

# Issues and Problems towards the Sustainable Dam Management System in Malaysia

Norlida Ismail

**Abstract**—Sustainable Dam Management Systems involve the whole aspect of management in order to overcome the management issues and problems in dam development. Dam management systems also help to reduce the reverse impact between dams, humans and the environment. Usually, developing dams affect humans and the environment in the form of changes in ecological, and socio-economic instead of humans and the environment having an impact on the dam in the form of urban development pressures, land use conflicts, climate change, earthquakes, landslides and the old dam structure. The main purpose of this study is to identify the issues and problems regarding sustainable dam management systems in Malaysia and to highlight the significant issues and problems in dam management systems in Malaysia. A qualitative research technique that involves fieldwork, map analysis, document analysis research and interviews was used. Results showed the significant issues and problems in dam management systems in Malaysia are more impacted by human activities to the dam water catchment area. The effects of humans on the dam exist such as garbage dumps, illicit stalls, and recreational use by urban residents near the dam. All of these problems happened because of land-use conflicts that occur in the dam catchment area. Implementation of laws related to land and development control is inconsistent with each other and thus becomes an issue. Dams in Malaysia are also vulnerable to environmental threats, such as climate change, earthquakes, landslides and old dam structure. Therefore, to ensure the success of a sustainable dam management system, Malaysia should seek to coordinate the function and the implementation of all laws and regulations relating to land use and activity control between the technical agencies.

**Index Terms**—Issues, problems, sustainable, dam management, Malaysia.

## I. INTRODUCTION

The relationship between dams, humans and the environment is a reverse interaction; they influence each other. Usually developing dams affect humans and the environment in the form of changes in ecological, and socio-economic. The preliminary study on dams concentrates more on the impact of dam development on humans and the environment. “Resettlement, or the involuntary and forced transfer of people, has already come to as among the most significant negative impacts of large water development projects such as dams” [1]. In addition to human resettlement, dams have a significant impact on the environment. For instance, “dams change flow regimes, sediment supply, and seed transport, one might expect

downstream reaches to have lower diversity” [2]. Dams have a major affect on rivers mainly through the changes in the timing, size, and low and high flows, finally producing a hydrology regime significantly differing with the pure impoundment natural flow regime [3]. “builds a dam on a river can block or delay moves upstream fish and will contribute decline and extinction species event. Especially the species which depend on longitudinal movement along the stream” [4]. Power dams release significant amounts of carbon dioxide and methane, and occasionally produce more of these greenhouse gases than power plants running on fossil fuels [5]. Occasionally dams are used to the diseases vector breeding. According to Goldsmith, dam reservoirs become a breeding medium for some disease vectors, such as mosquitoes for malaria and freshwater snails for schistosomiasis diseases [6]. Rivers deposit considerable debris in dams, resulting in the disruption of the natural spread pathways and resulting changes in river communities [7]. Sometimes, “dams debris the river of the continental United States and that their impact on river relief is several times greater than influences considered likely because of global climate change” [8]. Dams change rivers to reservoirs, with accompanying changes in erosion and sedimentation, chemistry and temperature, fauna and flora [9]. This occurs with a disastrous dam failure or a dam burst. After such events, researchers began focussing on the reasons for the dam’s failure. The biggest reason assisting in the failure of the dam is the environmental cause. The main impact of the environment on dams is events such as an earthquake. Earthquake analyses reveals that cracking of concrete limited to areas near the upstream and downstream faces of dams, especially in the upper parts and occasionally also near the heel, contribute significantly to dam breaks. Estimated cracking takes into consideration the assumed tensile strength [10], earthquake impelled sliding for different types of construction materials and earthquake shaking intensities [11]. The influence and impact of earthquakes on dams motivates researchers to study the dam design considered to be earthquake resistant where “the earthquake load relies on time variant ground acceleration applied in the upstream–downstream direction of the arch dam” [12]. In addition to earthquakes, landslide factors should also be included in the dam design and planning. It is important to have an understanding of geomorphic forms and the involvement of landslide-dam formation, stability and failure, part of which is inherent in the often passing nature of stream blockages in a coupled hill slope-valley [13]. Additional impact of the environment to the dam’s role is the climate change and extreme weather. The impact of climate change on stream temperatures below dams is more when the water released is from the reservoir surface rather than the deep water [14]. Weather also makes an impact on the dams. Flooding has caused several recent failures and

Manuscript received August 18, 2014; revised November 28, 2014.

