Emerging Issues Towards Sustainable River Basin Management in Cameron Highlands, Malaysia

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Abstract

Environmental problems arise when land is altered for economic activities. Normally, development itself is not the cause of the problems, but non-strategic planning in the area. Based on the results of interviews with local respondents, a number of critical water related problems were identified. Soil erosion was highlighted as the most serious issue by respondents at 68.9%. Degradation of water quality and degradation of freshwater ecosystems ranked second and third at 65.1% and 61.0% respectively; while water shortage was 50.0%. Problems associated with agricultural solid waste and water borne diseases were 46.2% and 23.6%.

In terms of the causes of water problems, the respondents gave seven areas. The highest score was haphazard planning and development (74.5%), followed by land erosion (68.9%) and degradation of water quality (65.1%). In addition, respondents mentioned water shortage (50.0%), a low level of awareness among the local community (61.3%), degradation of ecosystems (61.0%), and uncontrolled water abstraction upstream (54.7%) as being major causes.

With rapid urbanization in the Cameron Highlands, issues relating to water and other natural resources are expected to intensify and thus, need to be addressed in an integrated manner, such as through Integrated River Basin Management (IRBM). The study's findings provide an overview of water issues in the area and will be important in formulating IRBM strategies. However, the success of IRBM implementation requires political will and commitment from all stakeholders at all levels, especially local government. The recommendations put forward in this study are intended for policymakers and researchers of the River Basin Authority to further explore water related problems and to enable greater public participation in environmental and water issues.

*Key words***:** Integrated water resources management/ Issues and challenges/ Cameron Highlands

1. Introduction

Highland is extremely fragile and environmentally-sensitive area (Chan, 2006). However, development activities such as intensification of agriculture, over harvesting of resources and climate changes have put significant pressures on highland ecosystem. Land clearances for farming, housing, highways and dams have caused deforestation that lead to negative environmental problems. Issues such as soil erosion, landslides, sedimentation of rivers, water pollution, increasing temperatures and general environmental degradation, are threatening the sustainability of highland. Thus, an integrated approach for water resources management such as Integrated River Basin Management (IRBM) is important to manage this vital fresh water and its related resources (Dungamaro et al., 2003).

There are growing arguments that governance of water resources can be more effective with broader public participation. Inclusiveness, participation and transparency are elements required in achieving sustainable river basin management. In order to gain public participation, understanding the opinion from local community is important in order to achieve sustainable river basin development and should not be neglected

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from the planning process. Furthermore, dealing with water resources issues requires understanding of the community perception. Therefore, opinion survey is an essential step to gather the point of view from local community. With this regard, the purpose of this paper is to identify the water resources issues in Cameron Highlands by using local community survey practice.

2. Background of study area

Cameron Highlands which is situated in the state of Pahang has an estimated area of 712km^2 -. It is located on the Main Range between 4°20'N-4°37'N and 101°20'-101°36'E (DSM, 2005). Cameron Highlands shares its borders with the State of Kelantan and Perak, in the north and west respectively (see Figure 1). The economy of the highlands is largely driven by agricultural and tourism related activities. Cameron Highlands is one of the significant agricultural areas producing not only for domestic market but also for exportation. Cameron Highlands District is the headwater catchment for Pahang River (the longest river in Peninsular Malaysia) and Perak River. The three main rivers which drain Cameron Highlands, are Bertam, Telom and Lemoi. An estimated 5.8 million litres per day (MLD) of water is abstracted at several intake points from rivers originating from mountain forests in Cameron Highlands for drinking water supply. The average temperature recorded at Cameron Highlands is about 17.9°C while the mean minimum temperature is about 15.3°C. The mean maximum is around 22.4°C (MMD, 2005). The Meteorological Station at Cameron Highlands recorded 2972.3mm rainfall in 2007. The wettest period is from October to November with rainfall of about 372.3mm per month while the driest months are between January and February with about 118.3 mm rainfall per month.

