American-Eurasian J. Agric. & Environ. Sci., 14 (9): 882-893, 2014
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2014.14.09.12406

Incorporating Social Learning Process into the Integrated Water Resource Management in Malayan Peninsula

[1,2]*Mohammad Zahirul Haque,* [1]*Sahibin Abd Rahim,* [3]*Mazlin Bin Mokhtar,*
[3]*Rahmah Elfithri,* [4]*Ahmad Fuad Embi,* [1]*Tukimat Lihan,*
[2,3]*Md. Abdullah Abraham Hossain and* [3]*Mohammad Imam Hasan Reza*

[1]School of Environmental and Natural Resources Sciences, Faculty of Science and Technology,
Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia
[2]Bangladesh Forest Department, Bono Bhaban, Agargaon, Dhaka 1207, Bangladesh
[3]Institute for Environment and Development (LESTARI),
Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia
[4]Faculty of Engineering and Built Environment,
Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia

Abstract: Malaysia has been Integrated water resources management (IWRM) and making considerable progress since past few decades. An Integrated River Basin Management has been inaugurated in the Langat River Basin as part of IWRM implementation through newly formed Selangor Water Management Authority (LUAS) in 1999. This paper critically reviewed the scientific, management and evaluation literatures and reports on water resources management of this river catchment area. The study denotes, although a significant development it achieved, this river basin organization can be bettered in terms of its organizational structure, manpower strength and experience and balance between top-down and bottom-up decision making process by integrating social learning process. The growing challenges due to the inevitable effects of critical factors of economic growth, population increase and climate change impacts within Langat River Basin for the efficient and effective operation of river basin system. The aim of this paper is to highlight the drawbacks and policy gaps of water resources management in this river drainage area in order to tone up the management initiatives. Here we discuss about the process that led to an integrated approach to the water resources management through the inclusion of local stakeholders and also compare to the European Social Learning model that how it might be set with the perspectives of the Malayan Peninsula.

Key words: Integrated water resources management · Selangor Water Management Authority · Langat River Basin · Land use · Social Learning Process

INTRODUCTION

Globally, water is considered as finite and vulnerable resource [1-3]. Water resources management is increasingly becoming essential because of the increasing population resulting in increased water needs against a declining natural resource base due to environmental degradation [4]. The main aspects of integrated water resources are concerned with natural and artificial factors. Natural elements are predominantly environmental factors and ecosystem aspects. On the other hand, artificial factors evolve due to anthropogenic interference like the harvesting of water; various pollutants etc. from household, farming, industrial, land uses and hence alone. The factors of management include the actions of several organizations like government, local municipalities, community and the people. Therefore, Integrated Water Resources Management (IWRM) is to come up to the challenges of social and the innate demands of water [5,6].

Corresponding Authort: Mohammad Zahirul Haque, School of Environmental and Natural Resources Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia. Tel: +60389213357, Fax: +60389253357.

In Malaysia, unlike components of the water resources management role are carried out by different sectors and through different subject areas is a complicating factor, which can simply be done with a holistic approach [7]. Though Malaysia's location within equatorial zone [8] has blessed the country with abundant of water resources, however, its management has been facing numerous challenges [9]. As such, Malaysia has adopted an IWRM approach and brought modifications in its institutional arrangements for better water resource management [10]. Side by side continuous policy dialogue [11], formation of river basin organization [12], inter-organizational coordination, river study and river management plan preparation, river flow [13] and water quality monitoring, enforcement to control water pollution, considerable amount of investment for infrastructural development particularly for water supply and sanitation services, research and organizational capacity building [14] have been carried out predominantly under top-down approach. These initiatives have been carried out to improve water management in the country, however, water and associated resources management practices are yet to develop especially in cases of active participation of stakeholders at lowest appropriate level for decision making, joint monitoring, water demand management, effective waste management, conflict resolution, individual capacity building and above all preparation of local level strategies.

IWRM implemented primarily at the basin-wise context under the principles of good governance and public participation [15-17]. Integrated River Basin Management (IRBM) which is a subset of IWRM can be seen as the implementing arm of IWRM in a national water planning context [18]. A river basin is considered as naturally delineated hydrological spatial unit determined by watershed limits of the system of waters, including surface and ground waters, flowing into common terminus. It's integrated management consists all activities aiming at a better functioning of the river basin, including the water system and the land in the basin in as far as it is affected by or has an impact on the water system [19-21]. Intervention for water and related resources under ecosystem approach is said to be more appropriate and it is an integral part of IWRM approach in a river basin management [16].

Stakeholder Participation: In essence, to make water resources management effective, stakeholder participation is one of the conditions that need to be accepted [22]. However, in order to fulfill the condition, ignoring the involvement of the beneficiaries or the affected people during measures taken may be a little effective [23]. The EU Water Framework Directive introduces an innovative, integrated and holistic approach to the protection and management of water resources. To integrate environmental, social and economic concerns the involvement of interested parties in the formulation of strategies may be useful [24]. Jaspers [7] stated that the bare minimum is the participation in decision making the less effective the management. The decisions should be made at least after stakeholders are given privilege to bring their interests forward. Depending on the level of decision making and the specific management function envisaged, stakeholder participation can also be instrumental in planning, monitoring and enforcement. Jaspers[25] also stated that in Zimbabwe mechanism of self-arranging enforcement for social control was initiated in case of monitoring of water meters by neighboring water users in the same part of a river basin. Therefore, the interdependency of the water users appeared to be a very effective instrument of monitoring.

The Social Learning Process: The concept of social learning is described and an effort to show how communities of people with both diverse and common interests can reach agreement on collective action to solve a shared problem[26]. It is facilitated through concepts such as modeling and observational learning [27]. As a part of pioneering initiative for IRBM implementation, Government of Malaysia has formed the Selangor Water Management Authority (Malaysian acronym is LUAS) in 1999 as a river basin organization and LRB is one of the three river basins is now managed by this authority [28]. Role and responsibilities of the authority and collaboration, coordination and enforcement mechanisms are well defined by the Selangor Waters Management Authority Enactment 1999[29]. But existing organizational structure, manpower and functional experience are inadequate to address all these issues derived from the inevitable consequences of critical factors of economic and population growth as well as climate change effect prevailing in the basin area[30]. However, in the developed countries, there is growing interest on the involvement of local stakeholders to share responsibilities and create congenial setting for their capacity building and empowerment to supplement complex and immense water management responsibilities for effective river basin organization [31].

