

The Need for Land Use Assessment in Enhancing the Implementation of Integrated Water Resource Management (IWRM)

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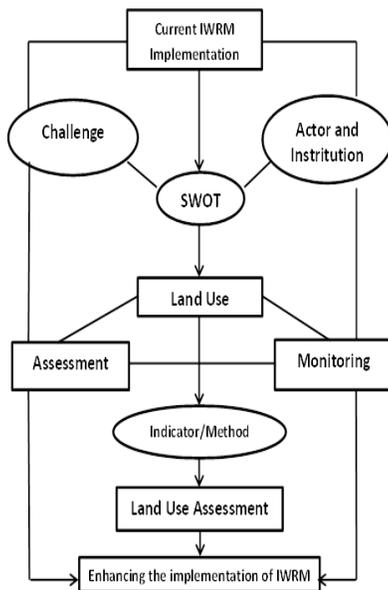
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Graphical abstract



Abstract

Over 20 years, there has been an explosive growth of interest in the application of Integrated Water Resource Management among majority of developing and developed countries in settling various type of water issue. Unfortunately, the effective implementation of this approach still remains in doubt. Fragmented water resources legislation, complexity of constitutional framework on water resources management, lack of coordination among stakeholders and overlapping of authorities in managing water resources are among the issues that challenge the Integrated Water Resource Management implementation. Therefore, this paper attempts to review the broad literature regarding what is still wrong with this approach and propose the solution on how to enhance the current implementation. Since, there is still no authorized framework available to be used by the stakeholders involved in assessing land use practice and comparing the effectiveness of the implementation progress between states in Malaysia, this paper briefly concludes that there is a need to develop a framework for Land Use Assessment as a work performance guideline especially to the various stakeholders involved. Therefore, it is hope that this finding would offer better improvement to water resource management through effective, good governance and practical ways.

Keywords: Integrated Water Resource Management; implementation; land use; assessment; performance

Sejak lebih 20 tahun, pertumbuhan ketara terhadap kepentingan pelaksanaan Pengurusan Sumber Air Bersepadu telah mula menarik perhatian di kalangan majoriti negara maju dan membangun dalam menyelesaikan pelbagai jenis isu air. Malangnya, keberkesanan pelaksanaan pendekatan ini masih lagi samar. Perundangan sumber air yang tidak selari, kerumitan rangka kerja perlembagaan terhadap pengurusan sumber air, kurangnya penyelarasan antara pihak berkepentingan dan pertindihan kuasa dalam menguruskan sumber air adalah antara isu-isu yang menghalang keberkesanan pelaksanaan Pengurusan Sumber Air Bersepadu. Oleh itu, artikel ini bertujuan untuk mengkaji sumber literatur dengan lebih mendalam mengenai perkara yang masih menghalang keberkesanan pelaksanaan pendekatan ini dan mencadangkan penyelesaian bagaimana untuk memantapkan kaedah pelaksanaan ini. Oleh kerana, setakat ini tiada rangka kerja yang digunakan dan memberi kuasa kepada pihak-pihak berkepentingan yang terlibat dalam menilai amalan guna tanah dan membandingkan keberkesanan kemajuan pelaksanaan di antara negeri-negeri di Malaysia, artikel ini secara ringkas menyimpulkan bahawa terdapat satu keperluan untuk membangunkan rangka kerja penilaian guna tanah sebagai garis panduan prestasi kerja terutamanya kepada pihak-pihak berkepentingan yang terlibat. Oleh itu, penemuan ini diharap menawarkan penambahbaikan yang lebih baik terhadap pengurusan sumber air melalui kaedah yang berkesan, tadbir urus yang baik dan boleh dipraktikkan.