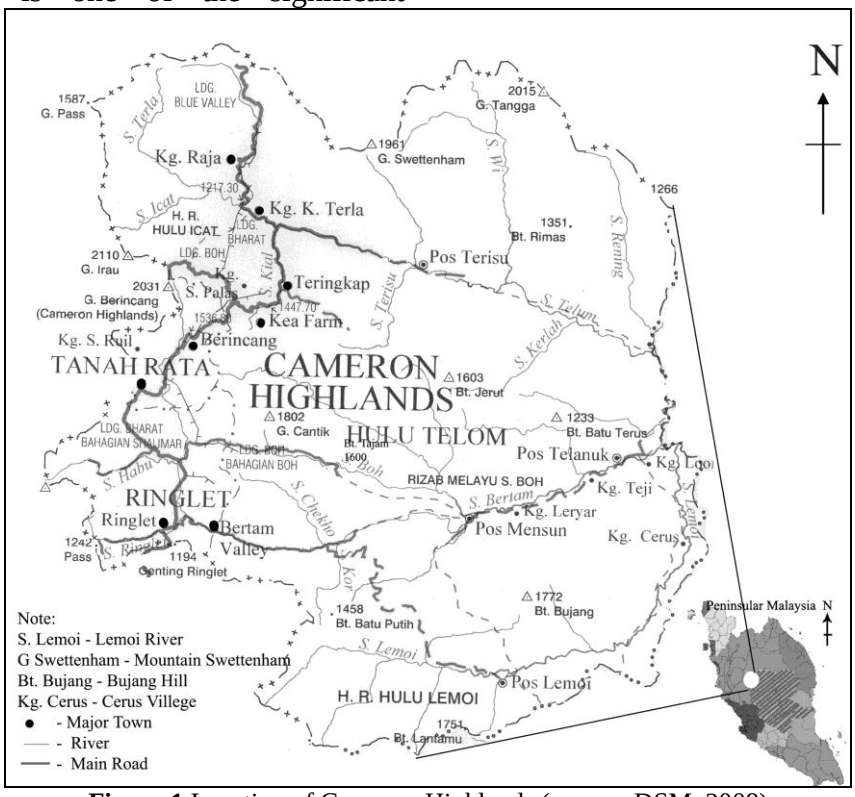

Figure 1 Location of Cameron Highlands (source: DSM, 2008)

3. Methodology

This study was conducted via four levels which consists of (i) literature review, (ii) field survey (iii) data analysis and synthesis, (iv) consultation and recommendation. Documents reviewed include national development plans and policies (e.g. Ninth Malaysia Plan 2006-2010, National Physical Plan 2006-2010, National Environmental Policy 2002, National Biodiversity Policy 1998, National Forestry Policy and National Agricultural Policy); local development plan (Pahang State Structure Plan); related technical agencies annual report (Department of Environment, Department of Irrigation and Drainage, Town and Country Planning Department and Forestry Department and Local Authorities) and provincial laws. These documents were reviewed based on the Integrated Water Resources Management components which were extracted from Integrated Water Resources Management Toolbox published by Global Water Partnership.

In order to gather more constructive inputs for this study, a formal interview session was conducted in 4-10 Julai 2008. A total of 106 respondents were interviewed; consisting of 68 male and 38 female respondents respectively. The background of the respondents was shown in Table 1. Thirty questions (11 relating to current water resources issues and causes, 9 relating to responsible parties and overcoming strategies, and 10 relating to the level of awareness of the local people) were posed for the purpose of case study evaluation.

Table 1 Classification of respondents

Terms	Descriptions	Numbers	Percentage	Total
Gender	Female	38	35.8	106
	Male	68	64.2	
Occupation	Farmers	26	24.5	106
	Hotel and restaurant workers	13	12.3	
	Others (e.g. Housewife, retiree factory and shop owner)	67	63.2	

3.1 Statistical Analysis Procedures

This study first applied the descriptive analysis on the data set to retrieve the score of issue and it can either be water problem or cause of the water problem. The score was calculated from the percentage of respondents who stated the water issue in Cameron Highlands. Eq. 1 showed the formula to calculate the score:

$$S_i = (a_i/b) \times 100 \qquad \text{eq. (1)}$$

Whereas, S_i = score of water issue $_i$

a_1= number of respondents who stated the water issue $_i$

b = number of respondents

Next, factor analysis was applied to seek the least number of factors which could account for common variance of a set of variables (water problems and its' causes). The Varimax rotation was chosen to produce a new set of factor. Each rotated factor loading for every variable is differentiated significantly to identify each variable with a single factor. This loading can be interpreted as a standardized regression coefficient, regressing the factor on the measures (DeCoster, 1998). Screen plot was used in this study to identify the number of extracted factors. The plot is initially curved and then developed into a linear relationship at which the curve straightens out and these are taken as the maximum

number of factor to be extracted (Child, 1979; Cattell, 1966). In deriving the factor loadings, this study adopted the Burt-bank formula to calculate the significant level of loading. This formula has the merit of allowing not only for the sample size but also for the number of tests correlated and the number of factors extracted up to and including the one under examination (Child, 1979). The following is the calculation for the significant value of loading:

Standard error of a loading = Standard error of a correlation $\sqrt{(n/ (n+1 – r))}$ eq.(2)

$= 0.206\sqrt{ (13/ (13+1-4))}$

$= 0.235$

Whereas, Standard error of a correlation = 0.206 at 0.05 significant level

r = number of extracted factors

n = number of variables

The mathematical and statistical computations in this study were performed using Microsoft Excel 2003 and SPSS 10.0 software.