MATERIALS AND METHODS

The methodology followed for this review paper is based on the survey of literature studies. A general search on the website for Integrated Water Resources Management Practice in the LRB, Malaysia was carried out and huge numbers of the articles were found. Among the number of articles, abstracts were screened first and related literatures were selected for in-depth study. These articles were then studied between the line in order to illicit important and relevant information and have been cited accordingly. Most of the articles were found as the case study approach and qualitative and quantitative analysis of research. As the title of the paper indicates, our focus in this paper is those portions which are directly empirical and related to the key words about the importance of approaching social learning models for the integrated water resources management practice.

Finding reliable and valid sources of information on integrated water resources management in LRB were a challenge for the writers. The writers found the pertinent information by using the descriptions of Integrated Water Resources Management, Integrated River Basin Management, Selangor Water Management Authority, Langat River Basin, Land use, Social Learning. The writers also used traditional sources such books and some fundamental ecological and environmental research articles.

The writers checked the credibility of the information found by searching the background information on the authors readily available in the online sources and determined if the information was credible. The primary rationale for selecting the sources described above was reliability.

Ecological and Environmental Aspects of Langat River Basin (LRB):

Ecological and Geographical Distribution of LRB: The Langat River has a total catchment area of approximately 1,815 km^2. It lies within latitudes 2°40 M 15.2" N to 3°16 M 15" and longitudes 101°19 M 20" E to 102°1 M 10" E [32] and represents only 1.41 percent of Peninsular Malaysia[33]. It is delineated by the ridges of the Langat river flow and the total length of the river course is about 141 km mostly situated around 40 km east of Kuala Lumpur. The source of this river is the Banjaran Titiwangsa (Titiwangsa Mountain) and has several tributaries of which main tributaries are Sungai Semenyih, Sungai Lui and Sungai Beranang[34]. The mean annual rainfall in the watershed is 2145±237 mm for the area of 1443 km^2 and the mean annual river discharge is 35.38±4 m^3/s. The mean annual temperature at Langat is 26±0.3°C with mean relative humidity of 82±1%. Total estimated population is about 1.2 million in the basin, mostly live in urbanized areas such as Kajang, Bangi and Putrajaya[35] and expected to be 2.50 million by 2050.

This basin is adjacent to the highly urbanized Klang Valley[32,36] and has been one of the fast growing regions in Malaysia since last two decades. Administratively these basins occupy the districts of Hulu Langat, Sepang and Kuala Langat of Selangor State and southern part of the Seremban district of Negeri Sembilan State. This basin also includes the area of Putrajaya- the federal administrative capital of Malaysia. In 2000, forest cover in LRB was 803.8 km^2 [37]. In the past several decades, considerable forest areas have been altered to other land uses[38]. Geo-morphologically, this river basin can be divided into three regions: mountainous areas, hilly areas and flat lowlands. Elevation of the area ranges from 1000 m above sea level (asl) in mountain areas, to about 150 m (asl) in hilly areas near by Kajang[39]. From Kajang to Paya Indah wetland's area below Dengkil, the elevation drops to 50 m (asl)[40]. The Whole basin area is characterized by both natural and manmade ecosystems. Landscape spatial arrangement of this basin is characterized by irregular and discontinuous distribution of patches in its matrix. Natural and hard artificial habitat patches form a complex land mosaics which provide barriers for structural and functional ecological integrity.

Anthropogenic Development and Stressors: Including LRB, there are 189 river basins in Malaysia which are under water resources management[41]. Many reports characterized this basin by rapid urbanization, new built-up areas, modern road network, industrialization and agricultural expansion causing land-use change and loss of ecosystem services[42]. Reduction of forest cover, change in landscape spatial pattern, degradation of riparian areas, river water pollution due to cumulative impact of increasing number of urban, industrial and agricultural discharges, morphological distortion of water course due to river bank erosion, sedimentation, deterioration of aquatic habitat, increased water demand, increased threat of health hazard and so on are common issues. These are directly influenced by critical factors of economic growth and population growth[43]. The spatio-temporal dynamics of vegetation are largely determined by water availability. Groundwater is an important water source for many plants, where groundwater supports a

great density of vegetation by providing additional water for plant growth and transpiration. Rapid anthropogenic development causes degradation of groundwater recharging. In addition, groundwater, as a component of total water resources, plays a dominant role in environmental protection[44]. Besides, another dimension of critical factors that pose threat to the river basin management is climate change impact.

Climate Change: The extreme events of climate change are now serious concerns, particularly in the water sector[45]. In many cases historical records are no longer unique basis for infrastructural design, planning and investment. While go for development planning, it has become essential to foresee possible climate change impacts in addition to historical evidences[46]. Appropriate design for urban storm water management and drainage, protection of treatment plants during flooding, water borne disease control during flooding, alternate sources of potable water during drought, precautionary measures to protect life from landslide hazards, biodiversity loss, change in ecosystem functioning are climate change related issues[11] which will negatively impact on sustainable development in the basin area.

Many flood prone areas like Sg. Langat, Sg. Bangi, Sg. Jernih, Sg. Bala, Sg. Sekamat and Sg. Pangkas within LRB have been identified by Department of Irrigation and Drainage, Selangor. These areas will be more susceptible to flood when climate change extreme events will occur in the basin area. Therefore, possible consequences of climate change events should brought under consideration during structural design and infrastructural planning within river basin. The Water sector is more sensitive to the climate change impact. It is always beneficial to consult local people before finalizing any structural design in the river basin to avoid unexpected consequences of climate change impact[47].

Socio-economic and Demographic Factors Affecting Water Resources Management of LRB: The future of water resources in LRB is fraught with challenges due to impacts of inevitable consequences of critical factors of population growth, economic growth[48,49] and followed by climate change [50]. It is time that people have to ponder for a moment and be prepared to hear new concepts of water scarcity, water pollution, high cost of water treatment and many other environmental issues [51]. Yet, efforts will limit sustainable development [52] unless a holistic, integrated and participatory approach is adopted at the lowest appropriate level in time [53].

