Geoscience in Landuse Planning for Environmental Sustainability

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Abstract: The Selangor State Policy on Environmentally Sensitive Areas (ESAs) was officially launched on 5 June 1999. Three types of ESAs are identified. These are ESAs for Heritage Value, ESAs for Life Support Systems and ESAs associated with Hazards. The paper aims to highlight the importance of geoscience in landuse planning, particularly through the Selangor Policy on ESAs. The issues and challenges in contributing effectively to ensure environmental sustainability are discussed in this context.

Abstrak: Dasar Kawasan Sensitif Alam Sekitar (KSAS) Selangor telah dilancarkan pada 5 Jun 1999. Tiga jenis KSAS telah dikenalpasti iaitu KSAS Nilai Warisan, KSAS Sokongan Hidup dan KSAS Risiko Bencana. Kertas kerja ini membincangkan kepentingan geosains dalam perancangan gunatanah, terutamanya melalui Dasar KSAS Selangor. Isu dan cabaran dalam menyumbang secara berkesan bagi memenuhi tuntutan kelestarian alam sekitar dibincang dalam konteks tersebut.

INTRODUCTION

The rapid pace of development has made the utilisation of land extremely competitive in Malaysia. This is particularly pertinent is Selangor, where poor land-use practices in certain instances, has resulted in serious problems that pose barriers to development in the long term (GoS 1999). Conversion of land from forest to agriculture has resulted in widespread deforestation and reduced the amount of pristine forests and biodiversity of the forestry and wildlife. Continued deforestation and forest degradation in catchment areas has affected the yield and quality of water resources and caused flood related problems in lowland areas. In Selangor, large tracts of land have been converted to accommodate urban expansion in the form of housing, industrial estates and recreation areas, among others.

The establishment of such built-up zones has contributed to sterilisation of mineral resources (Pereira 2000). As the density of population increases in urban areas, infrastructure development is increasingly being forced to less suitable and problematic sites. These sites tend to be subject to hazards such as floods, river erosion, landslides and sinkholes unless proper mitigating measures are taken (Pereira & Komoo 2004). In certain cases mitigating measures are not possible and for the safety of the population it is best that these sites not be developed for housing but be used for conservation purposes in the form of parks, nature reserves and recreation areas instead. This may assist in alleviating the pressure on nature and biodiversity as the demand for land development increases to support economic growth and human settlements.

Even as the living segment of nature becomes beneficiary of such protection, the non-living segment i.e. the physical form, also needs to be recognised and appreciated for its intrinsic value. Examples include significant rock outcrops such as the quartz dyke at Klang Gates and karstic features such as Batu Caves. A range of uses adversely affects the integrity of the physical form due to land mismanagement and benign neglect because it's value is not recognised (Komoo 2003). Therefore, conservation of significant landforms should be looked into seriously to ensure that it is not lost to the next generation of Malaysians.

This paper is based on policy research conducted jointly between the Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia, Town and Country Planning Department of Selangor and State Government of Selangor since 1999. The paper aims to highlight the importance of geoscience in the Selangor Policy on Environmentally Sensitive Areas (ESAs). It commences with a description of the concept of ESAs, which evolved from a sectoral approach at the international and national levels, but was modified to be more integrated for its implementation in the State of Selangor. This is followed by a short discussion on the types and scale of conventional geoscience information, which is primarily focused on separate aspects of geoscience. The increasing demand for geoscience information due to legislative and administrative changes is briefly discussed. The final part focuses on the need for integrated geoscience information, to be channelled to appropriate levels, as well as issues and challenges that relate to ESAs in the context of its contribution to progress towards sustainability.

CONCEPTS AND APPROACHES

Perspectives on ESAs

The concept of Environmentally Sensitive Areas (ESAs) initially evolved from the need to protect an area or a fragile ecosystem that was sensitive to the interference of man from the negative impacts of development. At the international level, the development of the ESA concept fulfilled the sectoral demands related to the agriculture, forestry and park management sectors. The focus appears to be on landuse management, environmentally friendly farming practices and forest resource management. For example, in the United Kingdom, the concept of ESA was first introduced through the Agriculture Act 1986 where certain environments of national interest were defined as ESAs (MAFF 1989). Characteristics of national importance included the conservation of areas that were important for environmental well being as well as areas that were environmentally threatened by changing farming practices, among others. In the United States, the concept of ESAs defines lands set-aside for the purpose of protecting special natural environments (Watson *et al.* 1995). Such lands included National Recreational Areas, Wild and Scenic River Systems, National Wilderness Areas, National Wildlife Refuges, National System of Trails, National Forest Systems and National Historic Sites. In British Columbia ESAs covers a wider scope. Several types of ESAs are identified for the purposes of forest management, riverine, catchment and recreational protection, among others.