4. Results

4.1 Descriptive analysis

Opinion survey data was gathered based on questionnaire through several field investigations in Cameron Highlands. The questionnaire consists of two parts namely (i) water problems (ii) causes of water problems. The descriptive analysis result was shown in Table 2.

A total of six water related problems were identified namely soil erosion, solid waste, water borne diseases, degradation of water quality, degradation of freshwater ecosystem and water supply shortage. Soil erosion was the most highlighted water problem by the respondents, scoring 68.9%. Degradation of water quality and ecosystem scores 65.1% and 61%, while water shortage scores 50%. Meanwhile, agricultural solid waste problem and water borne diseases score 46.2% and 23.6% respectively.

In term of causes, the respondents highlighted seven causes of water problems. There were legal land clearing, illegal legal land clearing, uncontrolled river water abstraction in upstream, poor solid waste management, low awareness of local community, haphazard planning and development, and administration mistake. The score of haphazard planning and development in Cameron Highlands is 74.5%, which was highest score among of water issues. Land erosion (68.9%) and degradation of water quality (65.1%) were ranked in second and third position among of water issues. Apart from that, more than 50% of the respondents expressed that low awareness of local community (61.3%), degradation of freshwater ecosystem (61%) and uncontrolled water abstraction on the upstream (54.7%) are the major problems in Cameron Highlands. The descriptive analysis provided the score for each variable. Nevertheless, it was not able to group the water problems with its causes. In order to reveal underlying information to this study, principle factor analysis was applied to reduce the dataset into factor matrix.

Table 2 Local perception on water resources issues in Cameron Highlands

Issues		Scores (%)	Ranked by respondents
What are the current water related problems in Cameron Highlands?	Land erosion	68.9	2
	Degradation of water quality	65.1	3
	Degradation of freshwater ecosystem	61.0	5
	Water shortage problem	50.0	7
	Agricultural solid waste	46.2	8
	Water borne diseases	23.6	11
What are the causes of these problems?	Haphazard planning and development	74.5	1
	Low awareness of local community	61.3	4
	Uncontrolled river water abstraction in upstream	54.7	6
	Administration mistake	37.0	9
	Poor solid waste management	34.0	10
	Illegal land clearing	21.7	12
	Legal land clearing	15.1	13

4.2 Principle factor analysis

This study demonstrated the application of principle factor analysis (PFA) on opinion survey data in order to group different variables with similar characteristics. Based on Eq. (2), factor loading with $\pm$ 0.235 was considered as a significant variable at 0.05 levels. The total number of extracted factor was decided by screen plot. Based on the screen plot (fig. 2), total four factors with the total variance of 51.24% were extracted in this study. Table 3 showed the rotated factor loadings for the four extracted factors.

Factor 1 was loaded with seven variables: poor solid waste management (0.538), low awareness of local community (0.459), water shortage (0.473), degradation of water quality (0.369), degradation of freshwater ecosystem (0.486), land erosion (0.439) and agricultural solid waste problem (0.856). This factor was highly contributed by solid waste related problem such as poor solid waste management and agricultural solid waste problem. Poor solid waste collection service and low awareness of local community are among the main causes of water quality and quantity problem in Cameron Highlands. Irresponsible disposal of agricultural waste by farmers into rivers has brought along negative effect to water resources such as water pollution and ecosystem deterioration. Likewise, low level of community awareness and knowledge on water resources conservation was observed during field investigation in Cameron Highlands. Impractical use of fertiliser by farmers and improper sanitation in farming estate were also observed and this further contributes to the water resource pollution in Cameron Highlands (Tan and Mokhtar, 2010). Based on this finding, Factor 1 was summarized as water environment degradation caused by illegal solid waste disposal and low awareness of community.

