INTEGRATED WATER RESOURCES MANAGEMENT: A STUDY OF PUBLIC WILLINGNESS TO PARTICIPATE IN WATERSHED MANAGEMENT OF BATU KURAU, PERAK

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UNIVERSITI SAINS MALAYSIA

2018

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by

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Thesis submitted in fulfilment of the requirements
for the degree of
Master of Science

October 2018

ACKNOWLEDGEMENT

I'd like to express my gratitude to all who have contributed to the making of this thesis.

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LIST OF ABBREVIATIONS

ASM	Akademi Sains Malaysia
CBM	Community-based management
CBNRM	Community-based natural resources management
CCME	Canadian Council of Ministers of the Environment
CD	Conservation district
DEP	Department of Environmental Protection
DID	Department of Irrigation and Drainage
EA	Environmental awareness
EM	Environmental management
GWP	Global Water Partnership
GWP-TAC	Global Water Partnership Technical Advisory Committee
IRBM	Integrated river basin management
IWRM	Integrated water resources management
JFM	Joint forestry management
KeTTHA	Kementerian Tenaga, Teknologi Hijau dan Air
LUAS	Lembaga Urus Air Selangor
MoNRE	Ministry of Natural Resource and the Environment
MoSTI	Ministry of Science, Technology, and Innovation
NGO	Non-government organization
NRW	Non-revenue water
OPP	Outline Perspective Plan
PEB	Pro-environmental behavior
PEM	Participatory environmental management
PM	Participatory management
RBO	River basin organization
SPAN	Suruhanjaya Pengurusan Air Negara

UN	United Nations
UNDP	United Nations Development Programme
WHO	World Health Organisation
WM	Watershed management
WA	Watershed association
WPA	Watershed protection association
WRG	Water Resources Group
WRM	Water resources management
WTP	Willingness to participate

PENGURUSAN SUMBER AIR BERSEPADU: KAJIAN KESEDIAAN PENGLIBATAN AWAM DALAM PENGURUSAN KAWASAN TADAHAN AIR BATU KURAU, PERAK

ABSTRAK

Pengurusan sumber air (PSA) sedang mengalami perubahan di Malaysia. Kini terdapat anjakan kepada implementasi pengurusan sumber air bersepadu (PSAB) dalam perancangan PSA Malaysia untuk masa depan. Sebahagian daripada paradigma pengurusan ini ialah pengurusan kawasan tadahan air (PKTA) di mana kawasan tadahan air menjadi unit pengurusan, yakni asas PSA. Satu aspek dalam PKTA ialah penyertaan awam dalam proses membuat keputusan. Perkara ini bergantung kepada kesediaan penglibatan awam (KPA) dalam proses tersebut. Objektif kajian ini adalah untuk; 1) menilai KPA dalam PKTA dan 2) menilai faktor-faktor yang mungkin mempengaruhi KPA dalam PKTA dalam kalangan responden dari tiga penempatan di kawasan tadahan air (KTA) Batu Kurau. Batu Kurau dipilih sebagai lokasi kajian kerana kebergantungan populasi pada KTA itu untuk sumber airnya. Oleh itu, kajian potensi KPA responden demikian dalam PKTA dalam konteks ini adalah menarik. Untuk menjawab objektif kajian, suatu borang soal selidik dihasilkan terdiri daripada konstruk-konstruk faktor-faktor yang dikenalpasti daripada tinjauan literatur; 1) faktor sosioekonomi, 2) pengetahuan isu-isu KTA, 3) nilai-nilai dalam penggunaan sumber air, 4) kepuasan dengan PSA, 5) kepuasan dengan PKTA, dan 6) persepsi penglibatan dalam PKTA yang dianjurkan. Skor-skor para responden dalam KPA dan juga faktor-faktor seperti di atas dianalisa dalam analisis deskriptif bagi menjawab objektif pertama. ‘Chi-square cross tabulation’ (bagi faktor sosioekonomi) dan analisis korelasi (bagi faktor-faktor lain) digunakan bagi menjawab objektif kedua. Bancian dilakukan dalam tiga penempatan di Batu Kurau, di mana 302 responden (buat tahap keyakinan 95% menurut Krejcie & Morgan (1970)) disampel secara rawak. Keputusan menunjukkan bahawa; 1) dalam analisis deskriptif, 78.8% responden menunjukkan KPA dalam PKTA. Di samping itu, komuniti menunjukkan sikap positif terhadap penggunaan air harian dan pengetahuan sederhana

berkenaan isu-isu KTA. Mereka setuju bahawa penglibatan aktif dalam PKTA adalah perlu walaupun berpuas hati dalam aspek pengurusan air dan KTA oleh kerajaan. 2) Dalam 'chi-square cross tabulation', ditemui bahawa faktor sosioekonomi tidak memainkan peranan dalam menentukan KPA dalam PKTA bila seluruh populasi mendapat akses penuh kepada air. Di samping itu, berdasarkan analisis korelasi, faktor-faktor lain yang disebut; 1) pengetahuan isu-isu KTA, 2) nilai-nilai dalam penggunaan sumber air, 3) kepuasan dengan PSA, 4) kepuasan dengan PKTA, dan 5) persepsi penglibatan dalam PKTA yang dianjurkan mempunyai korelasi positif dengan KPA, dan dianjur supaya diberi perhatian dalam inisiatif bagi penglibatan awam secara efektif dalam PKTA. Sumbangan kajian adalah untuk menambah kepada literature dalam penglibatan awam dalam PSA di Malaysia dan juga memberi perspektif kepada pengaruh-pengaruh yang mungkin berperanan dalam penglibatan mereka. Oleh itu, juga diharapkan bahawa garis panduan ditetapkan untuk melibatkan awam secara berperingkat dalam apa-apa inisiatif PKTA di Batu Kurau.

