 15 Aug. | Analysis and report write up |
| 15 August | Submission of first draft thesis report |
| 16 Aug. – 2 Sep. | Review and finalise report |
| 3 Sep | Submission of revised draft |
| 4 -16 Sep. | Update and preparation of final thesis report |
| 17 Sep. | Submission of final thesis report |
| 29-2 Oct. | Presentation of thesis |
| 3-8 Oct. | Revise and submit final report |

# Appendix 2 List of Interviews and Meetings

| Organisation field | Interviewee and position | Name and address | Organisation relation to wastewater management/biogas recovery | Data collection methodology |
|---|---|---|---|---|
| **International Donor Organisations** | Programme Officer | Danish International Development Agency (DANIDA)<br>Wisma Denmark, Kuala Lumpur, Malaysia.<br>Tel: +603 3032 2001<br>Fax: +603 2032 2012 | Support in environmental management assistance in Kuching, including policy issues, planning for measures to improve the water quality of Sungai Sarawak. Support to National Energy Policy and Clean Development Mechanism (CDM) implementation. | Personal interview |
| | Chief Technical Advisor, UEMS project<br><br>Legal and institutional specialist, UEMS project | UEMS project office<br>19th floor Menara Pelita, 93050 Kuching, Sarawak, Malaysia.<br>Tel: +6082-442784 | Hands on experiences with environmental planning and management issues. In depth knowledge on wastewater management in Kuching. Legal and institutional knowledge of local situation. | Personal interview<br><br>Personal interview |
| | Chief Techical Advisor<br>CDM projects | Malaysian Energy Centre (Pusat Tenaga Malaysia)<br>Level 8, Bangunan SAPURA@MINES<br>7, Jalan Tasik<br>The Mines Resort City<br>43300 Seri Kembangan<br>Selangor Darul Ehsan<br>Tel : 603-8943 4300<br>Fax : 603-8941 1121 | Non profit organisation involved in renewable energy research and policy advise to the government. Involved in CDM project identifications, evaluation and preparation support | Personal interview and e-mail correspondence |
| **Government** | Director(Project Manager)<br><br>Chief Technical Advisor, | Economic Approach Project,<br>Regional Economics and Environment Section,<br>Economic Planning Unit,<br>Prime Minister's Department<br>Phone : (603) 8888 2837<br>Fax. : (603) 8888 2843 | Involved in demonstration projects related to using economic approaches in Malaysia<br><br>Policy advice to government on the use of economic instruments | Personal interview<br><br>Personal interview |

| | | | | |
|---|---|---|---|---|
| | Parliamentary member (politician) | Deputy chairman of Sarawak Environmental Authority (NREB), 18th Flr Menara Pelita, Kuching. Tel: 082-447488 | In depth knowledge and experience in policy making in environmental field, including water resources and wastewater. | Personal interview |
| | Legal Officer | State Attorney General Office Wisma Bapa Malaysia 16th Floor, 93050 KCH Tel: 082-442899 | Responsible for the drafting, amendment and prosecution of legislation at State level | Personal interview |
| | Controller (Director)<br><br>Environmental Control Officer | Natural Resources and Environmental Board (NREB), Sarawak 18th Floor Menara Pelita 93050 Kuching Tel: 082-442784 | Overall state environmental authority involves in environmental policy advise, environmental planning, management, monitoring and reporting. Direct involvement in the planning of EcoSan integration | Personal interview<br><br>Personal interview |
| | City Secretary (Director) | Kuching South City Hall (MBKS), Jln Padungan, KCH. Tel: 082-247000 Fax: 082-417372 | Local city councils directly involve in household waste management, including the discharge of wastewater. The local authority is also responsible for the approval of building structural requirement, including wastewater facility | Personal interview |
| **Business Organisations** | Director | Chemsain Engineering Sdn. Bhd. No. 41 Wisma Ko-Perkasa, Jln Simpang Tiga, 93350 Kuching, Sarawak, Malaysia. Tel: +60-82422736 Fax: +60-82415506 | Involves in various wastewater management related projects. Good knowledge of local decision making process and environmental related issues. | Personal interview |
| | Research and Development Manager | Sydkraft Gas AB Nobelvågen 66, Malmö, Sweden Tel: +46 40244713 Fax: +46 40244010 | Experience with biogas recovery from organic waste and wastewater. Also involves in upgrading biogas to high quality fuel for vehicle use and setting up integrated gas supply with natural gas system | Email correspondence and personal interview |