Factor 2 was loaded with seven variables: water supply shortages (-0.593), degradation of water quality (0.330), degradation of freshwater ecosystem (0.532), illegal land clearing (0.322), legal land clearing (0.304), uncontrolled river water abstraction in upstream (0.645), poor solid waste management (0.429) and haphazard planning and development (0.249). This factor was highly contributed by water quantity related problems. Uncontrolled river water abstraction by local farmers has caused the problem of insufficient raw water inflow to water treatment plant to produce clean water (Teoh, 2004). Ironically, excessive water abstraction by the agro-

farm is not monitored by the relevant government agencies effectively. Illegal water tapping was observed during the field investigation in Cameron Highlands. Moreover, the license fee imposed on water abstraction by farmer is a meagre RM10 (USD3) per year, thus resulting in water wastage by these users (Tan and Mokhtar, 2010). Low enforcement capacity by government agencies particularly in monitoring land clearing activities for agro-farm, illegal agricultural waste disposal and haphazard development was identified as the major cause of water quantity and quality problem. Based on this finding, Factor 2 was summarized as agricultural development leading to negative impacts on water resources such as water shortage and ecosystem deterioration.

Factor 3 was loaded with illegal land clearing (0.689), legal land clearing (0.658), poor solid waste management (0.368), haphazard planning and development (0.313) and land erosion (0.461). This factor was highly contributed by land development activities such as land clearing which consequently caused serious land erosion in Cameron Highlands. According to Malaysia Islands and Highlands Development Guideline, any forest lands situated 1,000 metres above the sea level is classified as Reserved Forest or Catchment Forest Land (MoNRE, 2005). Logging activities are prohibited in the area but substantial land clearing activities were observed during the field visit, particularly in respect of agricultural development in Cameron Highlands. Total 7 percent of the land; which is approximately about 72,000 ha of the total land area of Cameron Highlands has been allocated for agriculture; of which 51 percent have been used for vegetable cultivation while the remaining is dedicated to horticulture. Soil erosion and sediment transport ranging between 450,000 m^3- 600,000 m^3 occurred as a result of agricultural activities in the upstream of Cameron Highlands (Fortuin, 2006). Based on this finding, Factor 3 was summarized as land clearing activity leading to serious land erosion in Cameron Highlands.

Factor 4 was highly contributed by water borne diseases (0.686). In addition, it was also loaded with illegal land clearing (0.401), legal land clearing (0.438) and administration problem (0.619). Based on PFA result, the respondents showed that land clearing activity as the cause of human health problem (e.g waterborne diseases) in Cameron Highlands. Domestic effluent and organic fertilizer (e.g chicken manure) from agricultural area are the main source of biological pollution such as e-coli (Alley, 2000). Fertiliser residues are most likely to be washed into river during soil erosion process. In 2007, the concentration of total coliform was recorded at 21,000 MPN in Burung River (major water intake point) and 530, 000 MPN in Bertam River (DOE, 2009). In addition, the concentration of Nitrate was recorded at 4.38 mg/l in Ringlet Reservoirs in Cameron Highlands (DOE, 2009). Based on this finding, Factor 4 was summarised as human health due to e-coli bacterial pollution and land clearing activity in Cameron Highlands.

Factor 1, 2, 3 and 4 were summarised to four topics namely (i) water environment degradation caused by illegal solid waste disposal and low awareness of community, (ii) agricultural development leading to the degradation of water quality and quantity, (iii) land clearing activity leading serious land erosion (iv) human health due to by e-coli bacterial pollution and land clearing activity in Cameron Highlands.