At the national level, the concept of ESAs was first introduced in Malaysia in the early 1990's as "Critical Areas" in the National Conservation Strategy (EPU 1993). Critical Areas provided an operational framework and guideline for conservation of natural resources and the environment throughout the planning and implementation process. The Critical Areas identified were undisturbed habitats which serve as catchment areas and play an important role in soil stabilization, biological diversity and research, natural habitats which were managed to support human activities and environmental functions, areas with steep slopes, catchment areas, areas of historical, archaeological or geological value, and several other categories with special values in the future. As the Critical Area concept has yet to be implemented officially, its effectiveness cannot be assessed.

The Department of Environment has also specified guidelines for ESAs in Malaysia to assist in the assessment of development projects (DOE 1993). The DOE defines ESAs as areas that require special attention prior to the approval of development in that particular and adjacent site. This is to ensure that the scientific, economic and aesthetic values of such a site is not threatened and that the quality of life in the present and the future is not compromised. The concept of ESA as advocated by the DOE in principle fulfils the needs of environmental protection in the implementation of sustainable development. However, the extent of areas identified is wide and the number of items specified is limited. As a result, the list of ESA as documented in the guideline is difficult to utilise for operationalising sustainable development through existing planning and management mechanisms.

The Town and Country Planning Department of Peninsular Malaysia approaches ESA through the land-use planning perspective. A consensus was reached at the national level in 1998 regarding the scope of ESA that is relevant to Malaysia. Ten categories of ESA were identified and these are for Biological Diversity, Highlands and Steep Slopes, Catchment Areas, Wildlife Protection, Rivers, Wetland, Coastal Margins, Permanent Forest Reserves, Geological and Landscape Heritage and Cultural and Architectural Heritage (JPBD 1998). The Department has since prepared generic guidelines for the management of sectoral ESAs with a widened scope and recommended a consultation process to be used by State and Local Authorities in the identification and prioritisation of ESAs (JPBD 2004).

The State Government of Selangor endorsed the ten basic categories of ESA as identified at the national level for landuse planning (GoS, 1999; 2003). The State also recognised the need to resolve the issue of overlapping sectoral ESAs in order to ensure its practical implementation within the planning process. Thus, the concept of Sectoral ESAs was broadened to the concept of Integrated ESAs (Figure 1). This encompasses conservation, optimum resource use and societal well-being, to meet the needs of sustainable development.

Conventional Geoscience Information

Geological information encompasses data on geological resources, ground conditions and geological processes. Geological resources include a diversity of materials and structures in terms of rocks, minerals, soils and fossils, among others, as well as their topographic expressions and landforms. Depending on their quality, availability or scarcity and other factors, these resources are either used or conserved. Ground conditions are defined by their inherent properties based on material, structure and landform features, which determine the suitability of an area for construction. By incorporating this information into landuse planning, constraints and opportunities can be identified, which do not conflict with the ground conditions. Geological processes include weathering, mass movement, erosion and hydrogeological flow, among others, and these alter the state of geological resources and ground conditions with time. Geological processes are continuous and never cease even after an area is developed. Post-development monitoring of geological processes and its effect on buildings and infrastructure is useful to mitigate the risk of hazards and reduce the vulnerability of a population, particularly in urban areas.

Geological information is often portrayed in the form of maps to be used by various end-users such as planners, developers, engineers and decision-makers to improve land development for urban growth (De Mulder, 1986, 1990; Doornkamp *et al.*, 1987; Marker & McCall, 1990; Forster & Culshaw, 1990). When used effectively, geological information provides economic benefits such as cost savings in construction or long term maintenance of infrastructure and enhances societal well-being by preventing loss of life and damage to property.

