

## Water Catchment Management: A Malaysian Perspective

<sup>1</sup>Mohamad Suhaily Yusri Che Ngah and <sup>1</sup>Zainudin Othman

<sup>1</sup>Geography Department, Sultan Idris Education University, Malaysia

**Abstract:** Water catchment areas sustain life on this planet by providing food and water for our communities, contribute substantially to our economy and provide the foundation for our rich and diverse natural environment. Evidence has emerged that our catchment systems are facing enormous and ongoing threats from human activities and thus reducing the quality of our life over the coming decades. The effect on the hydrological environment will significantly increase if no steps are taken to minimise the possible impact. Past efforts to minimise the effects have not been paralleled to the development plan, which has left the water issues to remain unresolved and sometimes causing conflicts between the public and the development plans by the government. Sustainable management of water catchment is one of the options that need to be considered to ensure all development activities will have an acceptable impact on both water yield and water quality. Amongst challenges in water catchment management is lack of human resource capabilities, financial constraints and socio-economic issues. Water resource management in most tropical countries including Malaysia depends on government decision and, sometimes the need for development is given priority over the importance of managing water resources. Duly needs for the protections of water resource areas by government are based on the need to prolong economic development without any compromise. Applying scientific approaches and knowledge will give a clearer and better perspective in the complexity of the system and try to minimise the impact of land-use change on hydrological behaviour. These elements need to be introduced sooner rather than later for a bright future in water-resource management in the tropics. Catchment management plans, policies and guidelines needed to be strengthened to facilitate these controls.

**Key words:** Water catchment management • Sustainable development • Hydrological characteristics  
• Environmental degradation

### INTRODUCTION

The physical characteristics and numerous natural resources available within a drainage basin influence human activities and decisions. When there is conflict between human and natural requirements for available resources in the environment, normally human needs are given priority to ensure development can take place. Throughout history, many settlements were situated close to water supply to allow a wide range of activities such as agriculture and industry mainly for the survival of humanities. Together with technological advancement, the rate of development has become so rapid resulting in more of our natural resources being exploited. It is certainly the case that the development is carried out within the context of human-use systems that are governed by available policies and strategies [1].

However, interaction between the human-use system and the physical system has more often resulted in degradation of natural environment, due to increasing pressure from development. Therefore, the water quantity and quality in reality are getting more and more depleted in tropical region [2].

The subject of water supply and land use activities including forest conversion has been frequently discussed at many forums and scientific meetings. Despite past experiences in managing water resources over more than four decades of watershed related research (since the 1960s), people still struggle with water shortages and environmental problems associated with land use practices [3]. This issue raises the conflict between getting enough clean water and the need for land activities (i.e. deforestation) to fulfil the economic development needs of tropical regions. This is because

most of the logging activities are located in hill forests, which largely comprise the headwater catchments for many river basins. With all these uncertainties, a detailed understanding of the hydrological role of the forest becomes necessary in order to manage watershed resources sustainably. It has long been recognized that forests play many important roles in the environment other than for timber or other economic activities. Therefore, the impacts of their removal or disturbance in land development activities on water and other natural resources have become a subject of great concern.

## ISSUES OF WATER CATCHMENT MANAGEMENT

Forested catchments in tropical countries provide multiple benefits related to water production, soil conservation, biodiversity and other downstream activities [4-7]. However, quantitative studies are very few. In Southeast Asia, the sustainability of tropical forests is increasingly coming under discussion, particularly with regard to the environmental effects of widespread forestland conversion to agricultural production, with the associated problems of soil erosion, downstream pollution and sedimentation, nutrient losses, altered runoff patterns and decreased biodiversity [8-12]. It is important to understand the interactions between ecosystem processes and local climate, geography and socio-economic conditions in Southeast Asia in order to implement the sustainable management of tropical headwater catchments [11]. Moreover, the hydrological, geomorphic, biological and geochemical processes and their inter-relationships tend to be less documented in the tropics. Hence, this provides more challenges for the authorities as they seek to manage their river catchments.