INTEGRATED WATER RESOURCES MANAGEMENT: A STUDY OF PUBLIC WILLINGNESS TO PARTICIPATE IN WATERSHED MANAGEMENT OF BATU KURAU, PERAK

ABSTRACT

Water resources management (WRM) is undergoing changes in Malaysia. There is now a shift towards the implementation of Integrated Water Resources Management (IWRM) in future Malaysian WRM planning. Part of this management paradigm is watershed management, where the watershed becomes the management unit upon which WRM is based. One aspect of watershed management (WM) is the inclusion of the public in decision-making processes, however this would depend upon the willingness to participate, (WTP) of the public in such processes. The objective of this study was to; 1) assess public WTP in watershed management and 2) assess factors that could influence public WTP in watershed management in respondents from three villages in Batu Kurau watershed. Batu Kurau was chosen as location of study due to the local population's dependence on the watershed for their water resources. Thus, this context makes it interesting to evaluate the potential WTP of such respondents regarding involvement in WM of Batu Kurau. In order to answer the objectives, a questionnaire survey was developed consisting of constructs of factors determined from literature review; 1) socioeconomic factors, 2) knowledge of watershed issues, 3) values in water resources consumption, 4) satisfaction with water resources management, 5) satisfaction with watershed management, and 6) perception of involvement in watershed management. The scores of the respondents in WTP and also the above factors was analysed in descriptive analysis to answer the first objective. Chi-square cross-tabulation (for socioeconomic factors) and correlational analysis (for other factors) was used in order to answer the second objective. The survey was conducted in three villages in Batu Kurau, where 302 respondents (for 95% confidence level according to Krejcie & Morgan (1970)) were randomly sampled. The results show that; 1) in descriptive analysis, 78.8% of respondents showed WTP in WM. Also, the community shows a positive attitude towards

daily water consumption behaviour with moderate knowledge on watershed issues. However, they agree that active participation in today's watershed management is necessary despite satisfaction on government water & watershed management initiatives. 2) In chi-square cross-tabulation, socioeconomic factors do not play a role in determining WTP level in watershed management given full population access to water. Also, according to correlational analysis, the factors; 1) knowledge of watershed issues, 2) water consumption behaviour, 3) satisfaction with water resources management, 4) satisfaction with watershed management, and 5) perception of involvement in watershed management, positively correlate with WTP, and are suggested to be considered in any initiative to empower the public for their effective involvement in watershed management. The contribution of this research is to add to literature on public involvement in water resources management in Malaysia and also to provide insight into the influences behind their potential involvement. Thus, it is also hoped that guidelines be developed in order to gradually and effectively involve the public in future WM initiatives in Batu Kurau.

CHAPTER 1

INTRODUCTION

1.0 Overview

This chapter introduces public participation as an aspect of watershed management (WM) in order to supplement Integrated Water Resources Management (IWRM) governance principles. The first section provides a background of water resources issues and introduces IWRM as a water resources management (WRM) approach. The second section introduces WM and public participation as aspects of IWRM. The subsequent sections introduce willingness to participate (WTP) and the Malaysian context in WRM. The remaining sections present the problem statement, research aims and objectives, and the scope of study.

1.1 Redefining water resources management through integrated approach

Water-related issues globally continue to worsen. Given ever increasing demand, and diminishing or rather limited supply, the Earth will struggle to provide water for all its humans in the future (Wong, 2006).

In recent decades, the percentage increase in water use on a global scale has exceeded twice that of population growth (Rahman, 2014). This has led to more, and larger, regions in the world being subject to water stress where the current restricted rates of water use and consumption, let alone the desired rates, are unsustainable. Water demands and supplies are changing and are approaching disequilibrium, prone to issues like climate change, pollution, and overconsumption (Rahman, 2014). 2030 Water Resources Group predicts a 40% global water supply and demand gap by 2030 (2030 WRG, 2009). These demands are driven by population growth and higher per capita water consumption in the growing agricultural, domestic, and industrial, energy sectors (UNESCO, 2012).

Water is increasingly becoming a priority policy issue at the international level. The third United Nations World Water Development Report warns that extremely serious

consequences may result from the current inequitable, unsustainable use of water (UNESCO, 2012). Both economic development and security are placed at risk by poor water management (Biswas, 2008). Concerns for a global energy and food production crisis has recently begun to be accompanied by a concern about a looming global water crisis, given water's role in both sectors (Saravanan et al., 2009).

Even so, it is still indeed possible to provide for the world's water needs via a change in the management of its provision (Biswas & Tortajada, 2011). This view has been supported by research positing that mismanagement rather than physical scarcity of water resources as the major cause for current related issues (Biswas, 2008). For example, non-revenue water (NRW) water leaked in distribution pipelines to consumers was at 36.7% in 2014, while Penangites consume water on average 285 L/day, more than twice the recommended 100 L/day water consumption rate given by the World Health Organisation, WHO (Lai et al., 2017). Up till now, the emphasis has always been on supply management, tapping new resources to provide for increased demand. This however, is no longer sustainable. Demand will also need to be managed in the future, in order to ensure sustainable water provision in the future.

The new paradigm seems to be integrated management, an approach taking into account multiple factors including social, economic and environmental aspects related to water consumption. This approach includes balancing water supply and demand in these facets important in human life (Butler & Memon, 2005).

Water management generally, and in Malaysia, has been conducted in a sectoral manner, with multiple government departments catering to different aspects of water, such as water quality, quantity, provision to industry, agriculture, domestic usage, and floods and droughts (Chan, 2005; Soderbaum & Tortajada, 2011). This fractured approach is deemed diametrically opposed to water's relationship with nature and its resources, where it permeates its every aspect and thus links different types of human activity to each other (Mukhtarov, 2008).

Globally, this has also been the case, however a continuing shift towards an integrated approach to water resources management is taking place, known as integrated water resources management (IWRM). IWRM is defined as:

> a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP-TAC, 2000).

IWRM, first announced at the World Summit in Rio de Janeiro and Dublin in 1992, remains a broad term (Jønch-Clausen & Fugl, 2001), as seen in the framework as laid out by Global Water Partnership, GWP (2000). The GWP, in its own definition, is the organisation created to foster IWRM globally. Created in 1996 with support by the United Nations pursuant to the UN's goal of sustainable development, it commands a network consisting of 87 nations and thousands of institutional partnerships globally. Research in general thus cites GWP's definition in describing the IWRM framework. It is seen as follows:

- Economic efficiency usage of water: Water must be used with the highest efficiency due to its growing scarcity, vulnerability as a resource, and the limited financial resources to harness it.
- Equity: All humans' access to potable and enough water for daily life should be recognised as a universal right.
- Environmental and ecological sustainability: Water as a resource should be used in a manner that is sustainably supportive of ecosystems and natural environments in order to preserve its availability to future generations.