Table 1: Population projection in Langat River Basin (1991-2050)

Year	HulLangat	Sepang	Kuala Langat	Total
1991	423,774	56,825	134,746	615,345
1995	539,369	61,116	146,847	747,332
2000	689,110	76,232	162,942	928,284
2005	832,473	104,562	179,988	1,117,023
2010	950,416	157,792	198,124	1,306,332
2015	1,060,929	214,386	217,107	1,492,422
2020	1,176,619	266,208	236,842	1,679,669
2025	1,264,460	311,306	259,795	1,835,561
2030	1,330,620	362,229	283,126	1,975,975
2035	1,391,170	419,380	306,400	2,116,950
2040	1,438,563	459,793	331,090	2,229,446
2045	1,477,934	501,587	355,275	2,334,796
2050	1,501,771	544,450	378,756	2,424,977

Source: *Economic Planning Unit 2000*

Population Growth: Pollution of the LRB is strongly correlated with increasing population and water deficit is aggravated by the river pollution [9]. Increase of population in a river basin means increased water consumption from the sources and also increased disposal of solid and chemical pollutants into the waterbodies. Thus whole water cycle in a river basin is impacted by the increased population in that basin. As on the statistics of 2000, the total population of Langat River Basin is about 1.18 million (Table 1). There is a significant increase of population in LRB during the last three decades[54]. Abdul Samad [55] has documented the projected population of LRB for the period 1991-2050 as also shown in Table 2. Who also stated that population growth was recorded 3.7% during 1970-1980 and 4.8% during 1980-1991. Population of districts (located in LRB) of Hulu Langat, Sepang and Kuala Langat increased from 615345 in 1991 to 928284 in 2000. It is expected that this figure will be nearly 2.50 million by 2050 (Fig 1) [54].

Within the basin area, the highest population growth rate was recorded from the Hulu Langat district. Such increase of population growth was due to rapid urbanization and industrialization in this area [56]. Population density of Hulu Langat, Sepang and Kuala Langat for the year of 1970, 1980, 1991 and 2000 and estimated projection up to 2050 in Langat River Basin are shown below.

Population growth in this area leads to rapid land use change for social and economic development activities. In addition to that, agriculture, built-up-areas, road network causing transformation in the natural ecological arrangements characterized by fragmentation and degradation of terrestrial and aquatic ecosystems of the basin area in addition to water pollution pressure[57].

Table 2: Population density in Langat River Basin (projected up to 2050).

	Density /Sq.Km								
District	1970	1980	1991	Year 2000	2010	2020	20030	2040	2050
HuluLangat	132.3	224.2	497	745.8	1198.1	1483.2	1677	1813.4	1893.1
Sepang	57.2	66.1	77	165	226.6	382.3	520.2	660.3	781.4
KualaLangat	106.9	119.5	151	232.8	233	278.5	332.9	389.4	445.4

Source: Abdul Samad[55]

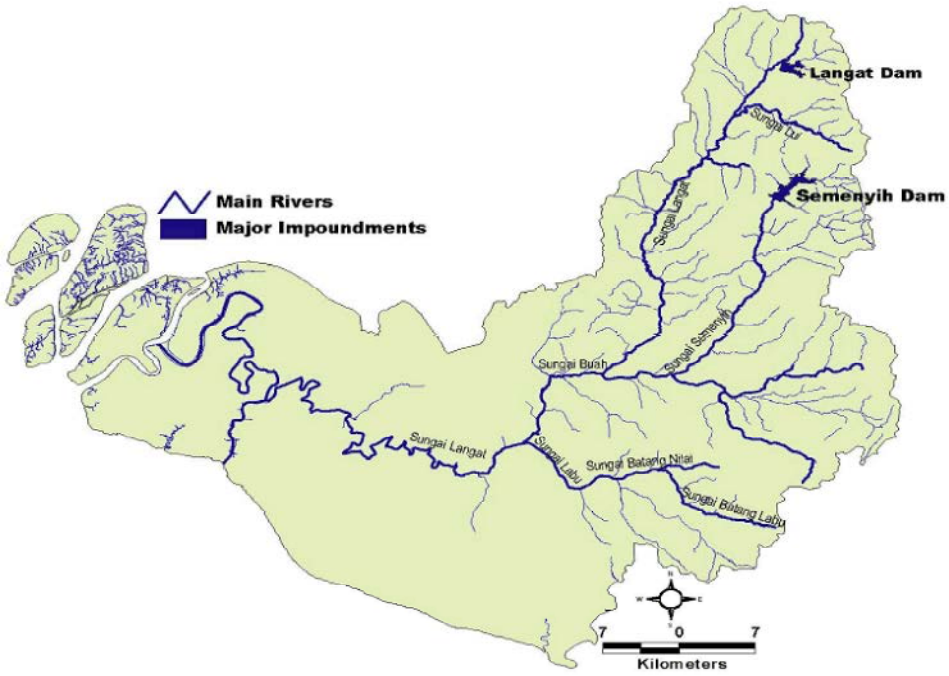

Fig. 1: The map of Langat River Basin (modified)[32]

Economic Growth: Stable consumer prices, full employment and increasing per capita wealth might be the economic and political goals and aggregate economic growth has been the principal means for realizing these goals[58]. Consequences of economic growth are land use changes to support industrialization for commodity production, built up areas for accommodation of modern life style, road networks for communication, agricultural expansion for food supply [59]. LRB is experiencing almost all these consequences of rapid economic growth and is infrequently documented in literatures and scientific journals[1,60,61]. There exists an increasing demand for clean water due to the rapid economic growth and side by side pollution pressure is also increasing[53]. Increasing demand, wasteful and inefficient industrial and agricultural uses, loss caused by non-revenue water within the supply system and continuous water pollution are now approaching towards water crisis which will lead to environmental degradation and loss of ecosystem functioning in this basin [62]. Water demand management, improvement of water use efficiency, improvement in adaptation and changing attitudes and behavior of water users is recommended to ensure sustainability[63]. Adoption of efficient technology in the industrial sector [64], reduction of water loss in the irrigation activities [65], increase water recycling[66], infrastructure development for rain water harvest, waste management[67], better enforcement for pollution control, water quality monitoring, education, communication, economic incentives and subsidies or rebates[68] are important mechanisms to improve water uses, water quality and can cope with influences of economic growth.