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the resultant damage to dams [15]. Wind also causes dam damage as noted in a study conducted by Wang and Bowles. The authors note, “multiple dam breaches resulting from waves is resulting from wind. Waive overtopping studied for a theoretical long not strong earthy dam with an uneven crest” [16]. Third, the impact of the environment to dams is seen in impact on plants and animals. According to the Federal Emergency Management Agency (FEMA), embankment dams are vulnerable to damage from wildlife intrusions. Twenty-five states in U.S. stress that animals have caused or contributed to unsafe or outright failure of an embankment dam. Numerous animal species excavate burrows, tunnels, and den entrances for shelter, while other predatory animals will enlarge these by digging in search of prey [17]. Plant damage caused to dams occurs in the form of uprooted trees that caused large voids and lessened the side, decaying roots that create leach ate paths, problems of internal erosion, falling trees causing possible damage to spillways and outlet, and clogging the embankment under the drain [18]. Based on previous studies on dams, dams have a greater influence on the environment and humans. Continued studies also show the environmental and human causes to dams. Humans build dams to meet their needs. Dam development, has an impact on humans and the environment in the form of resettlement and river and ecology changes. Afterwards, the impacted environment will have an impact to the dam in the form of disaster (dam failure) and that impact will eventually return to humans. Human impact is defined in the form of land use conflict. Conflicts of land use lead to a variety of interferences and pollution problems at the dam water catchment area. Numerous dam watersheds in Australia have experienced problems of land use conflicts. For instance, Mungalup, Quinninup and Serpentine Dam Catchment Area, indicate that there are other land uses besides forest in the water catchment boundaries. There are tracks around the reservoir allowing full access to the water body. Recreational use will lead to potential risks on water quality includes breeding of pathogens, wildfire, the turbidity, nutrients and landfills. Mungalup dam water catchment area has a native title in the form of a land title that recognises the unique ties to some Aboriginals [19]-[21]. Based on the above discussion it is shown that between humans, dams and the environment, there is a reverse interaction where they are influencing each other (See Fig. 1). From the three types of reverse interactions between dams, humans and the environment, this study will indentify the most significant issues and problems in dam management in the context of Malaysia.

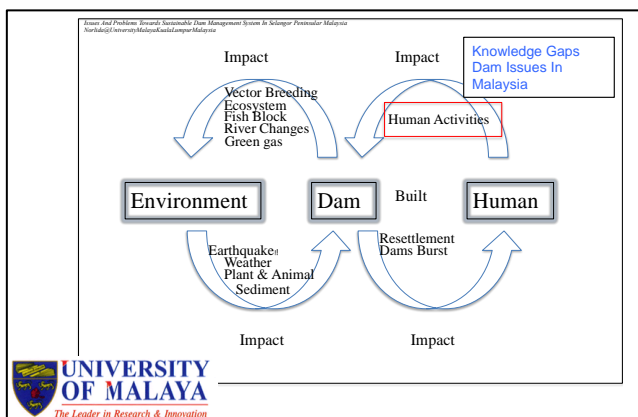


Fig. 1. Reverse interaction theory between dam, human and environment.

## II. METHODOLOGY

### A. Primary Data

Primary data was collected in a focus group discussion on the administration and enforcement of dam catchment area . The discussion was managed by the Selangor Water Management Authority (SWMA) and involved all relevant agencies including the dam operator. Data were also, collected via a personal interview with the Deputy Director of Selangor Water Management Authority (SWMA). The interview related to the interference occurring in the dam water catchment area and was conducted during a site visit. Results of the site visit helped digitize the interference location in the form of maps. Processed maps are overlaid with secondary data involving dam water catchment area border (GIS Data, from Selangor Water Management Authority) to analyze.

### B. Secondary Data

Secondary data were gathered from a literature review of official document reports from agencies involved, such as SWMA, about the interference issues happening in the dam water catchment area. This included the newspaper reports related to the arrest of an intruder in the catchment area of the dam, Water catchment border (GIS data from SWMA), built up area maps (GIS Data from Peninsular Malaysia, Town and Country Planning Department), information from the Malaysia Meteorology Department regarding climate change and earthquakes, and the Department of Irrigation and Drainage (DID) and the dam operator regarding the level of water in the dam.