According to Savenije & van der Zaag (2002), there are four dimensions of IWRM to be considered in implementing the framework mentioned above:

1. Water resources - The water resources include all types of water including salt water and groundwater.

2. Water users - There are multiple categories of water consumers; domestic, industrial, agricultural, ecosystem, energy, navigational, recreational users are all included. Water users consist of consumptive and non-consumptive (often in-stream) users.
3. Spatial level – Issues in water resource are prone to arise at different levels; the international level, the national level, the province or district level and the local level. In addition to such administrative levels are the borders of hydrological systems such as river basins, sub-catchments and watersheds.

   Different decisions on water resources management belong at different levels, in other words, the concept of subsidiarity (decision making at the lowest appropriate level) needs to be a guiding principle in the development of IWRM. Interests and decisions at lower levels must be taken upward to be considered at higher administrative levels, including to the national and international levels. One useful element in this process is the inclusion of stakeholders in decision-making processes at all levels.
4. Timing of water availability – Water users and water resources themselves both possess particular temporal patterns. The temporal distribution of water resources is crucial (floods, droughts, base flows, flooding patterns) along the temporal distribution of users' water demands (peak demands, constant needs, agricultural patterns, etc.).

Since 1992, 82 percent of United Nations member countries are making changes to water laws based on integrated approaches recommended in Agenda 21 of the UN Conference on Environment and Development (UNEP, 2012). The UN groups countries according to the Human Development Index (HDI), the composite statistic of life expectancy, education, and income per capita indicators of a nation. Generally speaking, the changes made were observed across all groups of HDI (very high, high, medium and low HDI countries). Even so, the process of implementing policies is time-consuming; only 34 percent of these countries were at an advanced stage of implementing IWRM plans in 2012 (UNEP, 2012).

While this consisted primarily of high HDI countries, UNEP (2012) states that a nation's development stage was not an obstruction to better water resources management. Inculcating IWRM continues to be a priority as countries face challenges with implementation (e.g. Morin, 2009; Zarghami, 2011; Hadush, 2015) and water issues continue to increase in severity and complexity.

The changes mentioned prior occur in three aspects (GWP-TAC, 2004):

- An enabling legislative and policy environment that sets up and empowers;
- An appropriate institutional framework composed of a mixture of central—local, river-basin-specific, and public—private organizations that provides the governance arrangements for administering;
- A set of management instruments for gathering data and information, assessing resource levels and needs, and allocating resources for use.

Generally, in order to implement IWRM, the first aspect; law and policy must be created in order to help clarify and show guidelines for the implementation of IWRM in a nation. This is then followed by the formation of institutions to implement IWRM policy within the nation. Institutional organization may consist of a few levels; beginning with local (watershed-level), river basin level, and finally a central or national level. International-level co-operations may also exist, depending on the nature (if it occupies international boundaries) and size of the basin. The third aspect is regarding the management process itself; the institutions formed need to monitor and collect data on the health of the watershed or river basin under their responsibility, and may need to form management plans to remediate any issues based on the data collected.

Medema et al. (2008), however, argue that three components constitute a generic statement of the necessary governance conditions for implementing any natural resource management framework. However, implementation is further detailed in good practice

toolboxes for particular contexts (such as issues and local environment) by the Global Water Partnership (Medema et al., 2008).

Within this study's context, national IWRM implementation in Malaysia is still in planning stages. Malaysia has developed a new National Water Resources Policy 2012 to advocate IWRM application nationwide. Malaysia has thus made steps, in policy (see 2012 National Water Resources Policy), toward moving away from sectoral management towards an integrated approach to water resources management, in the form of IWRM. Naturally, a number of issues have been encountered in the efforts to adopt the approach. Such problems include lack of legislation, institutional framework, and the capacity to execute plans, as faced by most nations and regions seeking to implement IWRM (Abdullah *et al*., 2016).

1.2 Watershed management as a subset of IWRM

Watersheds are defined as biophysical systems that define the land surface that drains water and waterborne sediments, nutrients, and chemical constituents to a point in a stream channel or a river defined by topographic boundaries. Watersheds (see Figure 1.1) are the surface landscape systems that transform precipitation into water flows to streams and rivers, most of which reach the oceans (Brooks *et al*., 1991). Ridges and hills that separate two watersheds are called the drainage divide. The watershed consists of surface water--lakes, streams, reservoirs, and wetlands--and underlying ground water. Larger watersheds contain many smaller watersheds, forming nested watersheds. The outflow point is a guide for determining identifying its surrounding watershed; all of the land that drains water to the outflow point is the watershed for that outflow location.

Watersheds provide a number of ecosystem services to people, most importantly freshwater provision (Malinga et al., 2015). Within this context, watersheds are important because the streamflow and the water quality of a river are affected by factors, human-induced or otherwise, occurring in the land area "above" the river-outflow point. Watersheds consist of nested scales, hierarchical systems that function at different levels of organization from a local river valley to a larger, expansive region of water drainage (Thoms et al., 2007).

Thus, watersheds' boundaries can be drawn depending on problem definitions and management contexts (Cohen & Davidson, 2011).

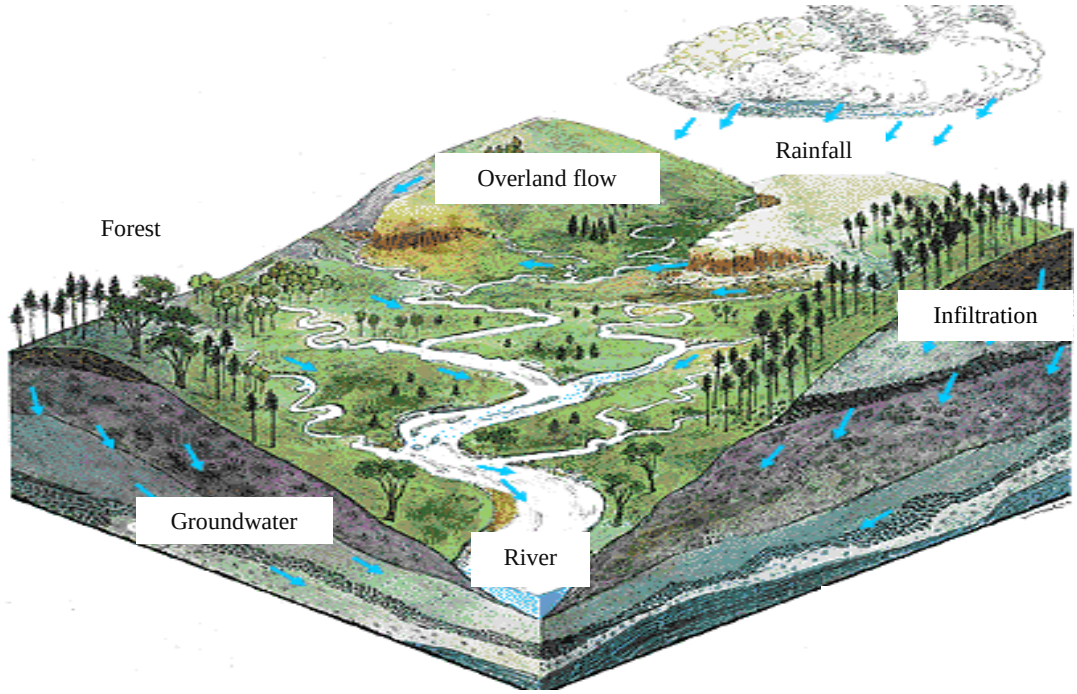


Figure 1.1 The multiple hydrogeological aspects of a watershed (DEP Montgomery County, n.d).