In modern times, rapid development programmes are taking place in many developing countries throughout the world. As a consequence, impermeable areas are increasing at a great pace and significantly influencing the hydrological regime of local river basins [13]. Understanding trends in land use change will provide essential information for land-use planning and sustainable water-resource management. To make the transition to more sustainable water management, most analysts recommend the management of water on river basins and increasing stakeholder participation in water management in order to make sure sustainable river basin management is achieved successfully [14,15].

Maria and Loise [16] stressed on the importance of river-basin management because any use of and

development related to the abstraction, supply and discharge of water will affect the health of the ecosystem particularly to the quantity and quality of the water environment. They also suggested that the management strategies for natural resource development would be more effective through implementation over the whole of the river basin, which involves a relation between water, land, vegetation and fauna. Meanwhile, Downs *et al.*, [17] suggested that river-basin management should have three potential attributes: it should be comprehensive (involving functional links between (e.g. water resources, water quality and flood protection), it should be integrated (involving purposeful overlap between these functions and an extended scope, e.g., land use); and it should be holistic (involving broad environmental/ecosystem goals and a pro-active vision for the basin - in effect a sequence moving towards 'stronger' sustainability). Good water management will provide water of acceptable quality for purposes ranging from supplying municipal water needs to maintaining the life cycles of fish and wildlife [18]. All of these suggestions are important especially for river managers or local authorities in order to minimise the environmental degradation due to land use change within a catchment.

In the context of Malaysia, the sustainable management of river catchment is one of the options that need to be considered to ensure all development activities will have an acceptable impact on both water yield and water quality. The issue of water degradation is not new in this country and this has particularly been evident on the west coast of peninsular Malaysia since 1970s where rivers are polluted by the agro-based industries, namely rubber factories and palm-oil mills [19]. Since urbanisation from 1970s, pollution has changed to heavy metal contamination due to factories being located alongside the riverbank. In certain catchments, it has been worsened by pollution from illegal pig farms and urban waste. Recently, many hillsides have been cleared for housing estates and thus causing accelerated erosion, enhanced flooding and increased siltation. All these human activities have led to water disruptions and shortages of potable water. Many downstream urban areas are affected by flash flooding and resulting in serious damages and loss of properties due to inadequate drainage systems and stream blockages. Attempts to monitor and minimise issues related to water quality were started by the establishment of the Environment Quality Act (1974), which has been enforced by the Department of Environment (DOE) in 1975.

## **LEGISLATION AND IMPLEMENTATION**

Efforts initiated by Britain more than a century ago give an indication that problems with water resources have been present since then. Although the problems have deteriorated over time, the intensity of human activities near water catchment is still increasing. As Malaysia Vision 2020 comes closer, more economic plans will be implemented with most of them located within the river catchments. The effects on the hydrological environment will significantly increase if no steps are taken to minimise the possible impact. From past experience, efforts to minimise the effect have not been paralleled to the development plan, which has left the water issues to remain dominant and sometimes, causing conflicts between the public, the developer and the government. To date, more than 45 Acts on environmental legislation relating to water or rivers have been implemented. Arguably, this should be enough to monitor and control any environmental issues. However, there have been conflicts between agencies where responsibilities have overlapped. Sometimes, the laws have been too technical resulting in lack of implementation. Moreover, lack of manpower and low enforcement has made things uneasy to handle [19]. To add to this limitation, the level of awareness amongst developers and the public is still low. Meanwhile, the implementation of environmental studies in schools has not been properly structured into the main curriculum.

The importance of integrated and sustainable management has been recognised internationally for more than a decade. The Rio Declaration on Environment and Development indicated the needs for 'global partnership' at various management levels in order to protect the environment and our resources in a sustainable way [20]. Through Agenda 21, they stressed that integrated management is a practical way to minimise conflicts, to move towards effective and efficient use of land and water resources and to achieve the objectives of sustainable management [21]. It sounds promising, but, as stated by Buller [22] and Margerum [23], the implementation of this concept at the local level can be extremely challenging and this scenario has been experienced by river managers in Malaysia. For instance, local authorities normally make decisions on land use planning and water management based on a short-term basis, which may cause greater problems in the long term [24].