Domestic and industrial demand of water in LRB have been continuously increasing whereas water demand for irrigation is diminishing. Table 3 indicated that the water demand in Langat basin for domestic purpose in 2000 is 3483.20 million $m^3 year^{-1}$ which might be increased by 11544.22 million $m^3 year^{-1}$ in 2050. Likewise, water demand

Table 3: *Water Demand for Economic Growth in Malaysia*[30]

	Year					
Sector	2000	2010	2020	2030	2040	2050S
Domestic*1	3483.20	5579.02	7423.37	8937.03	10267.82	11544.22
Industrial*2	3483	5579	7423	8937	10268	11549
Irrigation*3	7350	6517	6517	6132	6132	6132

(*1 =million m^3year $^{-1;}$ *2 =m^3year $^{-1;}$ *3 =million m^3year $^{-1}$) Source: M. A. Hossain[30]

Table 4: Possible sources of urban pollution in Langat

Sources	Major chemical pollutants
Household gardens, public open spaces, sporting facilities	Soils, pesticides, fertilisers
Street litter and garbage	Leaves, refuse, packaging
Refuse dumped in open drains and waterways	Garden waste, litter, packaging
Domestic and wild animals	Faeces, BOD, bacteria
Automobiles	Petrol, oil, heavy metals, exhaust deposition, tyre and brake materials
Wastewater discharges and sewer overflows	Nutrients, BOD, bacteria
Sewage infiltration and ex-filtration, septic tanks	Nutrients, BOD, bacteria
Industry and industrial processes,	Chemicals, metals
Commercial activities, Workshops, Restaurants	Service stations, wet markets
Construction sites, landfills	Soils, building materials and rubble
Accidents and spills	Petrol, oil, chemicals
Polluted groundwater	Nutrients, metals, pesticides
Run-off from contaminated landfills	Nutrients, metals, pesticides
Sewer breakages and overflows from emergency relief structures	Nutrients, BOD, bacteria

Source: Z. Mohd Ali (2012)[77]

for industrial sector in 2000 and 2010 is 3483 and 5579 m^3 year $^{-1}$, respectively and projected figures for the same for 2020, 2030, 2040 and 2050 are 7423, 8937 10268 and 11549 m^3year $^{-1}$, respectively. The declining water demand for the same period is from 7350 to 6132 million m^3 year$^{-1.}$ That indicates that due to the increasing of urbanization and industrialization, water demand for agriculture might be declined Table 3 (modified)[41].

According to 9th Malaysia Plan[69], water demand for domestic and industrial uses in Malaysia is increasing at the rate of 6.6% per annum. Such trend is applicable for LRB. Water supply coverage is also increasing to 96.8% during this plan period. Such trend will cause water stress condition in many places of Malaysia. So, water demand management becomes an important issue for the areas where economic growth is predominant factor[70]. Consequences of economic growth generally impact at different stages of the hydrological cycle in a river basin[71]. Run-off water quality within the natural area of the river basin is characterized by soil type of the area, geo-chemistry of the underlying bedrock and vegetation type of the catchment and riparian zone[72]. In undisturbed areas, suspended solids and nutrients are found in the run-off water are useful resources for aquatic ecosystem[73]. Due to disturbance of the area, quantity of these suspended solids and nutrients may increase and turned into pollutants to cause excessive growth of plants and algae and hinder aquatic ecosystem processes. The situation is further degraded when the area is converted to built-up area in the process of urbanization, road network development and industrialization[74]. In such area run-off water quality is further degraded by absorbing heavy metals, oils, organics, oxygen demanding substances and harmful micro-organisms. Presence of these components dramatically changes the quality of the run-off water and cause tremendous damage to the aquatic ecosystem. In addition to that, impervious areas of the urban area also cause higher water temperature in the water course. A large significant changes are observed in the natural environmental balance of flora and fauna when the area is converted to built-up area for urbanization and industrialization[75]. Similarly when the natural area of the river basin is converted to agricultural land, run-off water of this agricultural land contains fertilizers, pesticides and herbicides which are also toxic to the aquatic lives. Thus water resources in a river basin become polluted and the whole process put under pressure due to land use change for urbanization, industrialization and agriculture expansion. Moreover siltation in the river due to huge soil erosion causes reduction of the river water and increase of flood and overflowing of the banks where riparian vegetation may be influenced by elevated water tables or extreme flooding and by the ability of the soils to hold water that results landslides and soil degradation[76]. Thus pollution in the river water is very common in the area with high economic growth. The Langat River Basin is also facing such pollution problems. A list of possible sources of urban pollution in the river basin is shown in Table 4.

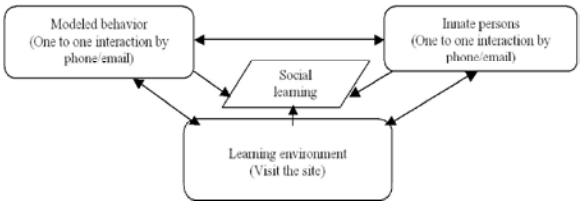

Fig. 2: Concept of Social Learning. Source: [Modified from E. Wenger (2010)[86]]

Social Learning Approach for Iwrm in Langat Basin: Main philosophy of social learning refers to capacity building by learning together to manage together any issue prevails in a society[78]. It is a process in which collaboration and networking take place to improve social capital of all stakeholders resulting improved collective norms and values for handling challenges in a river basin[79]. It is also termed as organizational learning when applied to solve problem by improving organizational capacity through active involvement of all concerned that is interactions between modeled behavior, (One to one interaction by phone/email), innate persons (One to one interaction by phone/email) and learning environment (visit the site). Each of these parameters is also directly related with Social Learning (Fig. 2). It is now a popular component for natural resources management for all kinds of processes of learning and is adopted for IWRM implementation in European countries[80-85].