| | | | | |
|---|---|---|---|---|
| | Manager | Sar-Alam Indah Sdn. Bhd.<br>Jln Matang Batu Kawa,<br>93050 Kuching, Sarawak.<br>Tel: +60-82-644923<br>Fax: +60-82-644920 | Company involves in the planning, designing and operation of biogas recovery facility in Kuching. | Personal interview |
| | Chief Engineer, System Planning | Sarawak Electricity Supply Corporation (SESCO),<br>Petra Jaya, Kuching.<br>Tel: 082-441188 | Main power utility company, involves in some renewable energy projects and understanding of current power market and procedures of power producers to follow. | Personal interview |
| | Farm Owner | JF Trading Farm<br>Sungai Pinang, Bau. | Involved in installation of biogas recovery system for pig manure treatment at farm scale level. | Site visit and personal interview |
| **Non Governmental / Profitable Organisation** | Hon. Secretary | Malaysian Nature Society (MNS)<br>Tel: +60-82428004 | Active in environmental conservation issues, nation-wide organisation. | Personal interview |
| | Director<br><br>Programme Officer | Global Environment Centre<br>2nd Floor, Wisma Hing,<br>No. 78, Jalan SS2/72,<br>47300 Petaling Jaya,<br>Selangor D.E.,<br>MALAYSIA<br>Tel: +60 3 7957 2007<br>Fax: +60 3 7957 7003 | Involve in environmental issues of global importance. Related experiences in Malaysia include water quality management and climate change issues. | Personal interview |
| | Research associate | Sarawak Development Institute (SDI), Kompleks AZAM, Jln Crookshank,<br>93000 KCH.<br>Tel: 082-415484<br>Fax: 082-412799 | Active in environmental issues – "think tank" for State Government on various policy related research. | Personal interview |
| **Media** | Journalist | Sarawak Tribune<br>Lot 231 Jln. Nipah, Off Jalan Abell Utara, 93100 Kuching.<br>Tel: 082-424411-5<br>Fax: 082-420358 | Active journalist who writes about environmental issues in the State. | Personal interview |

| | | | | |
|---|---|---|---|---|
| **Academic/ Research institutes** | Assoc. Professor | Water Institute<br>University Malaysia Sarawak (UNIMAS)<br>Tel: +82-671000<br>Fax: +82-671903<br>lauseng@tualang.unimas.my | Involved in environment research with areas covering water quality and river ecology. | Personal interview |
| **Public** | Public 1<br><br>Public 2 | Jln Arang, 93250 Kuching<br>Tel: 0198571112?<br><br>Jln Burung Bunga Api, 93250 Kuching. Tel: 082-451910 | Public with random background and knowledge | Personal interview<br><br>Personal interview |

# Appendix 3 Sample of questions used in interviews

(note: length of note taking spaces in this sample form is reduced from original forms)

## *Policy formulation*

Is there any existing national or state policy concerning domestic wastewater management and planning in cities?

| | | | | | | |
|---|---|---|---|---|---|---|
| YES | | | NO | | NOT SURE | |

If yes, please describe existing policy. Do you feel the existing policy is adequate?

If no, do you feel the need to establish a coherent policy for future wastewater planning?

| | | | | | | |
|---|---|---|---|---|---|---|
| YES | | | NO | | NOT SURE | |

What is the importance of having a clear and consistent policy? What are the constraints?

Do you see any problems of the existing policy?

In your opinion, what are usually the main drivers or reasons for establishing a clearly, written policy?

How is the policy making process and who are involved in Sarawak?