## **MANAGING THE ISSUES**

The need for proper management in catchments is not just about protection of the biological or physical components of an area from degradation, but it also involves many aspects related to health, economy and future needs [24]. The importance of this element was stressed by the World Commission on Environmental and Development in 1987 by introducing the concept of sustainable development where all aspects of land development have to be included in environmental considerations. This concept is vital for developing countries like Malaysia as they are vulnerable to the massive current economic plan to fulfil their public needs. In developing countries, it is common to put consideration on development at the forefront of any economic decision making, conservation issues always coming second. This 'culture' should be reviewed. This sustainable concept proposes new strategies and management plans which require a change in attitude and outlook of policy makers, environmental managers, local authorities and politicians, which is believed to bring a new dimension in managing the priceless natural resources [19].

The integrated management concept is widely used in water resources and environmental communities for sustainability [23,25]. To understand and manage the hydrological characteristics in developing countries requires integration between cultures, societies, economics and the government. It also needs collaboration and participation of various individuals and organisations that have an authority in the management of water resources [26]. To achieve integrated water management, conflict between various stakeholders must be avoided [27]. The awareness should be strengthened and cooperation and willingness amongst the public and every institution are vital for the implementation of sustainable development and if sufficient effort is made by the various parties and agencies, it is expected that effectiveness will show sooner rather than later.

All bodies should have the same objective in order to implement the concept of sustainable development, which could give benefit to ecosystems and the public. Any study about the importance of forests and water especially water movement through the physical catchment should be comprehensive and balanced. Some countries may have difficulties due to lack of fund or expertise and they should not be blamed according to

that problem. Therefore, effort and help from others are important to make sure they are also able to minimise the impact of land use change on water relations. Integrated management considers the interrelation between the natural system (water system), the social economic system (water users) and the administrative system (water management); where sustainable management addresses the long-term availability of the resource so that both present and future needs are fulfilled [28,24].

Water managers normally have little influence in the planning of land uses and water resources within the catchment. In spite of their warnings, new urban areas are still constructed on floodplains, while intensive industrial activities and agriculture continue to pollute groundwater resources and runoff. Integrated water management needs to be conducted on the basis of water catchments rather than political boundaries, in order to reduce conflict between local authorities [29]. Reducing the scope of management to each drainage basin will help for easy management. The political and social issues between upland and lowland communities or between neighbouring districts or states could be avoided in dealing with water scarcity. Every authority has a responsibility and sometimes collective consensus is required. However, it is widely recognised that the effective protection of water resources cannot be achieved by institutions of water management alone. Newson, [3] indicated that there exists a policy gap between water-management planning and land use planning, which leads to the lack of implementation. These two elements need to be bridged to make water management more effective. At the same time, the water managers need to look beyond watercourses and take account all human activities within each river basin, which may have an impact on the availability and quality of water resources [30].

Water resource management in developing countries including Malaysia depends on the government decisions. Sometimes, the need for development is given priority over the importance of managing water resources. In a normal ecological condition, runoff from forested hill areas plays a significant role in supporting economic development and public activities further down the catchment. Duly needs for the protections of water resource areas by government are based on the need to prolong economic development without problems. Here, exists a conflict of interest. Maintaining or preserving the remote areas as a source for water supply is hard as

compared to land use changes when they come under pressure from economic plans. It is enough to say that the success of any concept of water resource sustainability depends on administrative, political and legal-framework implementation. It is stressed by Faniran [31] that there is need for political stability, sufficient manpower and ample economic resources for this approach to be successful. Greater attention should be paid to conflict over the protection of forested areas, implementation of soil conservation measures and the provision of water supplies.