Watershed management can be defined as managing water resources within specific watersheds by knowing how much water is in the system, where it comes from, who is using it, how it is being contaminated and where it is ends up (Heathcote, 1998). Watershed management takes into consideration all the outside activities that can influence the quality and quantity of surface and groundwater (Heathcote, 1998). Watershed management is not a new management paradigm. It is considered to be a form of adaptive management, and is formed to tackle specific issues in particular watersheds such as pollution, inadequate supply, and degradation.

Effective watershed management should contain the following characteristics:

- Allows sustainable water supply;
- Maintains sufficient water quality standards;
- Allows sustainable economic development (Heathcote, 1998).

The three characteristics above exist as a dynamism between water supply and quality and economic development. Effective WM uses information collected on the conditions of the watershed in order to determine the level and location of development that will cause least loss of water supply and water quality (due to deforestation) while maintaining good quality of life for the locals via economic development.

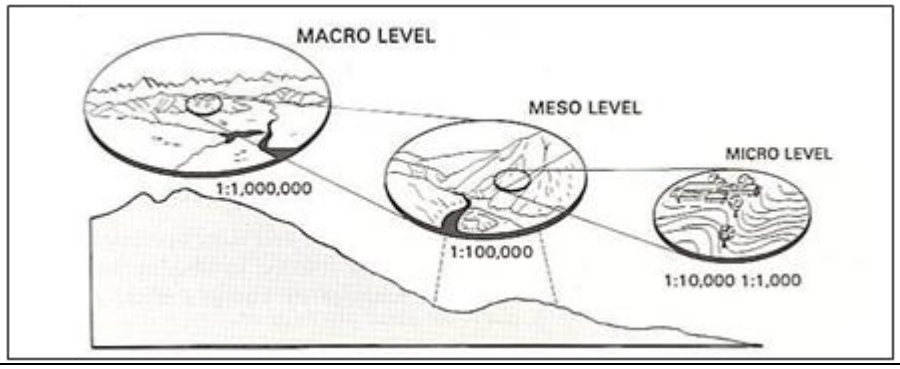
A WM plan typically takes into account a number of aspects:

- Water system uses and factors affecting water quality and uses;
- Understanding of watershed's hydrological regime;
- A model that can posit potential impacts produced by developments and uses in the watershed;
- Defined management objectives for the watershed;
- Public participation provision in determining objectives and management decisions (Pearse *et al*., 1985).

The WM approach is increasingly given attention globally as water issues continue to arise. It is opposed to centralised forms of water management determined by government jurisdictions, and instead moves focus to a watershed as basis of a plan of action, taking into account its problems as a whole and working out solutions to maintain its function (Roy et al. 2011). The questions of when WM approach is useful and what issues are best left to the watershed level need to be answered before proceeding. Cohen & Davidson (2011) state that WM can be suitable in instances cases where there is a hydrologically connected issue that guides the selection of boundary choice, and also in instances where the foundations of good water governance are in place in advance of scaling governance to the watershed. Such foundations include; a) the mandates of watershed organisations are clearly defined b) the scope of their powers and subsequent governance structure are clearly delineated , and c) they are properly resourced with expertise, equipment, human resources, and money (Nowlan & Bakker, 2010).

Water ecosystems form the basic unit of management in IWRM (van Hofwegen et a., 1999). Integrated river basin management (IRBM), a subset or sub-theme of IWRM, uses the river basin as its management unit. This is determined by river basin geography rather than political jurisdiction.

River basins can range vastly in size, as seen in Figure 1.2, however its management can be scaled according to needs and capabilities of a given dependent population or community (Roy et al, 2011). Following on from this, watershed management is a subsequent subset of IRBM, where the ecosystem is the primary concern as it services the local population's needs.



	Macro level	Meso level	Micro level
Natural system and resources	Part of a geographical zone such as a river basin or different ecological zones	Regional or local ecological resource system	Areas with relatively uniform ecological conditions
Mapping scale	>1:1,000,000	1:100,000 – 1:500,000	1:10,000 1:1,000
Mapping unit	Provinces	Land systems	Land units, land facets
Level of decision-making	National level Highest political decision-making, international agreements	Regional level Province, State, District, Territory	Local level and individual Village cooperative, farm, factory, forest, individual
IRBM organisation example	International commission	Inter-state basin authority	Local land and water management group
IRBM	International agreement	River basin management plan	Land and water management plan

Figure 1.2 Scales, mapping, decision-making, and organisation in IRBM (Hooper, 2005)

1.2.1 Public participation in watershed management

An important factor in watershed management is stakeholder participation, where issues are addressed via involvement of all parties concerned (Saravanan et al., 2009). The general public is included considering they rank as the most widespread consumer in a watershed. This follows on from the second dimension of IWRM, namely that of the water users, and the subsequent principle supporting it; equity. The right of humanity to water makes any individual a stakeholder under this management paradigm, and thus a place in participation in the management process of relevant local water resources (GWP-TAC, 2004).

Within a watershed management organization, participatory approaches to water management bring together water users who understand local water resources as well as physical and social circumstances can be more effective in resolving local water resource issues than regional and national government agencies (Bruns et al., 2005). Within this context, the value of public participation in watershed management is derived within their intimate knowledge of the local environment as well as the dependency they may have on the watershed. This presents a solid base from which to derive a suitable management plan, in co-operation with government agencies, in order to solve issues that may affect the very public themselves. This can occur in a river basin organization, formed involving the participation of all stakeholders of a particular river basin or watershed.