What is your general perception for incorporating and advocating the blackwater management system in the wastewater planning in Kuching? (Introduce EcoSan and proposed blackwater system if necessary)

Of the following criteria, - which do you regard as important when deciding upon which technique to use for wastewater treatment? Please, give your priority for each criteria; 3: very important, 2: important, 1: not important.

| | |
|---|---|
| | **Hygiene and disease protection** – of the receiving waters and users as well as agricultural land receiving the nutrient or water resource. Quality of the discharged |
| | **Water Protection** – amount of nutrients and other undesired substances reaching the receiving waters |
| | **Recycling of nutrients** – possibilities to reuse nutrients from the system |
| | **Recycling of water** – possibilities to reuse water from the system |
| | **Economics** – the cost of installing and maintaining the system |
| | **Reliability** – how well the technique works for variations in load etc |
| | **Flexibility –** e.g. if the system can easily be modified for a higher load. |
| | **User aspects –** if investment in own work is needed to keep the system running. |
| | **Sociological and cultural aspects** – washer/not washers, religious aspects etc. |
| | **Responsibility** - if the municipality, the village, or users are responsible for the system. |

## *Regulatory and institutional framework*

Are you aware of relevant legislation concerning domestic wastewater discharge? Do you think they are working?

What would be the process of legal and institutional amendment in relation to the above amendments in Sarawak? Who should be involved?

What constraints are foreseen? How do you think this could be solved?

What institutions are responsible for what? (refer to slide). Are there any gaps and overlaps and how should this be addressed for the case of blackwater management system?

## *Incentive-based scheme*

Is there any tendency of introducing market based instruments (economic instruments) in environmental related policy to address externalities into price of services?Are there any existing experiences locally? What are the possible constraints experienced or anticipated?

In the case of recovering biogas and nutrients from domestic wastewater, are there any possibilities of introducing economic instruments in view of the environmental benefits to spur the diffusion of similar systems? What types and how? Today, the energy produced from renewable sources has the same market price as from other sources.

Would the existing tax incentives for the use of renewable energy be applicable for the case of the biogas facility in Kuching?

Is there any plan to introduce incentive scheme for the use of organic fertilizer for better environment performance?

# Appendix 4 Draft Interim Policy on Basic and Rudimentary Services to Informal Settlements, South Africa (2002)

***DRAFT INTERIM POLICY ON BASIC AND RUDIMENTARY SERVICES TO INFORMAL SETTLEMENTS***

***WATER AND SANITATION SERVICES***

21 November 2002

Noahmaan Hendricks

***INDEX***

City of Cape Town - Isixeko Sasekapa - Stad Kaapstad

POLICY ON BASIC AND RUDIMENTARY SERVICES TO INFORMAL SETTLEMENTS

WATER AND SANITATION SERVICES – 21 November 2002

## 1 INTRODUCTION AND CONTEXT

This policy aims to address the need for access to Basic and Rudimentary Water and Sanitation for all informal households in the City of Cape Town, including that of settlements on private land. While the level of access to water and sanitation is relatively high in the informal settlements on Council land, access is low to non-existent in those settlements located on private land or land reserved for other uses. There are between 700 000 and 800 000 households within the City of Cape Town of which about 85 000 are considered informal.

South Africa has, in recent years, extended water supply to 7 million people, while at the same time only approximately 52 000 toilets were built, serving some 312 000 people. This lag in the extension of the sanitation service seriously impacts on the health of the community.

There are currently 89 informal settlements with an estimated total of 85 000 households residing in the City of Cape Town. These settlements grow annually by approximately 6-8% due to an influx from mainly rural areas. Presently these informal settlements are serviced by approximately 12 500 toilets and 1684 standpipes. With the current rate of housing provision of approximately 10 000 houses per annum, we can see that these informal settlements will remain with us for the foreseeable future. It can therefore be seen that informal settlements are not a temporary situation but form part of the urban fabric of the city and should therefore be planned as such.

The City of Cape Town must focus on the improvement of health and hygiene, the environmental impact of poor sanitation and the provision of adequate and sustainable sanitation facilities for all households, within the framework and principles of National Legislation regarding Sanitation Provision. The City of Cape Town must maintain its links with Provincial and National Government for co operative approach for Sanitation programmes. This is currently being achieved through the Provincial Sanitation Task Team (PSTT). The White Paper on Basic Household Sanitation directs that by March 2010 all South Africans must have access to a basic minimum level of sanitation. With adequate integrated planning and integration of resources, the government aims to reach the target by 2008.

Cape Town is actively engaged in national workgroups that are engaged in policy making in respect of servicing informal settlements. This policy, therefore, is subject to the final national policy that is to be promulgated in the next few months.