## III. RESULTS

### A. Old Dam Structure

Most dams in Malaysia are the old dam structure. There are 72 dams in Malaysia, 15 of which are more than 50 years old; 29 dams are between 25 and 50 years old and 28 dams are under 25 years of age. According to Ir. Zainal Abidin bin Othman, about 60 percent of the dams are of earth fill type. Statistics show dam ages plotted to reflect scattering dam ages in the country. 20% of dams in Malaysia began to show recurring maintenance problems . It is also worth noting the safety review of the Bukit Merah Dam (1906) conducted in 1998. The Dam Safety Review of the Sungai Perak Hydroelectric scheme comprising the Temengor (1978) and Chenderoh (1930) dams conducted in May 2003. There are no public records to discover conducted maintenance on the rest of the older dams in the country. It is worth mentioning that collection is constrained due to a shortage of funds and personnel, this is also the case in developed countries such as the United States. As dams age, owners face major decisions about granting finite financial and human resources to ensure continued safety. Under normal conditions, a dam may be required to be inspected regularly. Inspections frequency is usually set by experienced engineers who consider all relevant causes and data and any trends in the behaviour of the particular dam following earlier inspections, reports and safety reviews [22].

### B. Earthquake

Currently earthquakes have become the main threat to

dam management in Malaysia. This issue needs urgent preventive action from the country. Earthquakes are common in the southeast Asia region. Indirectly, earthquakes influence the dam, especially old dams. An earthquake may be expected to result in a dam's failure. Cracks have occurred because of earthquakes at the Timah Tasoh Dam in Perlis, Malaysia. According to a report from the Malaysia Meteorology Department, from 7 to 17 April 2012 earthquakes frequency in this region, such as north and south Sumatera, Sulawesi Indonesia, range from 5.0 to 6.1 on Richter scale; the vibration can be felt in West and East Malaysia.

### C. Climate Change

Climate change is a global problem that also affects the function and safety of the dams in Malaysia. Extreme weather conditions such as heavy rainfall will influence the ability of the dams to accommodate the increase in water level. Often flash floods are caused by the release of water from dams in Malaysia. Klang Valley is experiencing frequent problems of flash floods caused by the overflow of the dam. According to the Malaysian Meteorological Department, La Nina is responsible for three of the wettest years on record (1984, 1988 and 1999) for East Malaysia. A La Nina event led rainfall levels to increase and flooding happened in Taman Sri Muda Shah Alam in December 1995, Kuching in 2003, Kuala Lumpur in 2005, Petra Jaya in 2000 and Sibul Sarawak in February 2009. Heavy rains led to the overflow of the dam. At the same time, urban development is causing a disruption in the flow of rivers and urban drainage systems. Finally, climate change brings the floods.

The influence of climate change on the dam also happened in dry weather. According to the Department of Irrigation and Drainage (DID), hot and dry weather causes water retention; as a result almost all major dams across the country are shrinking. Langat Dam went from the normal level of 220.96 meters to 217.10 meters, Klang Gate Dam from 94 meters to 90.26 meters, and Sungai Selangor Dam water levels went from 220 meters to 199.65 meters. According to the Executive Director of Puncak Niaga, operation and maintenance, Abdul Rashid Abdul Satar, raw water levels in three major dams in Selangor only lasted for 70 to 172 days following the hot and dry weather that hit the country since the beginning of February 2014. Klang Gates Dam only survived for 70 days, Langat Dam, 84 days and Tasik Subang Dam for 172 days. The reservoir area was affected by climate change. Extremely hot and dry weather has affected the decline in the dam water level.

### D. Urban Sprawl

Tasek Subang Dam is the only dam in Malaysia surrounded by an urban area from the development area in Kuala Selangor in the north, which is Bandar Baru Saujana. The University Technology Mara (UiTM) Puncak Alam is in the northwest, Meru town in the southwest, Denai Alam housing area in the southeast, and Alam Budiman, Perdana Height, and Taman Puncak Perdana in the south. Last, Taman Bukit Subang and Guthrie Corridor highways are in the east, refer to Fig. 2. Maps explain the development within 3 kilometres of the dam water catchment area border. Yellow dashed lines represent the surrounding area within 3 kilometres of the dam water catchment border. Red Lines

represent the dam water catchment area (border from Selangor Water Management Authority). Pink lines represent the built up area that has been revised in the Selangor State Plan.