Public involvement at the watershed level has increased over time. For example, in China, an initiative involving two watersheds conducted IWRM over a 3-year duration and improved rainwater management, harvests, soil, crop, and pest management options, as well as income-producing small enterprises for the community (Wani et al., 2013). This produced significantly bigger yields, more diversified crops, and bigger family incomes.

The administration of watershed management thus presents an opportunity for bottom-up approaches in management, that is the inclusion of end-users in decision-making in WRM (Nowlan & Bakker, 2010). As public concern generally in the environment grows, so does

its concern to be involved in WRM. This is increasingly seen in local involvement in the management of natural sources of water resources, including monitoring and community-based management (Conrad & Hilchey, 2011).

1.3 Willingness to participate

Willingness to Participate (WTP) is an aspect measured within any public participation scheme or programs as a predictor of program success in terms of participation. Jennewein et al. (2015) defines as WTP as an individual's disposition towards contributing to future community-based management (CBM) initiatives. In this study, the definition is modified to mean WTP in WM initiatives.

Public willingness to participate in IWRM has been touched in some literature (Jennewein & Jones, 2016; Rault et al., 2013; Jingling et al., 2010; Wang et al., 2013). The studies all included measurement of public WTP in empirical research. Here, the overall consensus seems to be that in vulnerable watershed conditions (as in prone to environmental disruption due to human activity), the public is prone to either prioritize the environment or give it equal priority to economic development, taking the public's opinions into account can be beneficial to sustainable management of the watershed. Meaningful participation can increase the public's levels of satisfaction with the decision-making process. This would result in better implementation of planning decisions when considering that the public is the largest consumer of water resources and would need to comply with such decisions, for example. However, this cannot occur if the public does not portray WTP as this would mean there is no meaningful public participation. Thus, public WTP is an indicator of public participation potential in watershed management process.

1.4 The Malaysian context

Malaysia has not been without its share of problems over the years. Issues such as floods, pollution, and water resources demand have repeatedly plagued its people. Rivers in Malaysia, like in most countries, are important components of ecosystems and human

society. Over the years, a combination of low priority on the government agenda, public apathy, neglect, and poor management have however resulted in degraded rivers and their water quality (Chan, 2005). The country has developed economically swiftly over 40 the past years or so as the society has increasingly urbanised (Chan, 2005). Such urbanisation coupled with agricultural expansion and industrialization has adversely impacted rivers. The cost of degradation has been enough to negatively impact water supply in terms of quantity and quality for common water resource usage activities in irrigation, navigation, and recreation (Keizrul, 2002).

Water resource issues in Malaysia are mostly connected to water quality (Chan, 2012). Given that 97% of Malaysia's water supply comes from rivers, poor river water quality exacerbated by deforestation and water catchment deterioration is a major issue (Azhar, 2000; Sukereman et al., 2013). According to the UN Food and Agriculture Organization in 2010, 62.3% or about 20,456,000 ha of Malaysia is forested, of which only 8.8% (1,807,000 ha) is classified as primary forest, forests undisturbed by human activity (Chan, 2012). Forest disturbances by human activity have deteriorated water catchments, causing markedly increased sediment concentrations in the rivers (Mohamad, 1993). A combination of this and mismanagement, apathy, low priority on government agendas, insufficient funding, and poor enforcement of environment law has resulted in degraded river water quality (Chan, 2012).

Chan (2005, 2012) also mentions public involvement in the Malaysian setting as a factor in ensuring river health. Abdullah et al. (2016) identifies the need to involve the public as stakeholders in river basin management, particularly in aspects such as pollution control, and equitable water use. Thus, the benefits of involvement include awareness-raising, gaining acceptance of action plans and inculcation of local and expert knowledge in watershed management plans (Reed, 2008; Behmel, 2016). National IWRM implementation in Malaysia is still in planning stages. Malaysia has developed a new National Water Resources Policy to advocate IWRM application nationwide. With regard to public

involvement, the Policy has encouraged such involvement within the IWRM context, and has mentioned the potential involvement of environmental non-government organisations (ENGOs) as an example. However, the mechanism for such participation has not been detailed. In summary, the issues of water quality and quantity and watershed preservation are thus connected through watershed management, where stakeholders can play a role (Gottfried et al., 2014).

1.5 Problem statement

Malaysia has made steps, in policy (see 2012 National Water Resources Policy), toward moving away from sectoral management towards an integrated approach to water resources management, in the form of IWRM. Naturally, a number of issues have been encountered in the efforts to adopt the approach. Such problems include lack of legislation, institutional framework, and the capacity to execute plans, as faced by most nations and regions seeking to implement IWRM (Abdullah *et al*., 2016). Given the shift towards IWRM, an assessment must be made with regard to public willingness to participate (WTP) in water resources management.

Here, the issue with public participation in Malaysia is a lack of a proper space to inculcate meaningful input from the public in watershed management. Before advocating for such a provision, public WTP in the management process has to be proven. Here, such WTP needs to be understood in a local context in order to assess practicality of public participation. WTP is thus important in so such provision in IWRM is meaningful and credible.

While Malaysia has made moves to provide for the legislation and institutional support, the stakeholder participation to implement management practices is still lacking. Apart from this, Malaysian public awareness on their role in water resource management is still poor (Mokhtar *et al*. 2011; Lai *et al*., 2017). As the integrated approach requires full participation of all stakeholders, it is crucial that this aspect is managed in order to achieve goals. IRBM requires participation from all stakeholders to be truly integrated due to the

ecosystem- centric approach. This shift towards the 'bottom-up' approach would thus require willingness and cooperation from expected parties, from government to the common user.

1.6 Research questions

Given the problem statement made, a number of research questions arise:

1. Is the public willing to partake in management processes of geographically-relevant watersheds?
2. What are the factors influencing public willingness to partake in the participatory management process?

1.7 Research objectives

Following on from the research questions posed, the research objectives thus are:

1. To assess public willingness to participate in participatory management of geographically- relevant watersheds.
2. To assess factors that could influence public willingness to participate in participatory management process.

1.8 Research scope

This study of public willingness to participate (WTP) in watershed management (WM) falls under the research area of sustainable water management. This research is directed towards the assessment of public willingness to participate and the form in which it may be implemented in the paradigm of watershed management (which in turn falls under a Malaysian vision for IWRM). Here, the study identifies the factors involved in WTP in WM and assesses WTP level and the factors' correlation with WTP in respondents sampled in three villages in Batu Kurau watershed, Perak. The findings can hopefully aid insight into the potential for public involvement in watershed management under a changing water resources management paradigm in Malaysia.