## 2 FRAMEWORK FOR SERVICING INFORMAL SETTLEMENTS

This policy forms an addendum to the Framework for Servicing Informal Settlements and should be read in conjunction with that Framework.

## 3 DEFINITIONS

"Informal settlements": These are settlements that have arisen informally and without any planned layout or services infrastructure.

Informal settlements within the City of Cape Town may be further defined in 4 separate categories.

- "Informal settlements" - unencumbered: situated on Council land with no development constraints.

- "informal settlements" - encumbered: situated on Council land reserved for other uses such as, road reserves, storm water detention facilities, services servitude and other restrictions.

- "informal settlements" - state owned: situated on State land including Provincial.

- "informal settlements" - unlawful: situated on privately owned land.

"Basic Water Supply" (Water Services Act No. 108 of 1997 [Reg No. R509-3])

The minimum standard for basic water supply services is:

(a) the provision of appropriate education in respect of effective water use; and

(b) a minimum quantity of potable water of 25 liters per person per day or 6 kiloliters per household per month -

- at a minimum flow rate or not less than 10 liters per minute;

- within 200 metres of a household; and

- with an effectiveness such that no consumer is without supply for more than seven full days in any year.

"Sanitation": (as defined by the White Paper on Basic Household Sanitation –Section A3) refers to the principles and practices relating to the collection, removal or disposal of human excreta, household waste water and refuse as they impact upon people and the environment. Good sanitation includes appropriate health and hygiene awareness and behaviour, and acceptable, affordable and sustainable sanitation service.

"Basic level of sanitation": (White Paper on Basic Household Sanitation – Section A3)

- appropriate health and hygiene awareness and behaviour;

- a system for disposing of human excreta, household waste water and refuse, which is acceptable and affordable to the users, safe, hygienic and easily accessible and which does not have an unacceptable impact on the environment; and

- a toilet facility for each household.

## 4 LEGISLATION

### 4.1 Constitution

(1) The Constitution (Sections 151 - 156 and Part 3 of Schedule 4) makes Local Government responsible for the provision of Water and Sanitation in an affordable and sustainable manner.

(2) The Bill of Rights provides for the right of everyone to a healthy environment. (Chapter 2 Section 27) which includes the provision of water and sanitation services.

4.2 The Water Services Act: (108 of 1997)

(1) the right of access to basic water supply and the right to basic sanitation necessary to secure sufficient water and an environment not harmful to human health or well being.

(2) the setting of national standards and norms in respect of water services.

4.3 Municipal Systems Act 2000 (Act 32 of 2000)

General duties of a municipality are:

- Give priority to the basic needs of the local community
- Promote development of the local community; and

Ensure that all members of the local community have access to at least the minimum level of basic municipal services. (Chapter 8 Section 73.)

4.4 White Paper on Basic Household Sanitation (September 2001)

The Draft White Paper on Sanitation Policy aims to assist the Local Authority in meeting its responsibility in ensuring that all South Africans have access to adequate sanitation services. The principles that will guide this policy are as follows:

- Sanitation improvements must be demand responsive and supported by an intensive Health and Hygiene Promotion Programme.
- Communities must be fully involved.
- The health, social, and environmental benefits of improved sanitation is maximised when sanitation is planned for and provided in an integrated way with water supply and other municipal services.
- Sanitation improvement must be accompanied by environmental, health and hygiene promotional activities and education.
- Basic sanitation is a human right.
- The provision of access to sanitation is a local government responsibility.
- "Health for All" rather than "All for some".
- Equitable regional allocation of development resources.
- Water has an economic value.
- Polluters pay principle.
- Sanitation services must be financially sustainable.

Environmental integrity must be protected from potential negative impacts of developing and operating sanitation systems.

4.5 The Integrated Development Plan (IDP) & Water Services Development Plan (WSDP)

The mechanism for deciding on priorities and for steering and co-ordinating service delivery is the Integrated Development Plan (IDP) process, which for water, includes the preparation of a Water Services Development Plan (WSDP), indicating:

- the number and location of persons within the area who are not being provided with basic water supply and basic sanitation.
- the water services providers which will provide those water services.
- the operation, maintenance, repair and replacement of the existing and future infrastructure.