This alternative policy instrument can contribute in IWRM for capacity building of all authorities, experts, interest groups and the public to manage their problems effectively through their collaboration and active involvement[87]. It helps to build up trust, develop a common view on the issues at stake, resolve conflicts and arrived at joint solutions that are technically sound[88]. There are several evidences of success stories of collaborative participation and involvement of gender in development projects of irrigation, livestock, water and agricultural project[89-91]. Therefore, there is scope to have success by adopting social learning process which will ensure stakeholders participation, collaboration and interactive decision making in river basin management. Individual change is a prerequisite to bring community and social change and their empowerment[92-95]. Empowerment is a social process, since it occurs in relationship to others. One important implication of individual empowerment is that the individual and community are fundamentally connected. Walters[96] claimed that scientific understanding will come from experience of management as ongoing, adaptive and experimental process, rather than through basic research or the development of ecological theory. Therefore, social learning process is recommended for IWRM implementation at lowest appropriate level. Pahl-Wostl[97] argued that sustainability in the water sector implies social learning based on a dialogue between policy makers, scientists, stakeholders and the public at large. She mentioned "social learning implies learning about the dynamics of change of the human system and the ecosystem, about the mental frames that shape decision making and the biophysical and social consequences of change as triggered reciprocally in one system by the other through their interconnection". As such practice of social learning following iterative process will establish three basic IWRM policy principles which are economic efficiency, social equity and ecological integrity as embedded in the IRBM/IWRM approach. Generally, in Malaysia, mass people are much aware using computer devices, smart phones and many types of other communicating devices. If we compare this capability (peoples' power) with other countries in Southeast Asia, this perhaps is a very good and unique example. In fact, this is a capacity which general people have in Malaysia and this capacitymay be capitalized in integrated management like IWRM.

In the existing IWRM practices this particular strength have been ignored and not been used adequately. However, globally enlightened community, citizen scientists and peoples' power have been used as a management solution in many aspects like for IWRM, Protected Area (PA) management, disaster management etc. Here, we approach on this very important aspect to be included in IWRM system. On the basis of this gap, a conceptual framework for a social learning approach is developed for LRB, In this framework, secondary stakeholders at the Federal level have interactions with that of state level and Selangor Water Management Authority (SWMA or LUAS). Actually SWMA or LUAS deals with all the components in this framework and vice versa. They are concerned with the investment by private sector and joint monitoring activities and investment by the state government for the water sector development. SWMA or LUAS is also interlinked with working committee, which deals with identification of issues and innovative ideas, networking and consultation within local institution, harmonization of data and information support for decision making, primary stakeholders at local level and choice of suitable models and application of information technology for decision making support. In the approached framework the most important aspect, common platform of action or social learning which had no significant activity in existing management is further interlinked with all the componets describe earlier (Fig 3).

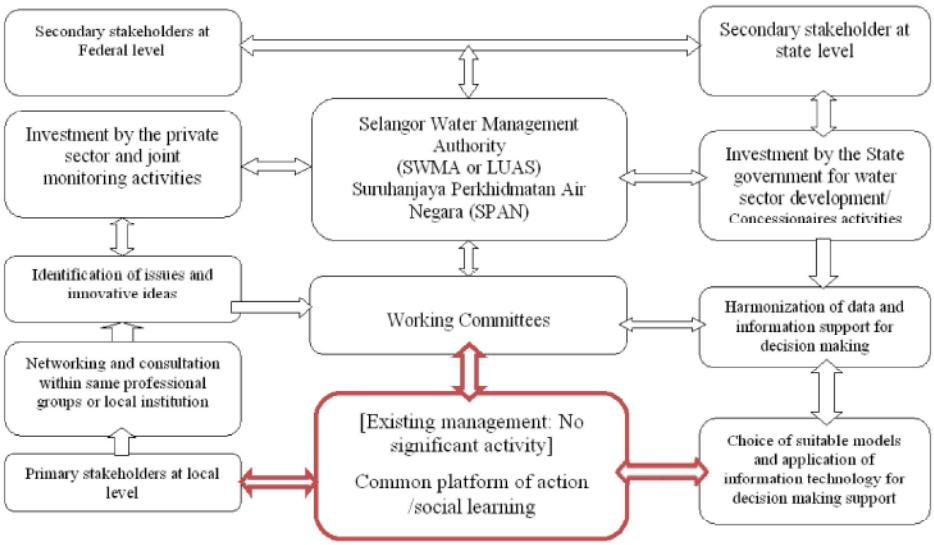

Fig. 3: Conceptual Framework for Social Learning at Local Level within River Basin. [Modified from M. Mokhtar (2010)[98]]

CONCLUSION

The growing concern for issues in LRB is due to rapid urbanization, population growth and associated anthropogenic development. Over consumption, wastes and pollutant discharges as well as rapid land use changes are among the principal causes of putting pressure on ecological integrity and natural balance of this river basin ecological systems. At present water and land resources in Langat River Basin are managed through organizational intervention of government agencies predominantly under top-down approach. In essence, to make water resources management effective stakeholder participation is one of the conditions that need to be accepted. To face the inevitable consequences of these existing critical factors, IWRM practice needs strong and active stakeholder participation for decision making and policy practice at the lowest appropriate level. But to fulfilling the condition, ignoring the involvement of the beneficiaries or the affected people during measures taken will not be or may be a little effective for IWRM. It is well understood that participants should be involved in decision making and the decisions will be made after all interests have been looked at or at least after stakeholders were offered the opportunity to bring their interests forward. Depending on the level of decision making and the specific management function envisaged, stakeholder participation can also be instrumental in planning, monitoring and enforcement. Taking experience from European countries perspectives, social learning process which will be iterative in nature is recommended for successful IRBM implementation in LRB and to make LUAS more effective and efficient. It is expected that practice of proposed social learning will provide new insights which may be useful for other river basins in Malaysia. Concerned politicians, policy makers, government officials, water managers, local leaders, academicians, researchers and interested parties may be benefited in their decision making from such lessons. Therefore, this paper argues for the adoption of 'social learning' as a framework for balancing between top-down and bottom-up approaches to guarantee three basic policy principles of social equity, ecological integrity and economic efficiency right at local level through integrated river basin management. Existing river basin organization may take the lead to practice social learning within LRB and contribute lessons for replication in other river basins in Malaysia. Action research may continue to find appropriate methods and tools for social learning practices for other river basins in Malaysia.