1.9 Chapter summary

This chapter introduces the thesis. It began with an introduction to integrated water resources management, followed by presenting watershed management (WM) and public participation in WM. This was then followed by introducing willingness to participate (WTP), before presenting the Malaysian context in water resources management. The chapter climaxes with the problem statement, research questions, research objectives, and research scope.

1.10 Thesis outline

This thesis consists of five chapters. Chapter 1 provides the contextual background to this research, problem statement, research questions and objectives of this research. The chapter readies readers in terms of the study's aims. Chapter 2 reviews literature regarding watershed management and willingness to participate. Chapter 3 discusses the methodology undertaken in this study; data collection and data analysis approaches are outlined in this chapter. Chapter 4 presents the results and discussion of the study, while Chapter 5 presents the implication and conclusion of the study. Reference materials are listed accordingly at thesis' end.

CHAPTER 2

LITERATURE REVIEW

2.0 Overview

This chapter reviews the literature on the following topics; watershed management and willingness to participate.

2.1 Public participation in watershed management

Watershed management (WM) is a management paradigm in place in many regions in the world. In addition, public involvement within WM is also not new. Here, a number of case studies are presented in context of public involvement in WM and the outcomes of such involvement. WTP is also examined in a few examples in this section.

WM is not merely limited to developed nations. However, WM programs in such nations are most efficient examples of WM implementation. One example given here is that of Spain and another in Canada.

The European Water Framework Directive (EWFD) is an initiative to ensure acceptable quality and quantity of water within the water bodies managed under the directive (Jager et al., 2016). In pursuing this aim, hydrogeological management units based on spatial catchment area of rivers, known as River Basin Districts (RBDs), have been delineated replacing previous administrative and political boundaries (Jager et al., 2016). This is seen even at international level as river basins can span often nations' borders, where national representatives co-operate in management of the basins, also known as transboundary basins. Such RBDs are managed according to river basin management plans, which contain aims set for the river basin and are to be achieved within a stipulated timescale.

One example within the EWFD is in Spain. Spain is home to the Ebro River, where the Ebro River Basin Authority (ERBA) was formed to manage the Ebro River Basin (ERB) (Bielsa & Cazcarro, 2014). In terms of public involvement, the Authority represents both the public and government, with user communities represented in ERBA in order to manage water scarcity, the main issue in the Basin (Bielsa & Cazcarro, 2014). For example, the 2014 Ebro Basin Management Plan was formed via the participatory process, where comprehensive societal representation (over 120 meetings of 1,609 representatives from 1,205 different organizations) included citizen groups, municipalities, water utilities, irrigators, hydropower representatives, businesses, recreational users, environmentalists, and researchers. The deliberations resulted in proposed managed actions that have been placed within the plan, such as preserving and restoring the river environments, wealth generation via agriculture, and managing water scarcity.

The Canadian experience in watershed management is long. The Canadian experience in watershed management is long. It was adopted early in the 20th Century amid declining quality due to industrialisation (CCME, 2016).The 1909 Boundary Waters Treaty between Canada and the United States, and the Grand River Conservation Commission (GRCC) in Ontario (1932) are examples of legislation introducing watershed-based WRM (CCME, 2016).

Given that water resources are under Provincial control, IWM implementation is unique within these Provinces. IWM implementation in Canada is governed by mandates set by the Provincial government. These help set legislation and clear policy in outlining IWM. These mandates can differ between the Provinces. Overall however, mandates are focused on specific issues and watersheds rather than broad IWM acceptance. With regard to public involvement, some examples are given by province:

Ontario	Decision-making a combination of bottom-up and top-down processes generally, however the potable water source protection program is a top-down process. Ontario's Conservation Authorities deliver watershed-based programs for member municipalities including review of and comment on growth and development plans, zoning and

	bylaws, from the perspective of the watersheds. Conservation Authorities are also the responsible agencies supporting the local multi-stakeholder committees carrying out the provincial source water protection program, primarily in the southern portion of the province. The planning approach for source water protection is risk-based with a view to protecting human health.
Saskatchewan	Citizens are encouraged to participate as stakeholders. Saskatchewan Association of Watersheds is an umbrella organization for the Watershed Associations (WAs). WAs were formed by watershed stewardship groups to develop watershed plans. WAs are non-governmental organizations that receive funding from the Saskatchewan government for education, awareness and coordination of program delivery. The planning approach begins with solicitation of issues from stakeholders and prioritizing them.
Manitoba	Bottom-up process is observed, where local government collaborate with stakeholders in planning. The Watershed Planning Authority (WPA) plans IWM implementation. Watershed teams comprised of diverse stakeholder groups commit to provide technical information about the watershed and to meet during plan development. The province's Water Stewardship Fund, supports implementation for water quality purposes. Manitoba has established a Conservation Districts Commission to oversee watershed planning on a conservation district basis. These CDs thus implement the IWM plan
Prince Edward Island	Bottom-up process is observed, where local government collaborate with stakeholders in planning

WM in developing nations is also fast catching on. Water provision in developing nations is increasingly under stress, given that economic development and population growth (both strongest in developing nations), require ever-increasing consumption of water resources to support their growth. The examples discussed here are in the nation of Tanzania and Mekong river basins.

The Mekong river basin is also administered via IWRM approach. The basin has a management plan (MRC, 2009). Within the context of public involvement, deliberations can take place via roundtable discussion. Within the MRB management, the issue of scale of ecological system is important. While the higher level is the basin itself, watershed level organisations also exist to manage respective watersheds. Thus, the discussions are relevant to particular watershed contexts within the basin (MRC, 2009). For example, given Thailand's monsoon climate, meetings are organized to discuss how to improve water management and determine how much water villagers need during the dry season and how much they can share. Communities can consist of upstream and downstream communities,

thus the roundtable formed is aimed at addressing upstream and downstream water conflicts and is a dialogue space for communities both upstream and downstream to air their concerns, share knowledge and try to find amicable solutions to water-related problems. The roundtable has a watershed leader and has representation by several ethnic groups and government officials. With the help of officials, the upstream community were able to understand better the effects of their actions, the importance of protection of water upstream and the associated impacts downstream. Now the upstream communities are demonstrating a number of positive adaptive responses, including making greater efforts to conserve and protect forestlands, and respond to the management goals of government and lowland communities.