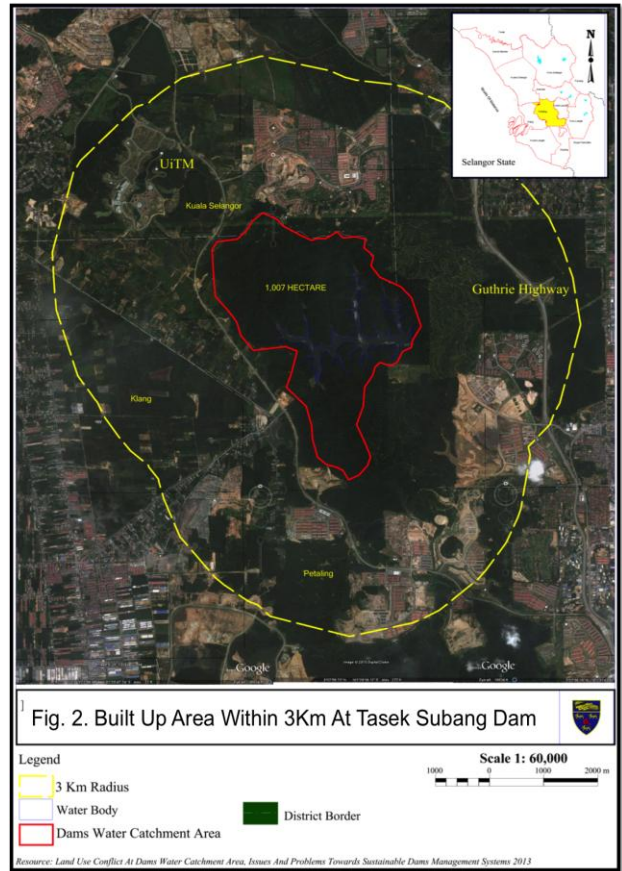


Fig. 2. Built up area within 3Km at Tasek Subang Dam.

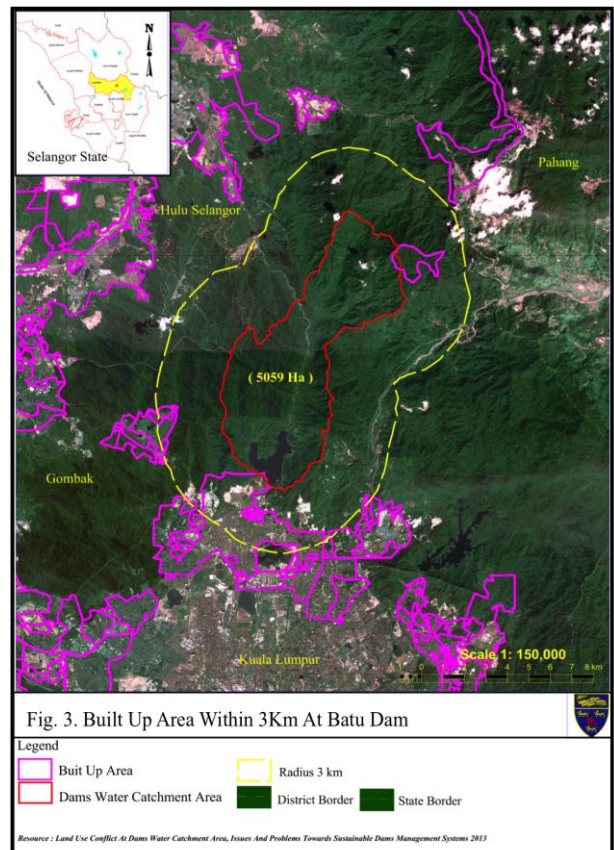


Fig. 3. Built up area within 3Km at Batu Dam.

Batu Dam area is near the development area of Selayang and Kuala Lumpur city, which is within 500 meter of the dam. Within 3 kilometres of the dam water catchment border, on the south, there has a comprehensive development area. The Kuala Lumpur and Bandar Baru selayang development is included in the area. Near the Batu Dam, Taman Jasa Utama, Taman Selayang Mulia, Taman Bukit Permata, and Taman Bandar Baru Selayang Phase 2A and 2B are near (see Fig. 3). To the south, west and east of Batu Dam there is only a forest reserve area.