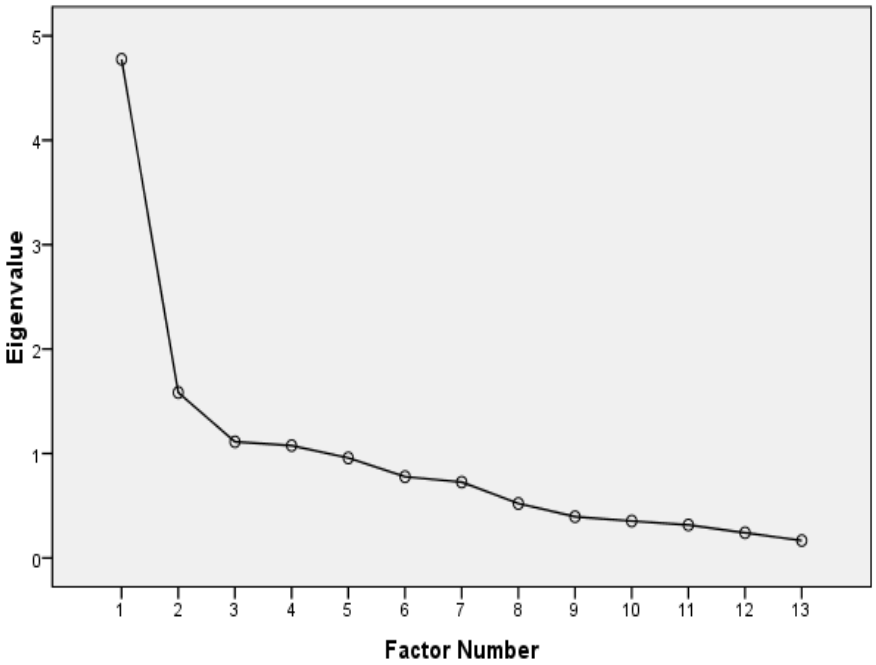

Figure 2 Screen plot of PFA

Table 3 Factors' loadings for the identified water related issues

	F1	F2	F3	F4
1. Land erosion	.439	-.038	.461	-.071
2. Agricultural solid waste	.856	.128	.142	.193
3. Water borne diseases	-.035	.125	.047	.686
4. Degradation of water quality	.369	.330	.097	.040
5. Water shortage	.473	.593	.058	.170
6. Degradation of freshwater ecosystem	.486	.532	.194	.079
7. Legal land clearing	.173	.322	.689	.401
8. Illegal land clearing	.184	.304	.658	.438
9. Uncontrolled river water abstraction in upstream	.065	.645	.188	.046
10. Poor solid waste management	.538	.429	.368	.177
11. Low awareness of local community	.459	.175	.141	.006
12. Haphazard planning and development	.155	.249	.313	-.183
13. Administration mistake	.189	-.031	.082	.619
% variance	**16.55**	**12.83**	**11.45**	**10.41**
% cumulative	**16.55**	**29.38**	**40.83**	**51.24**

5. Discussion and Recommendation

According to the Highland and Island Development guideline, any forest lands situated 1000 metres above the sea level is classified as Reserved Forest or Catchment Forest land. Logging activities are prohibited in such area (MoNRE, 2005). However, substantial land clearing activities were observed particularly in respect of agricultural development in Cameron Highlands.

According to Ekhwan et al. (2010), agricultural activities generate most of the eroded soils in Cameron Highlands. Activities like market gardening, floriculture, mixed agriculture, tea and orchard constitute more than 11,000 hectares of active land that produces silts to the water courses. Agricultural activities almost 36% of the total land use in Upper Telom and Upper Bertam catchments while constitute of more than 16% of the total land area in Cameron Highlands. Furthermore, most of the

farmers preferred to cultivate short term vegetable crops over soil conserving plants and these crops are normally harvested after 2-3 months period. Many of the annual vegetable crops have a short crop cycle so that farmers can harvest that particular type few times in a year. The soil is more sensitive to erosion during a crop cycle as it has no protection at all against raindrop impacts and consequently the farms are associated with high rates of soil erosion, runoff and nutrient loss (Fortuin, 2006; Hashim and Rahaman, 2006)

There is a lack of awareness and knowledge on water resources conservation observed in the local community of Cameron Highlands. Impractical use of fertiliser, improper sanitation and solid waste system in these farming areas further contribute to the water resource pollution in Cameron Highlands. Ironically, excessive water abstraction by the agro-farm is not monitored by the relevant government agencies. Licence fee for water abstraction by farmer is only RM10 per year, thus resulting in water wastage by the user. Low enforcement capacity by government agencies particularly in monitoring illegal land clearing for agro-farm and unplanned development has been identified as the major cause of water problems.

With rapid development in Cameron Highlands, problems and issues related to water and other resources needs to be addressed in an integrated and holistic manner such as through the Integrated River Basin Management (IRBM), which treats a river basin as a geographical unit (Jaspers, 2003). Apart from these, some recommendations are suggested for policy maker and researcher for further exploration as following:

Development of River Basin Authority

Some River Basin Authorities have demonstrated the best practice of water management in the world such as Murray Darling River Basin Commission, Australia and Mekong River Basin Commission. This is because different catchment areas may have different hydrological characteristics and functions. Formulation of the River Basin Authority may able to overcome the fragmented coordination mechanism, hence gathering all the key stakeholders under one roof to deal with the water resources issues.