Scientific studies based on drainage basins could bring along a lot of significant information, since it represents a proper example of an open physical system [19]. The drainage basin receives energy from the climate over the basin and losing it by output through runoff and sediment downstream. This open system emphasises adjustment and relation between form and process upon the multivariate character of the many physical phenomena including the influence of humans. The complex interactions between all components within a catchment show how all components are required to maintain equilibrium [26]. Naturally, the environment system can cope with minor changes in space and time, but not with major changes due to human activities and thus the environmental degradation occurs. Adding to this are the uncertainties of future current climate change, which may pose heavy demands on water resources. Implementation of a holistic approach and integrated management principles will be necessary to developed sustainable systems and prevent catastrophes. More research needs to be done to make sure water sources are made reliable.

## **CONCLUSION**

The need for water catchment management is well recognized in the Malaysia. To exclusively putting attention on integrated management in attempting to tackle the water resource problem is not the best solution. Instead, there is a need for scientific research with long term monitoring alongside the integrated management that could avoid any misinterpretation. The environmental and water resource issues is not just the responsibility of the government but must also be tackled by all citizens. The water resources legislations which introduce various powers and responsibilities for water resources management which includes the

management of catchments can be further facilitated through monitoring access and enforcement for non-compliances. Catchment management plans, policies and guidelines should be developed to facilitate these controls. Amongst the challenges in water catchment management is lack of human resources capabilities in catchment management, financial constraints and socio-economic issues associated with proposed catchment management measures. Applying scientific knowledge and approaches will make it possible to understand the complexity of the system and try to minimise the impact of land-use change on hydrological behaviour. These elements need to be strengthened sooner for a brighter future in water catchment management in this country.

## REFERENCES

1. Mohd Nor, D., 2000. Recent rethinking in water in yrvab areas and unvertaities in hydrological modeling. In: M.J. Jamaluddin, Abdul M.N. Rahim, H.S. Abdul Hadi and M. Ahmad Fariz, (eds.). Integrated drainage basin management and modeling, Centre for Graduate Studies, Universiti Kebangsaan Malaysia, pp: 14-26.
2. Bruijnzeel, L.A., 1998. Soil chemical changes after tropical forest disturbance and conversion: The hydrological perspectives. In: A. Schulte and D. Ruhiyat (eds). Soils of tropical forest ecosystems: characteristics, ecology and management, Springer Verlag, Berlin, pp: 45-61.
3. Newson, M., 1997. Land, Water and Development. Sustainable Management of River Basin Systems. 2<sup>nd</sup> Edition. Routledge, London, New York.
4. Hardter, R., Y.C. Woo and S.H. Ooi, 1997. Intensive plantation cropping, a source of sustainable food and energy production in the tropical rain forest areas in Southeast Asia. Forest Ecological Management, 93: 93-102.
5. Greer, K.A. and D.A. Stow, 2003. Vegetation type conversion in Los Penasquitos Lagoon: an examination of the role of watershed urbanisation. Environmental Management, 31(3): 489-503.
6. Lefroy, R.D.B., H.D. Bechstedt and M. Rais, 2000. Indicators for sustainable land management based on former surveys in Vietnam, Indonesia and Thailand. Agricultural Ecosystem Environment, 81: 137-146.
7. Ashton, M.S., C.V.S. Gunatilleke, B.M.P. Singhakumara and I.A.U.N. Gunatilleke, 2001. Restoration pathways for rain forest in southwest Sri Lanka: a review of concepts and models. Forest Ecology and Management, 154: 409-430.
8. Laurance, W.F., 1999. Reflections on the tropical deforestation crisis. Biological Conservation, 91: 109-117.
9. Cramb, R.A., J.N.M. Garcia, R.V. Gerrits and G.C. Saguiguit, 2000. Conservation farming projects in the Philippine uplands: rhetoric and reality. World Development, 28: 911-927.
10. Rasul, G. and G.B. Thapa, 2003. Shifting cultivation in the mountains of South and Southeast Asia: regional patterns and factors influencing the change. Land Degradation Development, 14: 495-508.
11. Bruijnzeel, L.A., 2004. Hydrological function of tropical forests: not seeing the soil for the trees? Agriculture, Ecosystems and Environment, 104: 185-228.
12. Tomich, T.P., K. Chomitz, H. Francisco, A. Izac, D. Murdiyarso, B.D. Ratner, D.E. Thomas and M. Van Noordwijk, 2004. Policy analysis and environmental problem at different scales: asking the right questions. Agriculture Ecosystem Environment, 104: 5-18.
13. Niemczynowicz, J., 1999. Urban hydrology and water management - present and future challenges. Urban Water, 1: 1-14.
14. Philippus, W., J.M. Douglas and D.L. Marna, 2003. Boundaries of consent: stakeholder representation in river basin management in Mexico and South Africa. World Development, 31: 797-812.
15. Wester, P., 2003. Boundaries of consent: Stakeholder representation in river basin management in Mexico and South Africa. World Development, 31: 797-812.
16. Maria, A. and S. Loise, 2003. River basin management in Namibia. Physic and Chemistry of the Earth, 28: 1055-1062.
17. Downs, P.W., K.J. Gregory and A. Brookes, 1991. How integrated is river basin management? Environmental Management, 15: 229-309.
18. Viessman, W.J.R. and M.J. Hammer, 1993. Water supply and pollution control. Fifth Edition. Harper Collin College Publishers, New York, USA.