ACKNOWLEDGMENT

Two universiti research projects- Development of a Comprehensive Model for Erosion and Sediment Control towards Good Water Governance: UKM Campus as a Watershed Model AP-2012-006 and IWRM Research Group DPP-2013-063, Universiti Kebangsaan Malaysia (UKM), 43600 UKM, Bangi, Darul Ehsan, Selangor, Malaysia are gratefully acknowledged for supporting this research.

REFERENCES

1. Abdullah, S.A., 2003. Fragmented forest in tropical landscape--the case of the State of Selangor, Malaysia. Journal of Environmental Sciences, 15: 267-270.
2. Al-Radif, A., 1999. Integrated water resources management (IWRM): an approach to face the challenges of the next century and to avert future crises. *Desalination*. 124: 145-153.
3. Tan, K. and M. Mokhtar, 2009. An appropriate institutional framework towards integrated water resources management in Pahang River basin, Malaysia. *European Journal of Scientific Research*, 27: 536-547.
4. Ngana, J., R. Mwalyosi, P. Yanda and N. Madulu, 2004. Strategic development plan for integrated water resources management in Lake Manyara sub-basin, North-Eastern Tanzania. *Physics and Chemistry of the Earth, Parts A/B/C*. 29: 1219-1224.
5. Savenije, H. and P. Van der Zaag, 2008. Integrated water resources management: Concepts and issues. *Physics and Chemistry of the Earth, Parts A/B/C*. 33: 290-297.
6. Committee, G.W.P.T., 2004. Catalyzing Change: A handbook for developing integrated water resources management (IWRM) and Water Efficiency strategies. *Stockholm: Global Water Partnership*,
7. Jaspers, F.G., 2003. Institutional arrangements for integrated river basin management. *Water Policy*, 5: 77-90.
8. Bellwood, P., 2007. Prehistory of the Indo-MalaysianArchipelago. (ANU E Press, 2007).
9. Heng, L., M. Mokhtar, B. Rohani and J. Pereira, 2003. in *Ecosystem health of the Langat basin, Proceedings of the 2003 Research Symposium on Ecosystem of the Langat Basin*. pp: 44-57.
10. Leendertse, K., S. Mitchell and J. Harlin, 2008. IWRM and the environment: A view on their interaction and examples where IWRM led to better environmental management in developing countries. *Water SA*. 34: 691-698.
11. Gleick, P.H., 1998. Water in crisis: paths to sustainable water use. *Ecological Applications*. 8: 571-579.
12. Blomquist, W., K.S. Calbick and A. Dinar, *2005. Institutional and Policy Analysis of River Basin Management: the Fraser River Basin, Canada*. (World Bank Publications, 2005), Vol. 3525.
13. Hooper, B.P., *2005. Integrated River Basin Governance: Learning from International Experiences*. (IWA Publishing, 2005).
14. Bartram, J. and R. Ballance, *1996. Water Quality Monitoring: A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes*. (CRC Press, 1996).
15. Garande, T. and S. Dagg, 2005. Public participation and effective water governance at the local level: a case study from a small under-developed area in Chile. *Environment, Development and Sustainability*. 7: 417-431.
16. Chikozho, C., 2005. Policy and institutional dimensions of integrated river basin management: Broadening stakeholder participatory processes in the Inkomati River Basin of South Africa and the Pangani River Basin of Tanzania. *CASS/PLAAS Occasional Papers Series*,
17. Dukhovny, V., V. Sokolov and D. Ziganshima, 2004. In *Seminar on the role of ecosystems as water suppliers. Genava, UNECE*.
18. Hooper, B.P., 2006. Key performance indicators of river basin organizations. *US Army Corps of Engineering/IWR (2006-VSP-01). http://www. iwr. usace. army. mil /inside/ products/ pub/ iwrreports/ 2006 -VSP-01. pdf (Accessed 15 December 2008.)*, (2006).
19. Watson, N., 2004. Integrated river basin management: A case for collaboration. *International Journal of River Basin Management*. 2: 243-257.
20. Amakali, M. and L. Shixwameni, 2003. River basin management in Namibia. *Physics and Chemistry of the Earth, Parts A/B/C*. 28: 1055-1062.
21. Mostert, E., 1999. Perspectives on river basin management. *Physics and Chemistry of the Earth, Part B: Hydrology, Oceans and Atmosphere*. 24: 563-569.
22. Irvin, R.A. and J. Stansbury, 2004. Citizen participation in decision making: is it worth the effort? *Public Administration Review*. 64: 55-65.
23. Finsterbusch, K. and W.A. Van Wicklin, 1987. The contribution of beneficiary participation to development project effectiveness. *Public Administration and Development*. 7: 1-23.
24. Giupponi, C., 2007. Decision support systems for implementing the European water framework directive: the MULINO approach. *Environmental Modelling & Software*. 22: 248-258.