In addition to Mekong, Tanzania, in pursuing IWRM, made changes to its water management laws and institutional frameworks by formulating a National Water Policy (NAWAPO) and subsequently the Water Resources Management (WRM) Act (Kabogo et al., 2017). Three components of the new management framework are: the use of natural hydrological boundaries as units for management; the designation of an order for decision making on water allocation that prioritizes basic human and ecosystem water needs; and the encouragement of community participation in freshwater resources management. Institutionally, WRM now follows a nested approach, with the Tanzanian Ministry of Water operating at a national scale, nine basin water offices responsible for water allocation at a river basin scale, and formally recognized water users' associations as mechanisms for public participation at the catchment scale (Kabogo et al., 2017). To date, 93 water users' associations (WUAs) have been formed.

In one of the examples, WUAs have contributed to IWRM in the Wami/Ruvu in four main ways (Kabogo et al., 2017). The Wami/Ruvu Basin covers an area of about 66,820 km² just north of Dar es Salaam and drains to the Indian Ocean. The Wami/Ruvu Basin is an administrative designation created when the Wami/Ruvu Basin Water Board (WRBWB) was formed; the Wami and Ruvu are in fact two separate, but neighboring, hydrological systems.

The Wami/Ruvu Basin's human population is estimated at 5.4 million (2002 population census), and rivers are important sources of water supply for meeting human needs. For example, much of the water for Dar es Salaam, Tanzania's largest city, is drawn from the lower Ruvu River, as is water supply for other large cities like Morogoro or Bagamoyo. To date, at least 16 WUAs have been registered in the Wami/Ruvu Basin, following official processes established by the Tanzanian government. First, WUAs have helped with resolution of water-related conflicts, most commonly between upstream and downstream users, or between farmers and livestock keepers. The local presence of WUAs has been advantageous in conflict resolution, allowing for a better understanding of the history and the intricacies of conflicts than that typically possible for a basin-level institution. Second, WUAs have helped with building awareness in broad audiences of WRM and water-related legislation in Tanzania. The WUAs in the Wami/Ruvu are known to use brochures and posters, or even small plays where water-related scenarios are presented, to reach village level audiences. The WUA members have also been involved in national events in support of the BWB and as representatives of the basin. Third, WUAs have been of assistance in collection of water-use fees. Fee collection presents a perennial challenge for the Wami/Ruvu BWB, largely because of limited access to water users in remote areas of the basin. The WUAs' local presence allows more direct contact with these water users, and as an incentive for assistance in collection of fees, the Wami/Ruvu BWB recently began allocating 20% of collected fees to support WUA activities. Fourth, WUAs in the Wami/Ruvu Basin have been involved in conservation measures designed to protect water sources for the basin. Examples include reforestation or tree planting projects in headwater and riparian areas, delineation of areas of protection around water sources, and development of community water resources monitoring programs.

2.2 Willingness to participate

Willingness to Participate (WTP) is an aspect measured within any public participation scheme or programs as a predictor of program success in terms of participation. Jennewein et al. (2015) defines as WTP as an individual's disposition towards contributing

to future CBM initiatives. In this study, the definition is modified by replacing 'future CBM' with WM initiatives. WTP is often measured within a population quantitatively using surveys, along with a number of factors to predicted or hypothesized to influence WTP (Zanetell & Knuth, 2004; Jingling et al., 2010; Jennewein & Jones, 2016). WTP has not been studied well in literature. While, studies evaluate community participation and the processes and effects of such participation, there is not much study on what factors influence the public to participate in the first place.

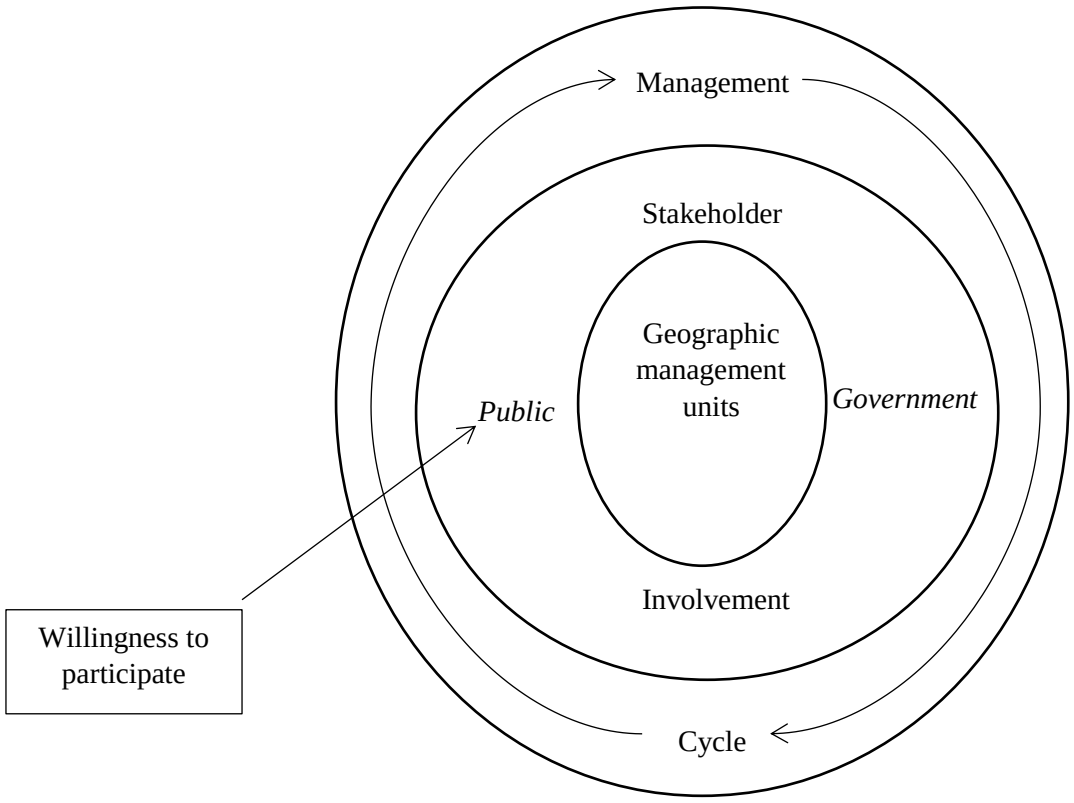


Figure 2.1 Willingness to participate within the context of the watershed management framework.