A second dam near an urban area is Klang Gate Dam. South of the dam there are Taman Desa Malawati housing within 500 meters. To the northwest is Malaysia International Islamic University (UIAM). Karak Highway is on the west and the forest reserve area are on the northeast and southeast areas, seeing Fig. 4.

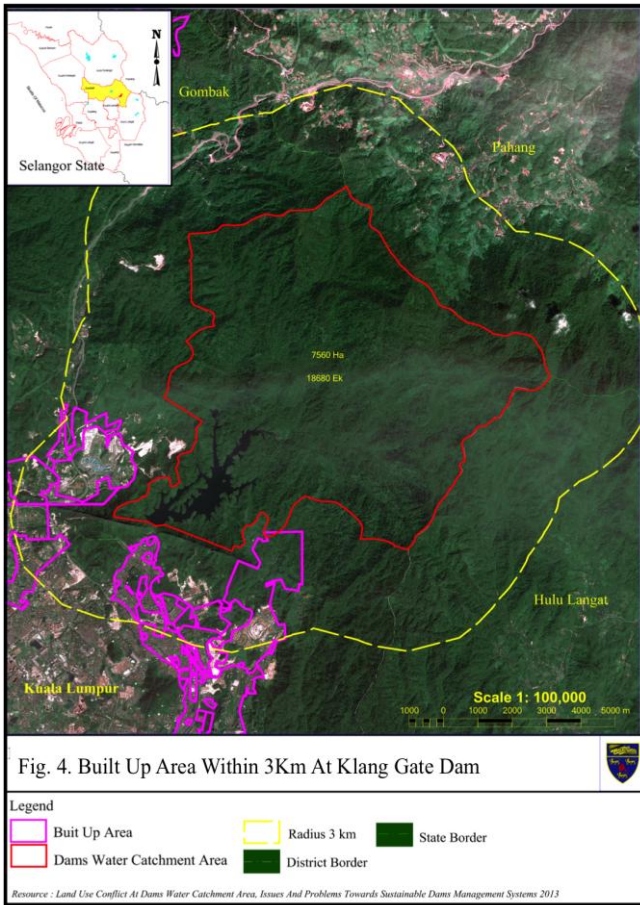


Fig. 4. Built up area within 3Km at Klang Gate Dam.

*E. Interference Issues at Dam Water Catchment Area*

Interference issues in the dam catchment area involve problems from fishing activity such as open small paths explored by anglers without permission, open campsites, land clearings, and garbage disposal. The dam catchment area often becomes a dumping ground. Also ecological nuisances occur in the dam area. There has also been a religious ceremony to release African catfish in the Sungai Selangor Lake dam. This ritual involves releasing fifty barrels of fish containing 100 fish in each barrel. Emissions from the African catfish in the dam lake disrupt the ecology and interfere with native fish species. It is feared that African catfish will monopolize the ecological chain of the natural lakes dam, seeing Fig. 5.

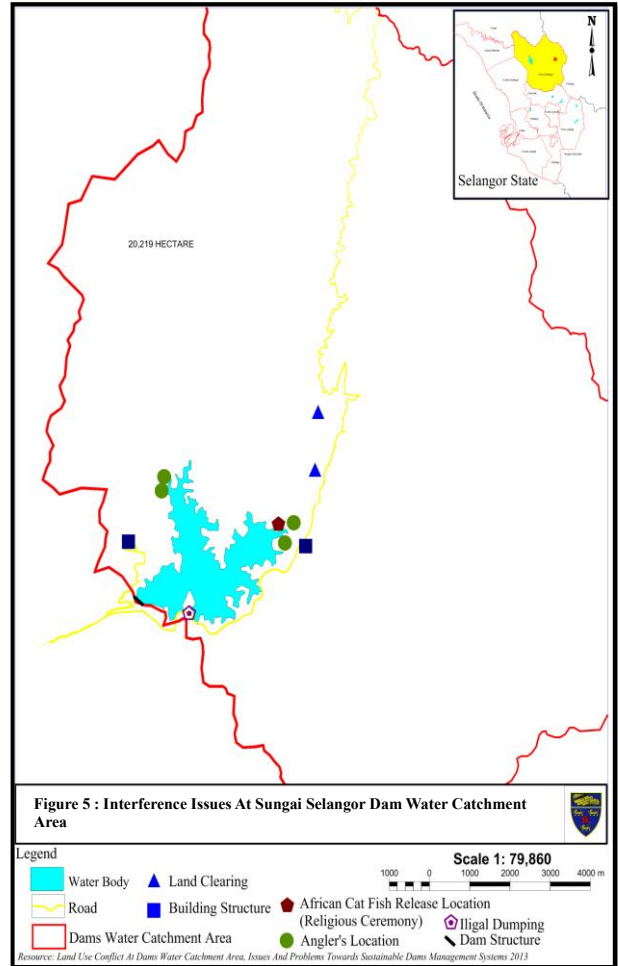


Fig. 5. Interference issues at Sungai Selangor Dam water catchment area.