The best geological maps make an effort to translate geological information into terms that can be understood by the potential user while the worst provides merely raw geological data. The maps which provide basic information appear under titles such as geology, geotechnical properties of rocks and soils, groundwater, mineral resources, slope gradient, landslides, coastal hazards, floodplain hazards and thickness of overburden. Derivative maps showing ease of excavation, landslide susceptibility, slope stability, seismic susceptibility, capability for solid waste disposal, percolation conditions, subsidence potential, availability of construction materials

INTEGRATED ESAs AND SECTORAL ESAs RELATIONSHIP MATRIX

Sectoral ESAs \ Integrated ESAs	HERITAGE	History and Archeology	Biological Diversity	Geology and Landscape	RISK OF HAZARDS	Highlands	River and Lakes	Coastal Area	Wetlands	LIFE SUPPORT	Clean Water	Basic Food	Energy and Construction Material	Space Requirement
FORESTRY														
Virgin Forest Reserve			■	●		●		●	●					
Catchment Forest			■	●		●		●	●		■			
Highland Forest			■	●		■					■			
Swamp Forest			■	●					■		●			
Other Permanent Forest Reserve			■	●		●		●	●		●			●
FISHERIES														
Freshwater Fisheries							●	●	●			■		
Coastal Fisheries								●	●			■		
FARMING AND ANIMAL HUSBANDRY														
Paddy Area									●		●	■		●
Fruit and Vegetable Area						●					●	■		
Pig Farm							■				●			
Grazing Land Area											●	■		
WILDLIFE														
Wildlife Reserve			■	●		●	●	●	●					●
COASTAL AREA & RIVERS														
Beaches			●	●				■	■			●	●	●
River and Lakes			●	●				■	■		●	●	●	●
Islands			●	●				■	■			●	●	●
MINERAL AND ROCKS														
Sand and Pebbles							●	●	●		●		■	
Rock Aggregates						●					●		■	
Clay Materials and Soil								●	●		●		■	
WATER BODIES														
Water Supply Dam (Reservoir)			●				■				■			●
Rivers			●	●			■				■	●	●	●
Lakes and Ponds			●	●			■				■	●	●	●
HISTORY AND ANTIQUITY														
Historical Area		■				●		●	●					
Monument and Statue		■				●		●	●					
RECREATIONAL PARK														
Recreational Park		●	●	●										■
GEOLOGICAL TREASURES														
Rocks			●	■		●								●
Exhausted Mine Area			●	■		●								●
Hot Spring			●	■			●							●
Waterfall			●	■				●	●					●
Hill / Mountain			●	■			●							

■ Primary Function • Secondary Function

Figure 1 – Matrix Depicting the Relationship of Integrated and Sectoral ESAs. Source: GoS 1999.

and recreation potential are also common. The choice of mapped parameters is a function of the nature of the geological environment and the geologist's perception of what the planners need to know for specific planning purposes (Doornkamp *et al.*, 1987; and Marker & McCall, 1990).

Scale of Geoscience Information

Based on the purpose of its application, geological information is provided on two levels, the general level and the specific level. Generalised maps and specific maps vary in content, emphasis, scales and aim but they basically provide geological information on surface and sub-surface conditions, which affect the planning and development of an area. Generalised maps are not designed to replace site specific information for particular development projects. Similarly, detailed site specific information, albeit useful, is not critical to produce generalised maps.

Generalised maps provide derivative geological information to guide planning and development as well as to serve as "early warning" regarding current or future problematic or contaminated foundation conditions. The end-users for this map are generally planners and decision-makers, and its aim is to strengthen land use planning and development control to manage urban growth in an environmentally sustainable manner. In some countries the maps are used as a basis for land zoning to support land use regulations or legislation and control or prohibit certain land use, as well as for insurance and tax adjustments (Doornkamp *et al.*, 1987).

Specific maps provide information based on detailed geological mapping and site investigation for various purposes. The content of such maps vary depending on the end-user. Engineers use specific maps to prepare geotechnical reports. These maps are prepared at a detailed scale specifically for engineers and decision-makers to ensure safety through engineering design and resource optimisation in the construction of buildings and infrastructure. Specific maps may also be prepared to provide information for environmental management, specifically in the preparation of an Environmental Impact Assessment Report or an Environmental Management Plan. Specific maps based on detailed geological investigation are also required when setting up a mining or quarry site, to ensure that there is enough a mineral or rock to be excavated for the operation to be economically feasible.