Kata kunci: Pengurusan Sumber Air Bersepadu; pelaksanaan; guna tanah; penilaian; prestasi

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1.0 INTRODUCTION

Water is one of the vital resources not only for the life being but also for development of the nation. All over the world acknowledge and realize water resources sustainability is their key element for securing various development sectors in the countries. Socio-economic development in the countries is only

probable when there are sufficient water resources that could sustaining and cope with all the needs and demands of the countries. In order to ensure water resource is sustainable for the living and countries need, therefore it has to well plan, administrate and manage. However, nowadays the water issues have always been addressed on global and local agenda. In Malaysia, evidence has emerged that our water resources are

facing massive and continuing threats from human activities which lead to impact on the physical environment. One of the main challenges that lead to water issue is related to land use. Previous studies agree that land use will affect water resources in term of quality [1] [2] and quantity [3], [4], [5], [6], [7]. In fact, rampant logging, unbridled land clearing, rapid development, unsustainable irrigation, and squatters: all of these issues actually led to destruction of water catchment area, exacerbate water quality, leading to water crisis, jeopardize nation water resources and finally left the water issues to remain unresolved.

Therefore, Integrated Water Resource Management (IWRM) has been promoted and heavily funded as the global trend in the last twenty years as an approach in solving all of water issues. In Malaysia, many policies, plans and programs are being conducted to ensure that the IWRM approach can be effectively implemented. Unfortunately, the implementation of this approach still remains in doubt when there is no formalized and authorized framework for monitoring the implementation progress of IWRM among the various stakeholders involved. Although several strategies of land use practices that support the implementation of IWRM were offered by federal, state and local entities through land development and planning aspect but none so far seems to be fully effective due to water issue that still happen until now.

Hitherto, several of integrated land use planning framework has been implemented in Malaysia such as National Physical Planning Plan (NPP), National Urbanization Policy (NUP), couple with some of physical planning guideline such as Physical Development of Town and Country Guideline (FPTCP), Environmentally Sensitive Areas (ESA's), Environmental Impact Assessment (EIA), Open Space and Rooftop Garden Guidelines, Planning Guidelines for Hill Land and Highland Areas, JPBD's Study on Geo-hazard Areas in Land Use Planning and Guideline for Installing a Rainwater Collection and utilization System. To date, there is still no authorized and standardize framework available to be used by the stakeholders involved to assess land use practice and compare the efficiency and effectiveness of IWRM implementation progress between states in Malaysia.

Therefore, this paper attempt to identify the relationship between land uses toward water resource sustainability and to

explore the current progress of IWRM and highlight several challenges of the implementation. Besides, the study also undertaken to highlight the significance in assessing land use for enhance the IWRM implementation progress. In line, since land use give mostly impact to water resources, this paper try to promote the need to develop a framework for Land Use Assessment as a work performance guideline especially to the various stakeholders involved as to offer an alternative way for progress monitoring the IWRM Implementation.

■2.0 RELATIONSHIP BETWEEN LAND USES AND WATER RESOURCES SUSTAINABILITY

As stated by Nasir *et al.*, [8], land use is the human use of land which involves the management and modification of natural environment or wilderness into built environment such as fields, pastures, and settlements. Land use is characterized by the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it [9]. It is based on the functional dimension of land for different human purposes or economic activities. Land-use denotes how humans use the biophysical or ecological properties of land. Land-uses also include the modification and management of land for agriculture, settlements, forestry and other uses including those that exclude humans from land, as in the designation of nature reserves for conservation. From several of definition above, land use can be summarized as a process of human activities in using various types of land to full fill their functional life whereas land use practices is the process of human act on land use.

World Bank [10] state that there are several typical categories for land use which are dwellings, industrial use, transport, recreational use or nature protection areas whereas due to Land Use Information Division of Town and Country Planning [11], land use classification divide into several types which are built-up, transport, infrastructure, utility, agriculture, livestock and aquaculture, forest, water bodies and coastal. Each of this type consisting several of land use activities as shown in Table 1 [11].