25. Jaspers, F.G., 2001. The new water legislation of Zimbabwe and South Africa–Comparison of legal and institutional reform. *International Environmental Agreements*. 1: 305-325.
26. Webler, T., H. Kastenholz and O. Renn, 1995. Public participation in impact assessment: a social learning perspective. *Environmental Impact Assessment Review*. 15: 443-463.
27. Bandura, A. and D.C. McClelland, 1977. Social Learning Theory.
28. Taylor, P., Performance and Capacity of River Basin Organizations.
29. Khalid, R., S. Rahman, M. Mangsor, S. Ali, S. Sulaiman, N. Bakar and I. Ismail, 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.
30. Hossain, M.A.A., M.B. Mokhtar and M.E.H. Toriman, Social learning in facing challenges of sustainable development: a case of Langat River Basin, Malaysia.
31. Davis, M.D., 2007. Integrated water resource management and water sharing. *Journal of Water Resources Planning and Management*. 133: 427-445.
32. Juahir, H., S.M. Zain, M.K. Yusoff, T.T. Hanidza, A.M. Armi, M.E. Toriman and M. Mokhtar, 2011. Spatial water quality assessment of Langat River Basin (Malaysia) using environmetric techniques. *Environmental Monitoring and Assessment.* 173, 625-641.
33. Lim, H., M. MatJafri and K. Abdullah, Atmospheric Profile over Malaysia Using CALISOP Data.
34. CHARLIE, L.B.S.A., 1985. Assessment of water quality characteristics during base and storm flow events on Sungai Langat Basin. *ASSESSMENT*,
35. Ishak, M.I.S., 2014. University of Ottawa,
36. Sidek, L., Z. Ibrahim, H. Basri, Z. Zalaluddin, N. Othman and W. Jayothisa, Development of an Urban Stormwater Quality Master Plan for Klang Town, Malaysia: A Case Study.
37. Abdullah, S., 2000. In *Proceedings of the 1999 Langat Basin research symposium, editor Nordin, HHM, Institute for Environment and Development, University Kebangsaan Malaysia*.
38. Noorazuan, M., R. Ruslan, J. Hafizan, M. Sharifuddin and J. Nazari, 2003. In *Map Asia Conference, Malaysia*. pp: 14-15.
39. Shaharudin, I., S.A. AGA and C. Lim, Using Geographical Information Systems (Gis) Applications in Mapping Land Use Changes in the Langat River Basin, Selangor 1974-2001.
40. Madsen, L., M.E. Hansen, M. Reumert Gjerding and S. Pedersen, 2003. Implementation of a Water Vision-In the case of Langat River, Malaysia.
41. Zakaria, S. and Z. Sharip, 2007. National Conference and Exhibition on Sustainability Malaysia 2007 (SM2007).
42. Juahir, H., S.M. Zain, A.Z. Aris, M.K. Yusof, M.A.A. Samah and M. Mokhtar, 2010. Hydrological trend analysis due to land use changes at Langat River Basin. *Environment Asia*. 3: 20-31.
43. Abidin, R.D.Z.R.Z. and E.P. Unit, 2004. In *Opening Remarks to the Conference on Asian Water*.
44. Zhu, Y., Y. Wu and S. Drake, 2004. A survey: obstacles and strategies for the development of ground-water resources in arid inland river basins of Western China. *Journal of Arid Environments*. 59: 351-367.
45. Hanjra, M.A. and M.E. Qureshi, 2010. Global water crisis and future food security in an era of climate change. *Food Policy*. 35: 365-377.
46. Solomon, S*., 2007. Climate change 2007-the physical science basis: Working group I contribution to the fourth assessment report of the IPCC*. (Cambridge University Press, 2007), Vol. 4.
47. Muller, M., 2007. Adapting to climate change water management for urban resilience. *Environment and Urbanization*. 19: 99-113.
48. Mohamed, A.F. and J.M. Jahi, 2000. Implication of manufacturing industries within Langat drainage basin: issues and challengers. *Malaysian Journal of Environmental Management*. 1: 143-161.
49. Molle, F. and J. Berkoff, *2006. Cities versus agriculture: revisiting intersectoral water transfers, potential gains and conflicts*. (IWMI, 2006), Vol. 10.
50. Robinson, J.B. and D. Herbert, 2001. Integrating climate change and sustainable development. *International Journal of Global Environmental Issues*. 1: 130-149.
51. Strayer, D.L. and D. Dudgeon, 2010. Freshwater biodiversity conservation: recent progress and future challenges. *Journal of the North American Benthological Society*. 29: 344-358.
52. Postel, S.L., 2000. Entering an era of water scarcity: the challenges ahead. *Ecological Applications*, 10: 941-948.