Various stakeholders from different sectors and levels need to be involved in the management of the precious water resources in Cameron Highlands. The National Policy on the Environment, 2002 has clearly stated that integrated and effective coordination among stakeholders shall be enhanced in order to achieve efficient environmental management and protection (MOSTE, 2002). Fragmented and overlapping institutions will only bring along the obstacle to sustainable development on water resources (Tan and Mokhtar, 2009). Engagement of stakeholders from the district level could be facilitated through the creation of River Basin Management Committees that can manage and develop the vital water resources in a sustainable manner without scarifying the economy efficiency and social welfare. The main responsibility of the committee is to plan, implement and monitor the activities within the Cameron Highlands (Bertam River Basin).

Joint river basin management approach

Lack of enforcement capacity is not a new issue in Cameron Highlands. There are numerous regulations and agencies involved dealing with sectoral functions. However, there is lack of financial resources to carry out the functions. In

order to overcome this problem, the authority needs to increase boundary patrols as well as building up the partnership with the local communities to report illegal land clearing events. The joint management approach may suitable to be applied on the current management framework, which could build up the partnership easily with the local community. This idea is mainly derived from the administration framework of the National Parks in Australia (e.g. Kakudu National Park). The term 'joint management' is referring to the working partnership between all traditional owners and relevant aboriginal people (Australian Government, 2007).

Joint management approach is to involve the various stakeholders that work together to solve problems, share the decision-making responsibilities and exchange knowledge, skills and information among each other. This approach requires a full commitment from all level stakeholders (e.g. government, NGOs, CBOs and aboriginal owner to include the really local issues in to management plan and ensure the environmental sustainability in future. Nevertheless, characteristics of the river basin such as physical, economic, social, and well as the aboriginal cultural should be understood and this may be the key to achieve the sustainable objective. However, this only can be approached if stakeholders have their opportunities to involve in decision making of any management programs.

Public participation

Participatory approach for all stakeholders in the entire planning and management process is a key factor to ensure success and sustainability of water resources management in the long term. The second principle of Integrated Water Resources Management (IWRM) had been developed in the International Conference on Water and the Environment, which was held in Dublin in 1992 (GWP, 2004):

"Water Development and management should be based on a participatory approach"

It becomes a buzzword in every water management related conference and the gap between the theoretical participation framework and its implementation is the main concern of policy makers and researchers. The term "public participation" is found in a lot of publications on water resources management. However, who are the stakeholder that we should include into water management system? This approach is widely used to refer to some aspects of local populations in the design, implementation and evaluation of the project and plan (Brown and Wyckoff-Baird, 1992). Public participation has always been recognised as a practice of stakeholder engagement. According to the International Association for Public Participation (IAP2), public participation is made up of five aspects, which are Information, Consultation, Involvement, Collaboration and Empowerment (IPA2, 2007). These aspects have specific goal on public participation. Effective public engagement require suitable platform to ensure the management practices are relevant and in due consideration of the local requirements (Tan and Mokhtar, 2009). Shifting of management power from the government to community group must be done through prescribed power sharing agreement. However, effective public participation may require changes in institutional arrangement to accomplish the participation goal. It has a similar philosophy of community based management on natural resources which promotes stakeholder participation through power sharing and responsibility

between government and local resource users (McCay and Acheson, 1987).

Besides, engagement of different level of stakeholders is not achievable without an enabling environment. A clear provision from legislation is essential to create a strong partnership among the government, NGOs and local communities. In Cameron Highlands, the involvement from the local communities is lacking and they do not seem to be aware of their vital role in this matter. Therefore, appropriate public awareness campaigns and educations programmes are required in order to instil such awareness. Community based organizations (CBOs) can play the role of facilitator in such campaigns in Cameron Highlands.

6. Conclusion

As conclusion, this paper identified the water related issues by local opinion. With rapid urbanization in Cameron Highlands, problems related to water and other resources are expected to intensify. Cameron Highlands needs to be managed in an integrated and holistic manner such as through the Integrated River Basin Management (IRBM) which treats a river basin as a geographical unit. There is an immediate need to organize people for better water management within the context of IRBM in order to enhance the capacity and capability of stakeholder especially government agencies. However, this requires political will and commitment from all level of stakeholders especially the Local Government- Cameron Highlands District Council to ensure the success of IRBM implementation. Some recommendations are suggested for policy maker and researcher for further exploration such as Development of River Basin Authority and enabling environment for public participation. Further prompt to following research questions, and identified as future exploration:

- To what extent does the political will of Malaysian Government toward a joint management approach for river basin management?
- To what extent does local community accept the community based management approach?

7. Acknowledgement

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