Table 1 Type of land uses

Land Use Types	Current Land Use	Land Use Activities
Built-up	Housing	Planned housing, unplanned housing
	Industry	Planned industry, unplanned industry, mines/quarry
	Commercial and service	Planned commercial, unplanned commercial
	Institutions and community facilities	Education, Health, religious, cemetery, safety, welfare homes, government/ statutory body usage, others communities facilities
	Recreational and open space	Open space, sport and recreational facilities and green area
Transport, infrastructure and utility	Vacant land transport	Road, rail, transport facilities
	Infrastructure and utility	Electricity, water, gas supply, irrigation and drainage, telecommunication, solid and waste toxic disposal, sewerage
Agriculture Livestock and aquaculture	Agriculture	rubber, oil palm, rice, other crops, idle land
	Livestock and aquaculture	Livestock and aquaculture
Forest	Forest	forest land, wetland forest, peat forest, cleared forest
Water bodies	Water bodies	Nature, artificial
Coastal	Coastal	Nature, artificial

However, behind the various land use changes that occur in an area, there is also many negative impacts that effect on the environment [12] which lead to ecosystem disruption due to exploitation of water resources. Mouratidis *et al.*, [13] defined the term 'exploitation of a region's water resources as *activities that aim in rational exploitation of these resources within the quantity limits of the annual fluctuation of water resources and in combination with works and activities with the lowest cost possible, not only financially but also environmentally*. In fact, Ngoye and Machiwa, [4] also state that in recent years there is a rapid declining availability of usable freshwater in terms of water quality and quantity due to unsustainable land use practices. In addition Sahin and Hall [3] mention to all those involved in hydrology and water resources, land-use change is the problem which will not go away.

Unfortunately, the main reason of unsustainable land uses practice that rapidly changes and degrades the environment particularly that relate in water issue were cause by man-made [14]. Besides, the implication of man-made effect was recorded since 18th and 19th century and there are several studies that prove unsustainable land use practice in the country will create a two-way conflict between development and physical environment [8]. However, Forsyth [15] argue that is it supposedly to really blame on human activities for apparent problems such as water shortages. He said that, a new research

is suggesting that human impacts on water resources are highly varied, and that's why many common perceptions, or generalizations, about human impacts of land use are simplistic. However, if environmental impacts like water resources deterioration is exit due to the human unsustainable land use practice how we cannot blame them?

According to Institute of Water Research [16], land use and water resources are unequivocally linked. The relation between type of land and the intensity of its use will have a strong influence on the water resource. The impact of any land use practice on either the quantity or quality of water can be substantial whether the source is natural or comes from a human activity. Besides, the relationship between land use with water quality and water quantity is bidirectional. Land use activities have direct impacts on water resources, while water quality and quantity greatly influence the sitting of land use activities [17]. The relationship between land use and implication to water resources as shown in Table 2 which illustrate that planning, administrating, and managing land use practice in sustainable way is important to ensure there is a best solution in resolving the water issues as well as helping in achieving sustainability of water resources and at the same time securing the development of the nation.

Table 2 Relationship between land use and implication to water resources

Source	Land Uses Types	Land Use Issues	Implication to Water Resources
Raini [18]	Forest	Increase intensity of deforestation	Increasing magnitude and frequency of runoff events and reduced base flows, increased pesticide contamination, erosion and sedimentation of stream and rivers
Reza and Singh [19]	Industrial	Coal mines, power plant and other Industries at Angul Talcher belt had encouraged rapid urbanization of rural landscape and extensive degradation land.	The villages located at the downstream to the power plants have been severely affected due to the pollution of their water bodies and streams by the effluents.
Shen <i>et al.</i> , [20]	Urbanization (Commercial, industrial)	High speed of economic development	Deterioration of the water resources system, drying and shrinking surface water bodies, Over-exploited and exhausted groundwater, water pollution and Extensive water management and low water use efficiency
Tyler and Fajber [21]	Infrastructure and utility (water supply)	The construction of large hydro dams to meet increasing demand for Electricity	Affecting seasonal inundation patterns both upstream and downstream, as well as water flow, fisheries habitat and agricultural production.

There are several land use changes occurring at an accelerating rate, which lead to negative impacts on water resources while other land use changes may effect to water-stress. Since the changes of land use become more rapid, it is critical to human being to better understand the interaction between human and environment.