5 LIMITATIONS

5.1 This policy is being developed in the absence of an approved policy on informal housing and in the absence of a National policy on servicing informal settlements. The White Paper on Basic Household Sanitation requires a toilet per household which will not be possible in densely populated informal settlements. Waterborne sanitation is also excluded. These issues are being addressed in the formulation of the draft National policy.

5.2 Absence of an informal settlement policy

Until such time as a policy on informal settlement has been developed for the city spelling out the way forward for these informal settlements such as development programmes for the settlements, it is assumed that these settlements are temporary in nature and that the installation of infrastructure should not be abortive.

5.3 Geological Conditions

Consideration should be given to the impact of ground conditions and the level of the water table in the Western Cape limiting the technology options available such as pit latrines.

6 OBJECTIVES

This policy aligns with the corporate intention to create a "Healthy City" and incorporates the following objectives:

- The improvement of health and hygiene,
- The minimization of environmental impact,
- The provision of adequate, affordable and sustainable water & sanitation facilities for households within the framework and principles of National Legislation,
- Promote wise water use, sanitation awareness and health related education within communities

- Ensure communities are informed around their choices and educated around the operation and maintenance of water services.

- Ensure the provision of rudimentary and basic services free of charge.

In the past sanitation has been seen primarily as a technical issue (toilet building, providing sewer systems, maintenance, etc.), whilst other aspects have been given secondary consideration. It is now recognized that toilets are just one element in a range of factors that make up good sanitation.

## 7 GENERAL POLICY

The servicing of informal settlements shall be addressed by means of the following strategic interventions:

### 7.1 Facilitation of the participation of communities

Communities shall be involved in all the decisions that affect them concerning water and sanitation projects. This shall include local planning, organization and implementation and particularly the involvement of women. The local staff shall be equipped to provide communities with information on appropriate technologies and on-going support around the full range of technologies.

### 7.2 Promoting Health and Hygiene awareness and education

The wise use of water, sanitation awareness and improved health and hygiene practices will reduce the risk of diseases and will result in improved health and quality of life.

An integrated Education Programme shall be implemented for the community.

Prior to the installation of the hardware there shall be an education drive which must be sustained within the community thereafter.

### 7.3 Protocol for technology options

A protocol must be implemented to identify appropriate technologies available for each settlement. The community must be informed about these appropriate technologies and the cost thereof.

### 7.4 Sustainable Developments

A sustainable system is that which is affordable to the community and the municipality over the long term without having adverse effects on the environment. An affordable system is a system which both the community and the municipality are able to fund with regard to its operation, maintenance and extension to ensure reliable service in terms of National policy.

Sanitation programmes should promote community ownership of the facilities provided within the community. This can form part of the public private partnerships within the community as well as employing community members to drive the operation and maintenance of such programmes. While the Basic Free component incorporates the conveyance and treatment of sewerage the user should contribute towards the operation of the facility.

## 8 SERVICE LEVELS

### 8.1 Basic Water Service

(a) The provision of appropriate education in respect of effective water use.

(b) A minimum quantity of potable water of 25 liters per person per day or 6 kiloliters per household per month -

- at a minimum flow rate or not less than 10 litres per minute;
- within 200 metres of a household; and

with an effectiveness such that no consumer is without supply for more than seven full days in any year.

8.2 Basic Sanitation Service

(a) an appropriate health and hygiene awareness programme;

(b) a system for disposing of human excreta and household waste water which is acceptable and affordable to both the user and the Municipality, safe, hygienic, and easily accessible and which does not have an unacceptable impact on the environment.

8.3 Rudimentary Service - Water And Sanitation

Intended for those settlements that are temporary or short term in nature, rudimentary water and sanitation services shall be provided at a level of service which shall ensure that the health and safety of the community are minimised. These shall include water standpipes and community sanitation facilities. Due to the temporary nature of the settlements, these services shall, wherever appropriate, not include abortive capital expenditure.

9 APPROACHES

It is critically important that the appropriate response is provided depending on the expected future scenario of each informal area.