Within the Figure 2.3 above, WTP is shown to be the measurement of the public disposition to be involved in watershed management schemes. The presence of such willingness is thus requisite to public involvement as stakeholder in WM. Government agencies are would naturally be involved in WM. Geographic management units refer to

particular watershed of concern. WM is an iterative process, as the management cycles attest to, with planning and implementation reviewed according to developing issues in a watershed.

There have been a number of studies to assess WTP within a watershed management context. For example, Jennewein & Jones (2016) sought to identify the factors that influenced willingness to participate (WTP) in water resources management by looking to forestry and fishery management initiatives. The location of study was in the Trifinio region (a region consisting of land in three nations) of Central America, where IWRM is being formulated to protect against water resources degradation. Over the years, degradation has resulted from population increase, economic activities, and land use change. The economy consists mainly of agriculture and tourism. Jennewein & Jones (2016) postulated that influencing factors may be different in WRM due the differing physical natures of forestry and fishery products with water; forest and fishery resources are tangible by users, whereas perceptions on degrading water resources may be more difficult to develop. Four primary variables were initially hypothesized by them to influence individual WTP in CBM: sense of community, dependence on natural resources, level of concern regarding water resources, and socio-economic predictors including wealth, gender and education. Their results revealed that social and personal connections within communities, perceptions of water resource management, and wealth all influence WTP in CBM.

Jingling et al. (2010) evaluated WTP as an aspect of WRM effectiveness in the Haihe River Basin. Other indexes included environment knowledge, information circulation channel, water environment satisfaction, and participation rate. Haihe is one of the most important river basins in China, approximately 3,182,000 km^2 in size and consisting nearly 3.3% of the country's total land area. Jingling et al. (2010) mention that public participation in local WRM is low due to low government emphasis on public involvement. However, high WTP was shown where the local community had dependency on the river basin for economic income, such as via tourism and fishery. In response to this, the authors suggested

that public participation be introduced into the process of water environment protection and water-saving behaviour to improve the participation ability and level of the public. Following this, when public participation capacity in terms of experience and know-how has improved , the public will be encouraged to participate in the policy-making of WRM. Thus, the community with good participation awareness and ability can be selected as the exemplary community to expand the channel of public participation in WRM

Rault et al. (2013) also studied WTP in the Levant. Their study was conducted in the Amman Zarqa Basin in Jordan, Chekka Bay in Lebanon, the Tartous Mohafaza in Syria and Gökova Bay in Turkey to determine public knowledge of water management challenges and their attitude to public participation in river basin management. They discovered that the public were willing to participate in debates over water management and preferably through direct involvement with the objective to express their opinions. This was determined from querying the public on involvement types including voting on options, electing spokesperson, and voicing opinions. The authors state that this does not mean respondents seek power in decision-making, but a more democratic process when it comes to water resources management to reach solutions more acceptable by all.

Wang et al. (2013) studied public opinion on watershed management in Min River, Fujian, China. This consisted of public willingness to participate in watershed management, public awareness and understanding of environmental issues, and public perception of watershed management and general environmental management. Overall, they found that more than 95% of the respondents indicated that they had some interest in the watershed's environment. Almost half the respondents claimed to be greatly concerned about watershed health. More than 94% believed that they are a part of the watershed ecosystem, and the same proportion believed that their lifestyle, living habits, and customs contribute to the overall health of the watershed. More than 80% of the respondents were willing to be involved in any watershed decision making, specifically to contribute their views or knowledge or to express their concerns. Their findings also reflected that of Jingling et al.

(2010), where low government emphasis has resulted in low public participation. In addition, respondents felt the government was doing little to combat the perceived degraded conditions of the Min Watershed.

In summation, across the cases mentioned while WTP is present, appropriate channels for participation is lacking Considering that the public wants to either prioritize the environment or give it equal priority to economic development, taking the public's opinions into account can be beneficial to sustainable management of the watershed. For this reason, the dialogue between decision-makers and the general public should be sufficiently flexible to enable public participation and community involvement, particularly in the planning process for large-scale watershed projects. Meaningful participation can also increase the public's levels of satisfaction with the decision-making process. Thus, public awareness and participation are key processes that can contribute to sustainable watershed management.

2.3 Watershed management in Malaysia

This section consists of multiple relevant subsections which are divided and discussed accordingly for ease of understanding.

2.3.1 Managing Malaysian water

Water governance in general begins with a number of Federal Ministries given mandates on related respective issues. Three ministries are endowed with, and share, water related governing powers. They are divided under three components; water for people, water for food and water for environment These include KeTTHA (water supplies monitoring and supervision), MoNRE (monitoring and safeguarding of natural resources), the Health Ministry (drinking water safety), MoSTI (water research and development), and water planning and development (Local Governments) (Mohamad et al., 2008). Government agencies under the respective ministries then implement the given mandates as seen in Table 2.1.

Table 2.1 Government agencies involved in WRM

Management	Statute	Agencies
Water and river protection	Water Act 1920 Drainage Water Act 1954 Street, Drainage & Building Act 1974 Environmental Quality Act 1974 Local Government Act 1976 National Forestry Act 1984	Water Supply Dept. Dept. of Irrigation & Drainage Town & Country Planning Dept. Dept, of Environment Local Authority Forestry Dept.
Land and soil	Land Conservation Act 1960 National Land Code 1965 Town & Country Planning Act 1976	Local Authority Land Office Local Authority
Water Services	Water Services Industry Act 2007 National Water Services Industry Commission Act 2007	Water Services Industry Commission Ministry of Energy, Green Technology Water
Proposed compulsory rainwater harvesting	Not Yet Commissioned	Ministry of Housing & Local Government Local Planning Authority

Watershed management (WM) in Malaysia is under the purview of the Forestry Department, though a number of other agencies also play roles (Shamsuddin et al, 2017). Here, the state forestry departments prepare Management Plans for Water Catchment Forest (MPWCFs) to ensure resource sustainability. Water Catchment Forests (WCF) are also gazetted by the Forestry Department to function as water resource providers (Shamsuddin et al., 2017).

Even so, the State Governments retain jurisdiction over the management of water resources like water catchment areas and ground water (Pidgeon, 2012). In fact, matters related to rivers, land and forests remain under the exclusive jurisdiction of the State. Nevertheless, since Federal Government has the power over water-based projects in the State, from time to time, it has been formulating policies that will be implemented at the state level (Pidgeon, 2012). This is sometimes made with little support from the State Governments. For instance, when the Federal Government initiates the need to gazette certain water catchments areas within States, the State Governments have shown some reluctance since most of their incomes come from logging and industrial activities that take place at those