LEVEL	MECHANISM	PROCEDURE	PARAMETERS CONSIDERED	WEAKNESS
LAND USE PLANNING	Preparation of Structure Plans, Local Plans, etc.	□ Estimation of Space Requirement □ Location Suitability Analysis	□ Economic □ Population □ Existing Land use □ Environment □ Transportation □ Utilities and Communication etc.	Only the availability of mineral resources is considered. No inputs on geohazard prevention and physical conservation.
REGULATION AND CONTROL OF DEVELOP-MENT	Application For Land use Conversion	Evaluation provided by technical departments prior to approval by State Executive Council	□ Site Gradient □ Land use Zone □ Access Road □ Road Reserve □ Flood Prone Area □ Drainage Requirements For Low Areas □ Availability Of Adequate Water Supply	No inputs on the type and level of geological information required by the Geological Survey Department to prevent geohazards occurrences and conserve physical heritage.
	Application For Planning Permission	Standards imposed by various technical departments prior to approval of DPR and layout plan by Local Authorities		

Figure 2. A simplified chart of the planning process and its inherent weakness from the perspective of geology prior to the 1995 amendment of the Town and Country Planning Act (1976). Source: Pereira and Komoo (1998).

REQUIREMENTS FOR GEOSCIENCE INFORMATION

General Requirements

Historically, the impetus for applied geoscience came from the demand for metals and minerals during the industrial revolution. Many of the Geological Surveys worldwide were established to explore and evaluate the potential of metals and minerals. The Geological Survey in Malaysia was established in 1907 to develop tin and gold resources in the Malay Peninsular (Gobbett & Hutchison 1973). The role of applied geoscience became even more important when the need for fuel minerals such as coal and petroleum became acute. In order to support mineral exploration activities, branches of geology such as mineralogy, petrology, structural geology, geochemistry, sedimentology, stratigraphy, palaeontology and geophysics evolved distinctly into disciplines in their own right.

The onslaught of infrastructure development in the early 1970's resulted in the introduction of engineering geology. This branch of geology supports the construction industry, particularly with respect to site suitability, safety and optimisation, for infrastructure such as roads, tunnels, dams and bridges, among others. The 1980's saw the expansion of hydrogeology to meet increased demand for groundwater, particularly in certain areas of Peninsular Malaysia and Sarawak (Chong & Tan 1986). A growing population and limited surface water required the exploitation of more groundwater resources to meet the demand for water in these areas.

Rapid development in the early 1990's resulted in expansion of growth centres onto areas such as hilly terrain, karstic bedrock, former mines as well as peat and soft sediment zones that are prone to geological hazards (Chand 1999). This brought to fore the importance of geological inputs for urban planning and development, in the form of urban geology. Unfortunately, the use of geoscience information is limited to major national projects, with direct inputs from the Minerals and Geoscience Department (JMG). Its use is not widespread for all development projects at the Local Authority level.

Environmental geology has been introduced to address current issues related to pollution control and environmental conservation. Environmental geology is the study of the non-living physical environment that is impacted by natural earth processes and anthropogenic activities. In recent years it's contribution has become more important due to the emphasis on sustainable development as articulated by the government (Pereira 2001; Pereira & Komoo 1998; Komoo & Pereira 1998). However, much needs to be done to make its application more widespread.

Requirements for Physical Planning

Land is a scarce commodity in Selangor and increasingly the emphasis is to ensure optimum use of land. Spatial planning is now more challenging, requiring comprehensive information and approaches that take into account multiple use and sequential land development to ensure the best use of each parcel of land. The demand for geological information specifically for the planning process has changed over time. The increasing demand for geoscience information can be attributed to changes at the Federal level, through the 1995 amendment to the Town and Country Planning Act (1976).

The Town and Country Planning Act (1976) exert primary control over the planning process in Malaysia. There are essentially two aspects and these are land use planning and development control. Landuse planning at the Local Authority level results in structure plans and local plans, which takes into account economic needs, population density, existing land use and other factors associated with the development process as well as environmental aspects such as conservation of wetlands and catchment areas. Development control involves the regulation and control of planning for projects. This takes into account consultation with and input from several technical departments, prior to the concession of land conversion or planning permission. The Local Authority consults several technical departments before permission is granted.