■3.0 IWRM IMPLEMENTATION SCENARIO

Due to lack of best solution in resolving water issue, the hydrological environment impact will significantly increase and continuing decline both of quality and quantity of water resources [22] if no actions are taken to minimize the possible impact. One integrated approach that been use by most of the countries including Malaysia known as Integrated Water Resources Management (IWRM). This approach could be define mostly by Global Water Partnership [23] 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 [24]. IWRM is a practical way to minimize conflict towards effective and efficient use of land and water resources and to achieve the objectives of sustainable management. However, the effectiveness of this approach is still questionable due to the factors of difficulties and problems that encountered during implementation progress primarily relating to political will, the lack of workable methods of distributive governance, the role of law, and stakeholder participation [25]. In addition, as stated by Buller in [26] and Margerum in [27], the implementation of this concept at the local level can be extremely challenging and this scenario has been experienced by river managers in Malaysia [22].

In managing and develop its water resources, Malaysia has adopted and continuously implemented IWRM since 2002 and highlights several major achievements which stated in the 8th Malaysia Plan (8MP, 2001-2005), 9th Malaysia Plan (9MP,

2006-2010) and the 3rd Outline Perspective Plan (OPP3, 2001-2010). Various actions and measures have been undertaken by government, private sectors and non-governmental organizations (NGOs) but the overall implementation of IWRM is still very slow and lack of understanding over the concept is still apparent among water agencies [28], [29]. In fact, it has also received widespread critiques particularly on the way its implementation has progressed [30]. In this section, this study attempts to apply key issues analysis to identify the underlying

group of major problems in IWRM implementation based on 10 years trend of previous studies from 2003 until 2013. These key issues are the elements that present partly of the current progress and will be elaborated into variables to highlight the challenges on the IWRM implementation. This analysis is formulated into matrix form to provide the clear picture of each key issue among the highlighted past studies.

Table 3 Matrix analysis on IWRM challenges in Malaysia based on previous studies from 2003-2013

Key Issues	IWRM issues	2003 [31]	2008 [32]	2009 [33]	2010 [34]	2011 [35]	2012 [36]	2012 [37]	2012 [38]	2012 [39]	2013 [40]	2013 [41]	2013 [42]	Total
Policies and Legislation	Fragmented water resources legislation and jurisdiction		/	/			/			/		/		5
	Complexity of constitutional framework on water resources management	/	/		/		/			/			/	6
	No standardized water policies/guidelines for states to adopt								/			/		2
Institution	Lack of coordination, cooperation and collaboration among government, stakeholders and local communities in water resources management				/	/						/	/	4
	Overlapping of authorities in managing water resources				/							/		2
	No single formally constituted entity that is empowered to execute IWRM								/					1
IWRM Concept	Centralization and decentralization issues in water resources management			/		/								2
	Slow implementation of IWRM			/			/			/			/	4
	Lack of understanding in IWRM concept			/			/			/			/	4
IWRM Tools	Lack of practicable IWRM instruments/tools that suit different local conditions							/						1

The given matrix analysis shows that policies and legislation together with the institutions are the major key issues that highlight various of challenges on IWRM implementation. Implementing IWRM requires change in various aspects, especially in what institutions do, and which institutions have responsibility for the various aspects of water resources management. It has been proved that Malaysia consist numerous water related laws and policy in protecting, conserving and preserving environment particular in water resource. However the various kind of policy is meaningless if those policies and legislation cannot effectively implemented and just lay under the vision not the action. Moreover, ineffectiveness of law enforcement can be daunting which result in increasing case of water and environmental degradation. Since effective enforcement is critical to a successful IWRM, therefore, it is important to identify some measure to enhance and revisiting those issues and challenges.

Based on the review, the study reveals that, lack of enforcement could be the major factor that challenges the implementation of integrated water resource management. To sum up, it could be state that all challenges in Table 3 could be relate with the lack of continuous monitoring action in effective, efficient and good governance manner during implementing the IWRM. For that reason, it is particularly important to tighten the linkage between enforcement and monitoring through assessment since assessments are an inexpensive way to monitor IWRM progress and to make sure reform is designed and implemented in effective and efficient ways [43]. Fortunately, the lack of useful assessment was seen as a constraining factor for enhanced progress of IWRM. Therefore, the need to develop a framework for Land Use Assessment as a work performance guideline especially to the various stakeholders involved must be explored first.