19. Jamaluddin, M.J., 2000. Building a holistic and integrated drainage basin management system for environmental management. In: M.J. Jamaluddin, M.N. Abdul Rahim, H.S. Abdul Hadi and M. Ahmad Fariz, (eds.). Integrated drainage basin management and modelling, Centre for Graduate Studies. Universiti Kebangsaan Malaysia, pp: 1-13.
20. United Nations, 1992. Rio declaration on environment and development. Report on United Nations Conference on Environment and Development June, pp: 3-14.
21. United Nations, 1993. Earth Summit: Agenda 21, the United Nations Programme of Action from Rio, United Nations, New York.
22. Buller, H., 1996. Towards sustainable water management: catchment planning in France and Britain. *Land Use Policy*, 13: 289-302.
23. Margerum R.D. and B.P. Hooper, 2001. Integrated environmental management: improving implementation through leverage point mapping. *Society and Natural Resources*, 14: 1-19.
24. Carter, N., R.D. Kreutzwiser and R.C. De Loe, 2005. Closing the circle: linking land use planning and water management at the local level. *Land Use Policy*, 22: 115-127.
25. Braga, B.P.F., 2001. Integrated urban water resources management: a challenge into the 21<sup>st</sup> century. *Water Resources Development*, 17: 582-599.
26. Abdul Samad, H., 2000. Malaysian urbanization and the environment: sustainable urbanization in the new millennium. Centre for Graduate Studies. Universiti Kebangsaan Malaysia.
27. Dubash, N., M. Dupar and S. Kothari *et al.* 2001. A Watershed in Global Governance? An Independent assessment of World Commission on Dams. World Resources Institute.
28. White, G.F., 1998. Reflections on the 50-year international search for integrated water management. *Water Policy*, 1: 21-27.
29. Murdiyarso, D., 2005. Water resources management policy responses to land cover change in South East Asian river basins. In: M. Bonell and L.A. Bruijnzeel, (Eds.), 2005. Forest, water and people in the humid tropics; past, present and future hydrological research for integrated land and water management, Paris. Cambridge University Press, UNESCO and Cambridge, pp: 121-133.
30. Moss, T., 2004. The governance of land use in river basins: prospects for overcoming problems of institutional interplay with the EU Water Framework Directive. *Land Use Policy*, 21: 85-94.
31. Faniran, A., 1980. On the definition of planning regions: the case for river basins in developing countries. *Singapore J. Tropical Geography*, 1: 9-15.
00. Margerum, R.D., 2001. Organizational commitment to integrated and collaborative management: matching strategies to constraints. *Environmental Management*, 28: 421-193.