53. Mokhtar, M.B., M.F.A. Ajlouni and R. Elfitrie, 2008. Integrated Water Resources Management Improving Langat Basin Ecosystem Health. *American Journal of Environmental Sciences*, pp: 4.
54. Chamhuri, S. and I. Shaharudin, 2006. Poverty, water and environmental degradation: Langat River Basin, Malaysia. *A history of water–water control and river biographies*, pp: 277-298 .
55. Abdul Samad, H., 2003. In *Ecosystem health of the Langat basin, proceedings of the 2003 research symposium on ecosystem of the Langat basin*. pp: 58-66.
56. Hashim, N.M., 2000. Water consumption analysis of Langat river basin. *Malaysian Journal of Environmental Management*. 1: 21-39.
57. Ngah, M.S.Y.C. and I. Reid, 2010. In *Land Degradation and Desertification: Assessment, Mitigation and Remediation*. (Springer, 2010), pp: 347-354.
58. Cleveland, C.J., R. Costanza, C. Hall and R. Kaufman, 1984. We approach macroeconomics from a thermodynamic perspective that emphasizes the production of goods, rather than the neoclassical perspective that emphasizes the exchange of goods according to. *Science*. 225, 890.
59. Grau, H.R., T.M. Aide, J.K. Zimmerman, J.R. Thomlinson, E. Helmer and X. Zou, 2003. The ecological consequences of socioeconomic and land-use changes in postagriculture Puerto Rico. *Bio. Science*, 53: 1159-1168.
60. Idrus, S., A. Shah and A. Mohamed, 2003. In *Ecosystem health of the Langat basin, proceedings of the 2003 research symposium on ecosystem of the Langat basin*. pp: 209-225.
61. Yusuf, M., 2001. Thesis submitted in fulfilment for the degree of doctor of philosophy, institute for environment and development, University Kebangsaan, Malaysia,
62. Weng, C.N., 2005. Sustainable management of rivers in Malaysia: Involving all stakeholders. *International Journal of River Basin Management*, 3: 147-162.
63. Gleick, P.H., 2003. Water use. *Annual Review of Environment and Resources*, 28: 275-314.
64. Rosegrant, M.W*., Water resources in the twenty-first century: Challenges and implications for action*. (Intl Food Policy Res Inst, 1997), Vol: 20.
65. Sunding, D. and D. Zilberman, 2001. The agricultural innovation process: research and technology adoption in a changing agricultural sector. *Handbook of Agricultural Economics*, 1: 207-261.
66. Oki, T. and S. Kanae, 2006. Global hydrological cycles and world water resources. *Science*, 313: 1068-1072.
67. Kumar, R., R. Singh and K. Sharma, 2005. Water resources of India. *Current Science*, 89: 794-811.
68. Bernstein, J.D. and B. Mundial, 1993. *Alternative approaches to pollution control and waste management*. (Banco Mundial, 1993).
69. Unit, E.P., 2006. The 9th Malaysia plan: 2006-2010. *Putra Jaya, Malaysia: Prime Minister's Department*,
70. Stek, P.E., 2008. Urban Groundwater Extraction in Kuala Lumpur, Malaysia.
71. Ridoutt, B.G. and S. Pfister, 2010. A revised approach to water footprinting to make transparent the impacts of consumption and production on global freshwater scarcity. *Global Environmental Change*. 20: 113-120.
72. Kendall, C. and D. Doctor, 2010.United States Geological Survey, Menlo Park, CA, USA. *Isotope Geochemistry: A Derivative of the Treatise on Geochemistry*. 7: 181.
73. Graves, G.A. Y. Wan and D.L. Fike, 2004. Water Quality Characteristics of Storm Water from Major Land Uses in South Florida1. *JAWRA Journal of the American Water Resources Association*, 40: 1405-1419.
74. Moss, B.R*., 2009. Ecology of fresh waters: man and medium, past to future*. (John Wiley & Sons, 2009).
75. Abdullah, S.A. and N. Nakagoshi, 2007. Forest fragmentation and its correlation to human land use change in the state of Selangor, peninsular Malaysia. *Forest ecology and Management*. 241: 39-48.
76. Nilsson, C. and K. Berggren, 2000. Alterations of Riparian Ecosystems Caused by River Regulation Dam operations have caused global-scale ecological changes in riparian ecosystems. How to protect river environments and human needs of rivers remains one of the most important questions of our time. *Bio Science*, 50: 783-792.
77. Mohd, Z., Ali, N.A. Ibrahim, K. Mengersen, M. Shitan, H. Juahir, A. Shahabuddin and F. Azna, 2012. Temporal water quality assessment of Langat river from 1995-2006.
78. Wolters, H., D. Ridder, E. Mostert, H. Otter and M. Patel, 2006. Social learning in water management: lessons from the HarmoniCOP6 Project. *European Water Association (EWA) Publication, Hennef*,
79. Berkes, F., 2009. Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. *Journal of Environmental Management*. 90: 1692-1702.

80. Foell, J., E. Harrison and R.L. Stirrat, 1999. Participatory approaches to natural resource management–the case of coastal zone management in the Puttalam District. *Summary findings of DFID-funded research 'participatory mechanisms for sustainable development of coastal ecosystems' (Project R6977), School of African and Asian studies. University of Sussex, Falmer, Brighton, UK*,
81. Borrini-Feyerabend, G., M.T. Farvar, J.C. Nguinguiri and V.A. Ndangang, 2000. Co-management of natural resources: organizing, negotiating and learning-by-doing.
82. Gregory, R., 2000. Using stakeholder values to make smarter environmental decisions. *Environment: Science and Policy for Sustainable Development*. 42: 34-44.
83. Bouwen, R., M. Craps and E. Santos, 1999. Multi-Party Collaboration: Building Generative Knowledge and Developing Relationships among 'Unequal' Partners in Local Community Projects in Ecuador. *Concepts and Transformation*. 4: 133-151.
84. Chambers, R*., 1997. Whose reality counts?: Putting the first last*. (Combat Poverty Agency, 1997).
85. Pretty, J.N. and R. Chambers, 1993. Towards a learning paradigm: new professionalism and institutions for agriculture. *Discussion Paper-Institute of Development Studies, University of Sussex (United Kingdom)*,
86. Wenger, E., 2010. In *Social learning Systems and Communities of Practice*. (Springer, 2010), pp: 179-198.
87. Tippett, J., B. Searle, C. Pahl-Wostl and Y. Rees, 2005. Social learning in public participation in river basin management-early findings from HarmoniCOP European case studies. *Environmental Science & Policy*, 8: 287-299.
88. Ridder, D., E. Mostert and H. Wolters, 2005. Learning together to manage together. Improving participation in water management. Harmonizing Collaborative Planning European Project. *HarmoniCOP, Druckhaus Bergman*,
89. Carloni, A.S*., 1987. Women in Development: AID's Experience, 1973-1985. Vol. I. Synthesis Paper*. (US Agency for International Development, 1987).
90. Abbot, J. and I. Guijt, *1998. Changing views on change: participatory approaches to monitoring the environment*. (IIED, 1998).
91. Uphoff, N.T*., 1992. Learning from Gal Oya: Possibilities for Participatory Development and Post-Newtonian Social Science*. (Cambridge Univ Press, 1992).
92. Chavis, D.M. and A. Wandersman, 1990. Sense of community in the urban environment: A catalyst for participation and community development. *AmericanJournal of Community Psychology*. 18: 55-81.
93. Florin, P. and A. Wandersman, 1990. An introduction to citizen participation, voluntary organizations and community development: Insights for empowerment through research. *American Journal of Community Psychology*. 18: 41-54.
94. Speer, P.W. and J. Hughey, 1995. Community organizing: An ecological route to empowerment and power. *American Journal of Community Psychology*. 23: 729-748.
95. Wilson, P.A., 1996. Empowerment: Community economic development from the inside out. *Urban Studies*, 33: 617-630.
96. Walters, C.J., 1986. Adaptive management of renewable resources, 1986. *C309, C320 References C329 Author Addresses* 1.
97. Pahl-Wostl, C., 2002. Towards sustainability in the water sector–The importance of human actors and processes of social learning. *Aquatic Sciences*, 64: 394-411.
98. Mokhtar, M., M.E.H. Toriman ands A.A. Hossain, 2010. Social learning in facing challenges of sustainable development: a case of Langat River Basin Malaysia. *Research Journal of Applied Sciences*, 5: 434-443.