4.0 THE NEED FOR LAND USE ASSESSMENT

The management of water, land and land use is critical to address in a co-ordinate and integrated manner and acknowledge that problem of land and water management is closely linked to the lacking of enforcement. The hurdles faced by stakeholders in each of the states are actually challenged but this may not necessarily mean that all issues of water resources are not impossible to overcome. In the author’s point of view, land use assessment is the first step to trigger changes that are needed to improve IWRM performance by showing where interventions would have the most impact and the potential gaps that could be reviewed together by stakeholders that are involved in IWRM implementation. Besides, land use has been chosen as the proposed of assessment framework since to ensure the effectiveness of water management, there must not confine itself to just looking at water alone, but also requires consideration and involvement in land use matters. Since monitoring and assessment is one of the governance indicators that serve the purpose of monitoring IWRM progress [43] it is hope that the Land Use Assessment can assist in terms of monitoring whether the implementation process is on track, diagnosing existing problems especially on land use matter and evaluating impacts to determine if actions are needed for defined any objective.

The objective of IWRM Implementation Progress Assessment is to monitor its progress and to make sure reform is designed and implemented in effective, efficient and good governance manner. It is hoped that IWRM Assessment will be widely used as the stakeholders’ work performance guideline which enables all the stakeholders to commit the responsibility in implementing IWRM activities. Besides, Land Use Assessment also is hoped to be particularly useful to assess ongoing water reform, close the implementation gap and provide an understanding of the information chain. All in all, although it is beyond the scope of this paper to answer the question on how to construct the Land Use Assessment framework, the author would like to briefly say that in other words, this Land Use Assessments should be used to investigate: Are we doing the right things (effectiveness) and are they done in the right way (efficiency)?

a) Good Governance Principles as the Basis of the Proposed Land Use Assessment

Jennings and Watts [44] state that land which is in the form of territory is a pre-requisite for a state's existence while water is a

prerequisite for life. Among these resources, even though land and water is different in term of form but the relationship is said to be equal significance [45] because of land and water are interconnected which can directly influence the consequences for ecosystem. In order to sustain the ecosystem and water resource for the living and countries need, therefore both land and water resources has to well plan, administrate and manage. However, with the current unsustainable land use practice couple with others development pressure it make the process to plan, administrate and manage become one of the most challenging task in the world agenda. Besides, since water is not issues that can be treated separately from land due to the linkages between the two resources are self-evident [46] and when looking at the main cause of water resources degradation and declining mostly related to land use practice, therefore good governance principle has been proposed as the basis of the land use assessment framework. However, the discussion on the proposed of good governance principles in this section will be limited only to land and water governance principles since both of them are more specific to the content of this study rather than governance itself.

According to Enemark [47], land governance is about the policies, processes and institutions by which land, property and natural resources are manage. Besides land governance also covers all activities associated with the management of land and natural resources that are required to fulfill political and social objectives and achieve sustainable development. Onesmus in [48] state good land governance is critical for addressing the current socio-economic challenges. Meanwhile, due to UNDP, water governance refers to the range of political, social, economic and administrative systems that are in place to develop and manage water resources and the delivery of water services at different level of society [33]. Guria [49] says that, for a country to better conserve and protects its water resource, its require in improving water governance whereas Chan [33] says, in determining whether a country will success or fail in their water management, if those country has a bad water governance, then its water resources would not be manage sustainably.

All in all, although it is beyond the scope of this paper to answer the question on how to construct the Land Use Assessment framework in order to enhance the implementation of IWRM, the author would like to briefly highlight several of good governance principles to be used as variables in the framework which shown in Table 4.