The demand for geological information has increased significantly since 1995. Two distinct phases can be delineated, separated by the 1995 amendment, Town and Country Planning Amendment (1995), to the Town and Country Planning Act (1976). One of the triggering factors is the realisation of the importance of geological information in minimising the occurrences of hazards through planning responses. This is primarily due to the efforts of the JMG, in response to frequent incidents of landslides, slope failures and subsidence, among others. In addition to such incidents, lack of prior investigation into geological processes pose serious threats to existing infrastructure and future development activities. The weakness within the planning process in incorporating geological information was addressed through the amendment of the Act.

Prior to the early 1990's, the formulation of the regional land use plan is based primarily on the estimation of space requirements, with relatively less emphasis on location suitability analysis. The basic geological information utilised in the location suitability analysis relate to the physical features of the area that may constrain urban development and the availability of mineral resources for construction purposes (Norasiah and Lok, 1990). In describing the physical features of the area, the emphasis was on the existing landforms, particularly with respect to the ruggedness of the terrain, which constrained urban development. The identification of potential geohazard prone areas, which require suitable planning responses, was largely ignored (Figure 2).

In terms of regulation and control of development, the various technical departments consulted in the planning process have imposed standards, for matters that come under their respective jurisdiction. The standards include parameters such as the site gradient and land use zone, availability of access road and road reserves, engineering controls for flood prone areas, drainage requirements for low areas and availability of adequate water supply, among others (Norasiah & Lok, 1990). Unfortunately, the JMG was not one of the technical departments consulted on a routine basis for this part of the planning process, particularly at the Local Authority level (Pereira & Komoo 1998). Thus, adequate standards with respect to proper geohazard mitigation were not set and enforced.

In 1995 amendments were made to the Town and Country Planning Act (1976). This involved the incorporation of several new clauses as a measure to ensure the integration of public safety, environmental protection and preservation of cultural heritage into the planning process. When submitting an application for planning permission to the Local Authority, developers are now required to include a description of the land in the Development Proposal Report (DPR). Among the features specified in the land description are the geology, topography, drainage, landscape and catchment. The onus was on the developer to show to what extent the development proposed would effect the physical environment of the project site and adjacent areas.

Requirements for Environmental Planning

The need for comprehensive geological information in preparing development strategies was highlighted in a landmark study funded by the Selangor State Government in 1999 (GoS 1999). The study introduced the concept of Integrated Environmentally Sensitive Areas (ESAs), which was the basis for the Selangor Policy on ESAs, which was officially launched on 5 June 1999.

The Policy takes into account the importance of an area from the perspective of the implementing government agencies and the perspective of its major function in terms of providing life support systems, heritage value as well as risk associated with hazards. Three groups of ESA are identified. These are ESA of Heritage Value, ESA Associated with Hazards and ESA that is important for Life Support Systems (GoS 1999; Komoo 1998). The evaluation of impacts of development in these areas should be within the framework of natural heritage value, risk associated with various hazards and its value as a life support system. Using this approach, an ESA is categorised based on the perspective of its value and its function in the overall ecosystem.

ESA of Heritage Value is defined as an area that has historical, cultural or scientific value. Examples include historical or archaeological sites, areas with high biological and geological diversity, unique landscapes and sites of importance for education and research. Further subdivision of this ESA can be based on an assessment of its status as local, state, national or world-class heritage.

ESA Associated with Hazards is defined as areas that are associated with high risks of natural or man-made hazards. Examples include areas with problematic ground conditions for infrastructure development, areas that are prone to flooding, landslides, subsidence and erosions. A majority of these sites require careful planning and detailed site investigation to avoid the occurrence of human induced hazards. Included in this category are high risk areas associated with past development such as former industrial sites, mining areas and dumpsites that may be potentially hazardous to the community, should such areas be redeveloped.

ESA for Life Support Systems, which ensures the present and future well-being of society and other forms of life is not given emphasis in many of the ESA concepts that have been promoted both at the national and international levels. ESA for Life Support Systems should be identified and classified so that the quality of life for the future generation is not compromised due to uncontrolled usage of the State's resources. Examples of areas that come under this category are sources of clean water, energy, building material, food production, settlements, parks and recreational areas. The classification of an area under this category is subjective and should be guided by existing state and national policies and priorities on development, settlement, agriculture, energy, water, natural resources and tourism.