9.1 Settled informal settlements, typically situated on Council land with no development constraints and or other impediments such as servitudes

The provision of a basic water and sanitation service in line with this policy and prioritised

a) Situations where a significant Health risk is present.

b) Situations where an inadequate water and sanitation service exists.

9.2 Transitory informal settlement, typically those situated on Council land reserved for other uses and which Housing are proposing to relocate to a more appropriate location

The provision of a rudimentary water and sanitation service in line with this policy and prioritised for those situations where a significant health risk is present.

9.3 Informal settlements typically situated on Government land and privately owned land

Follow the process prescribed in the Health Act and as described in the "Framework for Servicing Informal Settlements" which includes the notification of the government and private land owners of their responsibility. Where a health risk exists instruct the government or private land owner to comply with

provision of water and sanitation delivery, failing which the City shall provide the services in line with the principles of this policy at the cost of the owner.

## 10 FUNDING FOR WATER AND SANITATION SERVICES

Capital funding for servicing informal settlements shall be obtained wherever possible from Government and other funding sources. Government funding includes the DWAF household sanitation subsidy, the Consolidated Municipal Infrastructure Programme (CMIP) and the Community Water Supply (CWS) Grant. Other funding sources shall be sought at every opportunity. Where a shortfall exists, the balance shall be provided from the Water Services capital budget.

The operating costs shall be met through the Water Services operating budget unless funded through other subsidies such as the equitable share.

# Appendix 5 Incentives for the use of natural gas vehicles in Malaysia

To encourage the use of natural gas for vehicles (NGV) the following indirect tax incentives are given:

(a) the retail price of NGV has been fixed at half the retail price of petrol, determined through the automatic price mechanism for petroleum products;

(b) import duty exemption on equipment for the conversion of petrol/diesel vehicles to NGV;

(c) import duty and sales tax exemption for the conversion of vehicles to use natural gas.

This exemption is given to local vehicle assemblers/manufacturers;

(d) a 50% reduction in road tax from the prevailing rates for monogas vehicles (solely powered by gas);

(e) a 25% reduction in road tax from the prevailing rates for bi-fuel vehicles (petrol vehicles modified to use NGV); and

(f) a 25% reduction of road tax from the prevailing rates for dual-fuel vehicles (diesel vehicles modified to use NGV).

# Appendix 6 Summary of interviews results on willingness to use organic fertiliser

| | Estate: | Size in Hectare: | Distance of Fertilizer Storage from MSSTP (One-way),km | Type of Soil of Estate: | Consensus on using alternative liquid form fertilizer: | Method of Applying Fertilizer: | Willingness in using recycled organic fertilizer: |
|---|---|---|---|---|---|---|---|
| 1 | Zuhrah Pelangi Mulberry Plantation | 50 | 138 | Mineral Soil | Incentive Driven | Manual Labor | Very Keen |
| 2 | SALCRA Taee [1]OPP | 1686 | 73 | Mineral Soil | Incentive Driven | Manual Labor | Prefer solid form fertilizer |
| 3 | Samarahan Sdn Bhd OPP | 1585 | 67 | 10-20% Peat & 80-90% Mineral Soil | Incentive Driven | Manual Labor | Not Interested |
| 4 | FELCRA Belimbing OPP | 2268.9 | [2]n.a. (7 storage areas) | Mineral Soil | Incentive Driven | Manual Labor | Not Interested |
| 5 | FELCRA Tamang Sembawang OPP | 570 | 87 | Peat & Mineral (Sandy) Soil | Only on the nursery (because estate is mostly hilly) | Manual Labor | Not Interested |
| 6 | SALCRA Stenggang OPP | 1085 | 39 | Mineral Soil | Willing to try | Manual Labor | Very Keen |
| 7 | FELCRA Asajaya OPP | 1002 | 78-79 (3 storage areas) | Peat Soil | Not Interested | Manual Labor | Not Interested |
| 8 | SALCRA Undan OPP | 3062 | 53 | Mineral Soil | Will consider using if only method of fertilizer application is upgraded to machinery | Manual Labor | [3]Very Keen |

1. OPP denotes Oil Palm Plantation

2. Denotes data not available due to time constraint during the first site survey, second site visit is needed to acquire the information

3. Denotes estate's manager is willing to use recycled organic waste but need to try it out first on a small area