Table 4 Good land and water governance principles

Principles of Good Governance	
Land Resource	Water Resource
Security	Inclusive and Communication
Sustainability	Coherent and Integrated
Equity	Fair and ethical
Effectiveness and Efficiency	Effectiveness
Rule of Law	Responsive and Sustainable
Transparency	Open and Transparent
Accountability	Accountability
Civil Engagement	
Subsidiary	

5.0 CONCLUSION

Since water and land are essential for many life supporting functions and key for satisfying basic human needs and

development, therefore both of these elements need to be conserve and protect comprehensively. Effective water management must not confine itself to just looking at water alone, it also requires consideration of and involvement in land

use matters. A comprehensive approach to water resources management in the country is impossible without having a linkage to authorities dealing with land, forests, minerals, and other such related resource or activity sectors. Even there are many issue regarding land use and water resources, however the accurate causes on how land use can effect on water issues is due to the lack of enforcement and continuous monitoring action during implement the IWRM. Although IWRM are being used mostly by countries all over the world in managing water resource, but the effectiveness of this approach is still not yet successfully implemented. In fact, since there is no formalized and authorized framework for monitoring the progress of IWRM implementation among the various stakeholders involved, it is difficult to claim whether the current status of IWRM is effective or not.

Therefore, to identify the effective way that blend all the three aspects which are land use, water resources and land resources matters together at the same time in integrated way, development of assessment framework as one part of progress evaluation and monitoring have been suggested in this study. Besides, in order to assure the good governance concept with IWRM is in line and to strength the relationship between monitoring and enforcement, it could be merged through assessment since well-designed assessment can encourage effective and efficient progress especially when the assessment delivery is innovative and engaging. Therefore, to enhance and support the effectiveness of IWRM implementation, this paper briefly concludes that there is a need to develop a framework for Land Use Assessment as a work performance guideline especially to the various stakeholders involved. By that, it is hope that in the future the land use assessment can be applied as the work performance guideline, enhance the implementation of IWRM and ensure the sustainability of water resource as well minimizing and solving any issues relate to water.