GEOSCIENCE INFORMATION FOR ESAs

Type of Information

Integrated geoscience information is required for ESAs. The identification of ESAs for Heritage requires geological information related to rocks, fossils and minerals, relict mines, hot springs, waterfalls and landscape of significant value for conservation purposes. The identification of ESAs for Life Support requires information on geological resources to meet the basic needs of society. These include mineral and rock resources for provision of shelter, energy resources, groundwater resources including associated recharge areas and subsurface space requirement for the future. ESAs for Risk of Hazards take into account highlands, coastal areas, wetlands, rivers and lakes that are prone to geological hazards such as landslides, slope failures, floods, erosion and subsidence. Geological input is also required to identify high-risk areas associated with past development such as former mining areas and dumpsites, to identify the hazards of redeveloping such areas. All this information should be integrated to identify ESAs and its degree of sensitivity from the perspective of geoscience (Komoo & Pereira 2005; Pereira *et al.* 2006).

Efforts are now required to develop guidelines for providing integrated geoscience information. This is to ensure that the geoscience information provided is relevant and sufficient in terms of substance and scale, for the appropriate activity within the planning process. In 2001, the Town and Country Planning Department and the Malaysian Institute of Planners published a Development Proposal Report Manual (Manual Laporan Cadangan Pemajuan), to strengthen the preparation of such reports by planners (DPRM 2001). The Manual takes into account the elements of the Selangor Policy on ESAs. Unfortunately, the geological aspects that should be included are not specified. Further guidelines are required for the preparation of geological reports that are suitable for the planner and the Development Proposal Report, in terms of scale and content. The Malaysian Institute of Planners has held a joint dialogue on this matter with the Institute of Geology Malaysia in 2003, in collaboration with the Minerals and Geoscience Department and LESTARI, UKM. Discussions are currently ongoing in the development of such guidelines.

Levels of Input

Within the Integrated ESA framework, areas will be classified for controlled management, environmental conservation and as buffer zones. The implementation of the Policy in Selangor will be monitored by a Development Coordination Committee on ESA that will define the types of development within the ESA. The State Government is presently in the process of preparing a detailed inventory of ESAs based on its degree of sensitivity. Upon completion of the inventory, an interim list of ESAs will be prepared for consultation and gazettement. The State of Selangor would implement ESA in two stages (GoS 1999, 2003). The first stage involves the implementation of Sectoral ESA in the short-term. Each agency is to identify ESA that are relevant to their sector, which could then be gazetted or managed based the degree of sensitivity, which would be determined. In the long-term, the State would develop and implement the concept of Integrated ESA to resolve the overlapping sectoral ESA problem and accommodate the dynamic nature of ESA, as a tool to operationalise sustainable development.

Development plans assist in the translation of socio-economic objectives into spatial and physical forms. Such development plans include the National Physical Plan, State Structure Plan, Local Plan and Special Area Plan. In terms of hierarchy, the National Physical Plan is the most macro while the Special Area Plan is relatively micro. The provision of integrated geoscience information for ESAs should be integrated into the process of formulating such development plans so that environmental aspects are considered in a more integrated manner. ESAs based on geoscience information should be identified and its degree of sensitivity determined and mapped, at scales that are appropriate for the various development plans.

The Planning Permission process ensures that all development projects are conducted as stipulated in the development plans and other guidelines. In order to ensure that ESA are managed effectively, reference to and consideration of ESAs should be made mandatory in the Planning Permission process (Pereira *et al.* 2006). In this context, integrated geoscience information is required at the project level and the information provided can also contribute to the preparation of a comprehensive Environmental Impact Assessment for development within ESAs.

Issues and Challenges

The translation of geological information for various purposes is very end-user specific. Currently, there is some confusion regarding the type of geological information required by different end-users. Certain quarters are under the impression that geological information provided for engineers is similar to that required by planners. This results in a situation where the planner is unable to understand the geological information provided and use it effectively for planning purposes.

The provision of geological information for planners should correspond to the two different aspects of the planning process in the country i.e. land use planning and development control, and take into account any additional policy instruments, where required. One example of an additional policy instrument is the Selangor Policy on

ESAs, which is embedded into the planning process of the state. Geological information for both aspects of the planning process would be in the form of generalised maps based on integrated geoscience information.