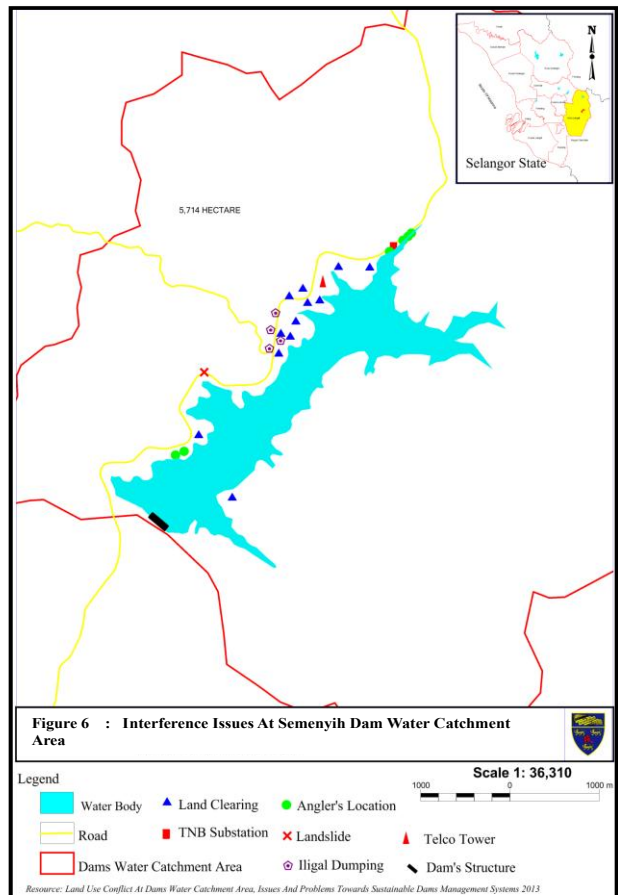


Fig. 6. Interference issues at Semenyih Dam water catchment area.

The dam catchment area is likewise facing a conflict of land use with an agricultural location. In Semenyih Dam area, there are two public roads that cross the water catchment. The roads are Sungai Lalang Road and Sungai Tekali Road. Because both are public roads, the area is often visited for recreational, especially fishing, use. This area is also confronting waste problems from fishing activity and became a site of rubbish. Field survey, found the waste deposited from night market business garbage and solid waste. Have many small areas explored for not identified purposes. The slope area around the dam is also prone to landslides. During the field survey, two locations for landslides were identified. The first landslide occurred outside the catchment area, but it is closest to the dam area. Another landslide occurred close to the dam water body at Sungai Lalang road near the main entrance of the dam, seeing Fig. 6.

#### IV. DISCUSSION

Malaysia should move forward to a sustainable dam management system. The World Commission Of Dams has seven strategic policies in dam and water management: (1) Gaining Public Acceptance; (2) Comprehensive Options Assessment; (3) Addressing Existing Dams; (4) Sustaining Rivers and Livelihoods; (5) Recognizing Entitlements and Sharing Benefits; (6) Ensuring Compliance; and (7) Sharing Rivers for Peace, Development and Security [23]. Sustainable dam management policy covers all dam management issues, especially a decrease and control of dam development and the impact to the environment, ecosystems and human life. Malaysian dams are facing the problems of water catchment interference, old dams, climate change, earthquakes and landslides because of noncompliance of sustainable dam management policy. From the issues happening in Malaysia dams, the human and environmental influences on the dam area are more significant. In this regard, humans and the environment must include, as main approaches in Malaysia, sustainable dam management policies and strategies plans in the future. Malaysian dams, also face challenges in existing dam management and administration, as Malaysia is a bit behind other countries regarding the rules of the Act and laws related to dam safety and management. Regarding reservoir management in Malaysia, there is more administration on dam structure. Dam management is not comprehensive and does not include water catchment management. Dams and the catchment areas are administered by different agencies that have no integrated roles and duties between them. This invites several problems, especially in the enforcement of nuisance and interference in the catchment areas. Compared to the United States and Australia, both countries have a special act on the safety of the dam, the Dam Safety Act. The Act has set-up a joint committee involving all the agencies involved in managing the dam, including the authority managing the water management. This committee is in charge of performing dam safety programs included in the Dam Safety Act. The committee is accountable for coordinating and providing guidelines and standards in dam management. The committee is lead by FEMA. In Malaysia, FEMA is equivalent to the National Security Council. Malaysia faces role conflict in land use control and