Reference

- [1] Kibichii, S., Shivoga, W.A., Muchiri, M. and Miller, S. N. 2007. Macro Invertebrate Assemblages Along a Land-use Gradient in the Upper River Njoro Watershed of Lake Nakuru Drainage Basin, Kenya. *Lakes and Reservoirs. Research and Management*. 12: 107–117.
- [2] Jamil, N. R., Ruslan, M. S., Toriman, M. E., Idris, M., and Razad, A. A. 2014. Impact of Land use on Seasonal Water Quality at Highland Lake: A Case Study of Ringlet Lake, Cameron Highlands, Pahang. In *From Sources to Solution*. Springer Singapore. 409–413.
- [3] Sahin, V. and Hall, M. J. 1996. The Effects of Afforestation and Deforestation on Water Yields. *Journal of Hydrology*. 178: 293–309.
- [4] Ngoye, E., Machiwa, J. F., 2004. The Influence of Land Use Patterns in the Ruvu River Watershed on Water Quality in The River System. *Physics and Chemistry of the Earth*. 29: 1161–1166.
- [5] Mathie, B. M., Mutie, S., Gadain, H., Home, P. and Mtaló, F. 2008. Impacts of Land-use/ Cover Changes on the Hydrology of the Transboundary Mara River, Kenya/Tanzania. *Lakes and Reservoirs. Research and Management*. 13: 169–177.
- [6] Mango, L. M., Melesse, A. M., McClain, M. E., Gann, D., and Setegn, S. G. 2011. Land Use and Climate Change Impacts on the Hydrology of the Upper Mara River Basin, Kenya: Results of a Modelling Study to Support Better Resource Management. *Hydrology and Earth System Sciences*. 15: 2245–2258.
- [7] Mesese, F. O., Raburu, P. O., Mwasi, B. N., Etiegni, L. 2012. Effects of Deforestation on Water Resources: Integrating Science and Community Perspectives in the Sondu-Miriu River Basin, Kenya.
- [8] Nasir, N., Hashim, M., Ibrahim, M. H., Suhaily, C. N. 2009. Changes of Land Use and Status of River Quality in Ipoh, Perak. *Malaysian Journal of Environmental Management*. 10(2): 115–134.
- [9] Wasige E. J., Groen A. T., Eric S., and Victor J. 2013. Monitoring Basin-scale Land Cover Changes in Kagera Basin of Lake Victoria using ancillary Data and Remote Sensing. *International Journal of Applied Earth Observation and Geoinformation*. 21: 32–42.
- [10] World Bank. 2005. Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003. Studies in Methods, Series F, No.61(1), Glossary, United Nations, New York, 322.
- [11] (<http://www.townplan.gov.my>).
- [12] Ibrahim, H., Hashim, M., Nayan, N., Omar Baki, M. H., and Che Ngah, M. S. Y. 2011. Relationship Between Land Use Type and Temperature in Tanjong Malim, Perak. *Journal of Techno-Social*. 2(2).
- [13] Mouratidis, I., Dimopoulos, G., Astaras, T., and Savvidis, S. 2010. Sustainable Water Resources Management Through the Use of GIS Technologies. *Global NEST Journa*. 12(2): 140–151. In Newson, M. 2nd Eds. 1997. *Land, Water and Development. Sustainable Management of River Basin Systems*. London, New York: Routledge.
- [14] Aini, M. S., Fakhru'l-Razi, A., and Siew Suan, K. 2001. Water Crisis Management: Satisfaction Level, Effect and Coping of the Consumers. *Water Resources Management*. 15(1): 31–39.
- [15] Forsyth, T., (Eds). 2005. *Land Use Impacts On Water Resources—Science, Social and Political Factors. Encyclopedia of Hydrological Sciences*. John Wiley & Sons, Ltd.
- [16] Institute of Water Research. 2014. *Watershed Approach: Land Use Effects on Water Quality and Quantity* in <http://35.8.121.139/edmodule/water/wtrfrm1.htm>.
- [17] Silva, A., Rosa, A., Antunes, F., Nogueira, D., and Lessa, S. 2009. Relationship Between Water Quality and Land Use Along a Stretch of the Sorocaba River (SP). *Journal of the Brazilian Society of Ecotoxicology*. 4: 65–71.
- [18] Raini, J. A. 2009. Impact on Land Use Changes on Water Resources and Biodiversity of Lake Nakuru Catchment Basin, Kenya. *African Journal of Ecology*. 47: 39–45.
- [19] Reza, R. and Singh, G. 2010. Impact of Industrial Development on Surface Water Resources in Angul Region of Orissa. *International Journal Of Environmental Sciences*. 4(1): 514–522.
- [20] Shen, Y., Tang, C., Xiao J., Oki T., Kanae, S. 2005. *Effects of Urbanization on Water Resources Development and Its Problems in Shijiazhuang, China*. Paper presented at the symposium S2 held during the Seventh IAHS Scientific Assembly.
- [21] Tyler, S., and Fajber, L. 2009. Land and Water Resource Management in Asia. *Management*.
- [22] Suhaily Y. C. N. and Zainudin O. 2010. Water Catchment Management: A Malaysian Perspective. *Global Journal of Environmental Research*. 4(1): 34–39.
- [23] Global Water Partnership. 2000. Integrated water Resources Management. TAC Background Papers No. 4, p.22 (Stockholm: GWP Secretariat).
- [24] Maliva, R. and Missimer, T. 2012. Integrated Water Resources Management. Arid Lands Water Evaluation and Management. *Environmental Science and Engineering*. 911–924.
- [25] Hooper, B. P. 2003. Integrated Water Resources Management and River Basin Governance. *Universities Council on Water Resources*. 126: 12–20.
- [26] Buller, H. 1996. Towards Sustainable Water Management: Catchment Planning in France And Britain. *Land Use Policy*. 13: 289–302.
- [27] Margerum R. D. and B. P. Hooper. 2001. Integrated Environmental Management: Improving Implementation Through Leverage Point Mapping. *Society and Natural Resources*. 14: 1–19.
- [28] Kua, H. W. 2007. Information Flow and Coherently Integrated Policy Making for Promoting Energy Efficiency. *Environmental Science and Technology*. 9: 41.
- [29] Khalid, M. R., Rahman, A. S. and Mazlin, M. 2013. Legal Perspective on Development Policies For Sustainability Of Water in Malaysia. *Sustainable Development*. 21: 144–151.
- [30] Butterworth, J., Warner J., Moriarty P., Smits, S. and Batchelor, C. 2010. Finding Practical Approaches to Integrated Water Resources Management. *Water Alternatives*. 3: 68–81.
- [31] Ahmad, A. R., Hasnah, A. 2003. Governance Scenario for Water Resources in Malaysia. In: Zafar Adeel. *East Asian Experience in Environmental Governance*. Tokyo: United Nations Univ. Press.85–110
- [32] Mohamad, Jamilah M., Firusza, B. and Wan, S. W. 2008. Water Governance in Peninsular Malaysia: Strategies for Reform.
- [33] Chan, N. W. 2009. Issues and Challenges in Water Governance in Malaysia. *Iran Journal of Environment, Health and Science*. 6: 143–152.
- [34] Khalid, R. M., Rahman, S. A., and Mazlin M. 2010. *Legal Analysis of Sustainable Development and Water Management in Malaysia*. Unpublished note. Presented at 16th International Sustainable Development and Research Conference.
- [35] Alatas, S. M. 2011. Urustadbir Air Tawar di Kuala Lumpur dan Lembah Klang: Satu Kejayaan atau Kegagalan. *Akademika*. 81: 95–102.