There is a need to strengthen integrated geological mapping for urban areas in term of its appropriateness for the use of planners, developers and decision-makers. In terms of integrated planning, the geological contribution lies in the identification of areas with potential mineral resources, water and groundwater resources, geohazard occurrences and unique geological or physical features. To aid the planner in the formulation of an appropriate development plan, all this information should be integrated in the form of maps to show the potential of land for various uses based on its degree of sensitivity. Such information includes open spaces and conservation sites, the vulnerability of areas to land degradation, the suitability of land for various types of development (including its carrying capacity), the risks involved in the development of these areas, the types of site investigation needed (and the level of detail required) in each terrain situation, and the relative costs of development in different terrain (Marker and McCall, 1990). The capacity of geoscientists has to be strengthened to provide such information. The provision of integrated geoscience information will enable the planner to incorporate these with socio-economic and other environmental considerations.

In Selangor, the provision of geological information for planning purposes is primarily in the form of direct communication between the Town and Country Planning Department and the JMG, particularly for development in highly sensitive areas. However, such communication is not the norm in all states, and hardly conducted at the Local Authority level. Due to human resource constraints, the JMG cannot provide its expertise to all Local Authorities and private developers. Therefore, clear guidelines need to be formulated to enable geologists in the private sector to support the need of developers and Local Authority in the preparation of proper development plans. Both the planning and geoscience profession should formulate the guidelines jointly. The guidelines will aid in the provision of appropriate geological information to Local Authorities for preparing structure and local plans, and to developers for preparing the Development Proposal Report (DPR) and related layouts.

The provision of complete and reliable information is imperative for informed decision-making. However, in practice, complete and accurate information takes time to compile depending on the size and complexity of the area, the current state of knowledge, budget availability and other factors. Thus, it is important to stress the limitation of any information that is submitted to the planner, developer or decision-maker, to avoid misinterpretation. This is particularly relevant to the estimation of risk involved, where scrupulous explanations are used to prevent untoward incidents such as fall of property values or withdrawal of loans. This brings to fore the issue of quality assurance geological reports. As the demand for geological information increases, the private sector will become increasingly involved. There will be a need to ensure that the quality of the reports are of the highest standards given its important contribution to the decision making process. Thus, it is imperative that the geoscientists, particularly in the private sector, are regulated to maintain a high level of professionalism. Currently, qualified geoscientists are registered with the Institute of Geology Malaysia. The Institute has played a significant role in promoting the Geologists Bill, which would require all geoscientists to register with the Board of Geologists so that they can be regulated. The Bill is now under consideration at the Ministry of Natural Resources and the Environment. Given the need and importance of geological information in the planning process of the country, it is urgent that the legislative measures are instituted to regulate the individuals and ensure that the quality of geoscience information is of the highest standards.

The Earth is dynamic and geological processes continue even after the development of an area. With time all developed areas will be impacted by geological processes. Buildings and infrastructure located on hazard prone areas may be damaged or slopes may fail along highways. Areas cleared of vegetation such as abandoned construction or quarry sites are prone to erosion that give rise to water pollution in the form of siltation after rainstorms. In order to ensure sustainable landuse, it is necessary that even after development of an area, further geoscience information is used for monitoring hazards, maintenance and remedial or rehabilitation works. This is particularly critical for built-up areas where the population is most vulnerable. Unfortunately, the requirement for post-development geoscience monitoring, particularly in hazard prone areas, is not legally instituted in the country. There are administrative measures taken but these are not very common and insufficient. As the country strives towards Vision 2020, this matter should be seriously looked, to ensure societal well-being and environmental protection.

CONCLUDING REMARKS

Malaysia has made the right move towards sustainable landuse by introducing legislative and administrative measures that require geological information to be considered in the landuse planning process. However, a lot more needs to be done to translate geoscience information for the use of planners, developers and decision-makers, in order to conduct effective integrated planning. The provision of geoscience information for planners should correspond to the two different aspects of the planning process in the country i.e. land use planning and development control, and take into account any additional policy instruments, for example the Selangor Policy on ESAs. There is a need to strengthen the capacity of geologists in integrated geoscience mapping for planning purposes so that the information provided can be used effectively. Guidelines on preparing geoscience reports should be formulated jointly by both the planning and geoscience profession to support the need of developers and Local Authorities in the preparation of proper development plans. And finally, given its significant contribution in the provision of complete and reliable information for informed decision-making, it is urgent that legislative measures are instituted to regulate geoscientists and ensure that the quality of geoscience information are of the highest standards.

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