management in the dam water catchment area. The dam water catchment area is a protected area under state law. However, this protected area law contradicts the land use zoning under the Town and Country Planning Act 1976 as happened in numerous dams in the state of Selangor. Some area of dam water catchment zoned as agricultural, housing and roads. Selangor Water Management Authority is facing problems in enforcement, with some areas in dam catchment not fully zoned as forest areas. Enforcement problem becomes more complicated when several land owned by individuals in the dam water catchment area. This owned land rule is under the National Land Code 1965 and clearly shows significant weaknesses in the Malaysia dam management and administration as there is no integration and cooperation between the involved agencies. This is especially true when coordinating to fulfil the Act and the law in regards to land use control in watershed dams. The main cause of the lack of cooperation and integration between the involved agencies is not any specific provision of the Act on the safety of the dam and its catchment area. Malaysia is still a long way from achieving sustainable dam management. To move towards sustainable dam management in Malaysia, there remains many strategies and actions to be accomplished especially, in provision of the Act on dam safety and coordination of related laws and orders.

#### V. CONCLUSION

Dams in Malaysia are facing problems of urban areas approaching the dam area, old dam structures, landslides, climate change and earthquake issues. Urban areas are approaching with the interference issues such as illegal garbage dump, fishing, and illegal stalls. This problem is that of development pressures around the dam. Proximity to urban areas is not the main factor of interference issues in dam areas. The real threat is the population of nearby towns. Activity in this population is associated with the existence of a public road in the catchment area of the dam. Detailed studies should look at why the public litters around the dam. Theoretically, municipal areas will produce an, of waste. In 2008, the disposal of waste generated in the State of Selangor was 4,378 tonnes / day at 1,598,380 tons / year in which the average rate of swaste generated per person in the state of Selangor was 0.85 kg / day. Landfills may be unable to adapt to the daily waste produced by the urban population. The high cost of landfill charges in urban areas, makes contractors reduce the costs by littering waste in the forest area, which is easily accessible and watched less by the authority. Unfortunately, most of the public access areas in the forest area are close to the dam area. Prohibited fishing comes from the issues of recreational shortage in urban area. The urban population has chosen the reservoir area because of the polluted lakes and rivers in urban areas. All issues must be addressed immediately to ensure dams do not suffer from threat and danger in the future and also to avoid disaster. Dams in Malaysia are also experiencing the issues of the old dam structure, earthquakes, climate change and landslides. All issues and problems that are found in the management of the dams in Malaysia are barriers to the achievement of the implementation of a sustainable dam

management system. In particular, issues related to conflicts of land use and activities in the catchment area of the dam, which is caused by the inconsistency between the implementation of laws and regulations relating to land use control in the catchment area of the dam, should be addressed. Dam management in Malaysia should take the coordination of laws and regulation relating to land use and management of the dam between the relevant technical agencies as well as taking into account the human and environmental causes to dam safety in development planning and strategies. Issues and problems in dam management in Malaysia show the pattern of impact between dams, humans and the environment is constantly changing. The determination or fixing sustainable dam management strategies must take into account environmental changes and new issues involving climate change, landslides, earthquakes, development, urbanisation and human activities.

#### ACKNOWLEDGMENT

I would like to express my sincere gratitude to my supervisor Prof. Khairulmaini Osman Salleh for his constant support, guidance, encouragement and motivation. I also would like to express my great appreciation to the staff of the following organisations for enabling me to visit their offices to get the data and the interview session, especially En. Nor Zamri bin Sondor, Deputy Director of Selangor Water Management Authority. Finally, I would like to thank all of the staff from other agencies involved.

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