- [36] Khalid, R. M., Mazlin M., and Rahman, S. A. 2012. Revisiting Water Governance to Reduce the Climate Change Impact on Water Resources in Malaysia. Unpublished note. Universiti Teknologi Mara, Universiti Kebangsaan Malaysia, Universiti Putra Malaysia.
- [37] Rahmah E., Rawshan A. B. and Mazlin, M. 2012. Instruments for Integrated Water Resource Management in Malaysia. *Journal of Applied Sciences Research*. 8: 5599–5607.
- [38] Ahmad H. S. 2012. Malaysia Water Resources Management Paper presented at the Perbadanan Putrajaya, Putrajaya. 26 November 2012.
- [39] Khalid, R. M., Rahman, S. A., Mazlina M., Shuhaeda A. M. A., Siti S. S., Noraziah A. B. and Ismah I. 2012. Constitutional Issues in Integrating Water Resources Management in Malaysia : A Case Study of the Selangor Water Management Authority. *OIDA International Journal of Sustainable Development*. 3: 11–18.
- [40] Mazlin M., Sarah A. A., and Rasyikah M. K. 2013. Water Governance and Soft Sciences in Water Research and Development. *Consultative Workshop Akademi Sains Malaysia*. 23 April 2013. Nahrin: Serdang.
- [41] Intan, S. S. and Nor, A. M. Y. 2013. The Need for Better Water Policy and Governance in Malaysia. *Procedia-Social and Behavioral Sciences*. 81: 371–375.
- [42] Rasyikah, M. K., Suhaimi, A. R. and Mazlin M. 2013. Legal Perspective on Development Policies for Sustainability of Water in Malaysia. *Sustainable Development*. 21: 144–151.
- [43] Larsen, H and Feilberg, M. Indicators For Measuring Iwrm Progress at National Level. 2011 in http://www.dhigroup.com/upload/publications/west/Larsen_2011.pdf.
- [44] Jennings, R. & Watts, A. (Eds.). 1992. *Oppenheim's International Law*. Longmans, London.
- [45] Hodgson, S. 2004. *Land and Water-the Rights Interface*. Food and Agriculture Organization of the United Nations, Rome.
- [46] IFAD. 2004. *Linking Land and Water Governance-IFAD Experience*. Proceedings of workshop Farmers' views first-Land and Water Governance, World Water Week, Stockholm. In www.ifad.org/events/water.
- [47] Enemark, S. 2013. *Building Spatial Frameworks for Sustainable and Transparent Land Governance*. Paper presented at the Annual World Bank Conference on Land and Poverty. 8-11 April. The World Bank-Washington DC.
- [48] Onesmus, M. 2011. Land Governance in Uganda: Large Scale Land Acquisition and Land Expropriation. *Policy Analyst Advocates Coalition for Development and Environment*.
- [49] Gurría, A. 2009. Sustainably Managing Water: Challenges and Responses. *Water International*. 34(4): 396–401.