Review Paper

Adaption and Applications of Computer Aided Pahang River Management in Malaysia

Nasly M.A[1*], Faisal Nadeem Saher[1], TutyAsmawatiBinti Abdul Kadir[2] and Nasehir Khan Bin E.M. Yahaya[3]
[1]Faculty of Civil Engineering and Earth Resources, University Malaysia Pahang, 26300 Gambang, MALAYSIA
[2]Faculty of Computer Systems and Software Engineering, University Malaysia Pahang, 26300 Gambang, MALAYSIA
[3]Division of River and Coastal Zone Management, Department of Irrigation and Drainage MALAYSIA

Abstract

The river management is a critical and more focused area where it faces heavy water feeds due to rains and high-sloped catchment. Pahang River is an example of such situation and it receives runoff due to 220 mm average monthly rainfall. Malaysia is going on fast track of development in infrastructure and focusing on transformation process of economy. Keeping in view this fact, the vulnerability may cause due to floods in Pahang River and itseems to be a threat for the sustainable development of this area. The study has main objective of to find out possible technology tools to fine tune the existing hydro management system with a priority of healthy growth of country with minimized threats of flood disasters. Learning lessons from Australia, which is already under the process to develop computer aided river management, used as a guideline for the implication of this system for Pahang River in Malaysia. The study has investigated the broader aspects of river management handled by the system of computer aided river management (CARM). These aspects discussed in scenario of future demands for the development of such system for Pahang River. Suggestions and possible ways of action for the implications of computer aided river management identified with key role of all stakeholders. The prospectus of CARM and its adaptation is in the benefit of the country because of its sustainability and future focused development fashion.

Keywords: Computer aided river management, Pahang River, floods, sustainable development.

Introduction

History shows that Pahang River has been facing problems of floods in different sub basins causing losses of life and property. Reasons for those floods were due to improper implementation of hydrology practices for river management moreover infrastructural and industrial activities causing deforestation and un-planned land[1]. Pahang River drains off water from the inundated area of Pahang Basin to the South China Sea during wet season caused by the northeast monsoon its management is a challenging task. This challenge becomes substantial due to extreme rainfall (220 mm average monthly) which is main source for overflowing of Pahang River resulting flood events in Pahang River Basin[2].

Keeping in view the fact, that vulnerability which may cause due to floods in Pahang River seems to be a threat for the sustainable development of the area. This was major motive to explore technology dimensions for improved river management. This study has examined different available tools and techniques wouldprove to be more sophisticated and time efficient. It was also paramount to engage active role of mass media in bridging the gap between the scientific community and population. In this way media would cause disseminating information in an effective and productive manner[3]. Pahang River is not only a source of water rather it also provides fish. This fish would

expose to danger of pollution due to heavy metals and bioaccumulation of metals in fishes, in caseif percentage of these accumulated metals increase then river would be considered as highly[4]. Due to the seriousness of river pollution, a sustainable river plan would ensure the pollution free environment for river lives. In this way, it becomes necessary to develop a system to continue monitor the status of river flows as well as quality of water. If river water is at danger then ground water will also under threat of pollution. However, thequality of groundwater isimportant as all groundwater contains dissolvedsolids in the form of solution[5]. These dissolve solids are resultant from the movement of water through surface as well as through sub-soil surface.

CARM project: Australia's Computer Aided River Management Project (CARM) (figure 1) costing $65 million for Murrumbidgee River is an up gradation of infrastructure and operational processes which provides opportunity to investigate new methods of water measurement, integration of real time data for improved operations of river management to minimize wastage[6]. This paper discusses the factors, which need to improve and to consider as a part of CARM system development for Pahang River, taking an example of best practice adopted by Australia. The difference is that concept of CARM is discussed under local circumstances and challenges.
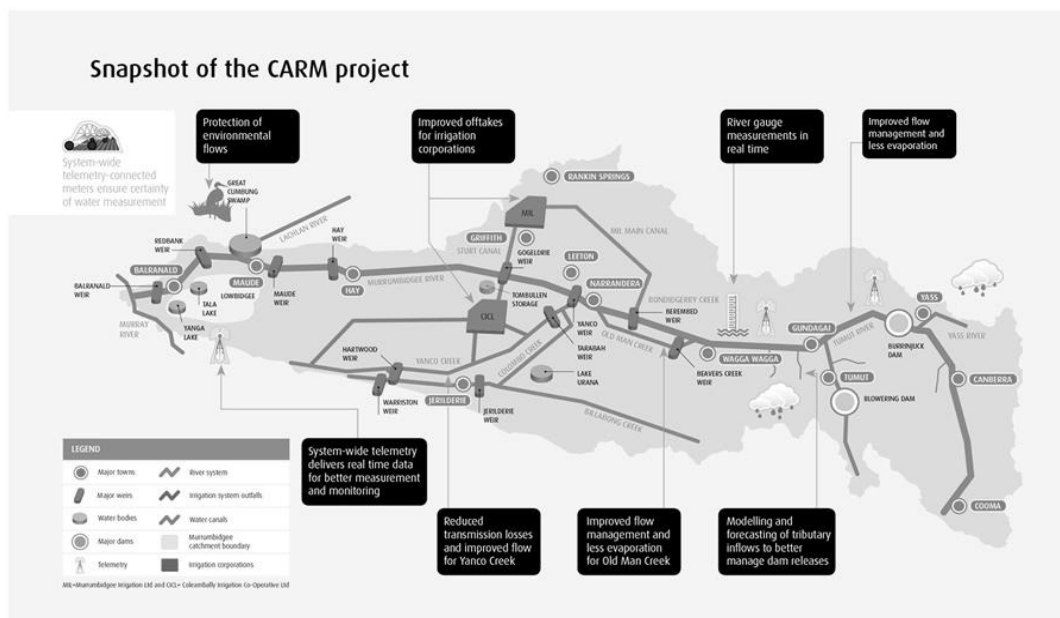
Figure-1
Australia's CARM project and its components,

Challenges Faced by River

Challenges faced by Pahang River include water quality, floods and flood related impacts of soil erosion and heavy sedimentation.

Flood monitor and early warning: Improved monitoring of river flows and optimized water use in the basin to draw maximum potential from river water are desired objectives. Otherwise, poor monitoring and improper water usage will cause to increase the dangers of floods. Damages would reduce at its maximum if alerts for dangers propagate timely and quick response to combat the flood situation through rehabilitation and evacuation plans. Isochrones maps (map showing, water travel time in a given stream) and flood zone maps would digitally combined to identify the safe places and response time. How we can adopt this kind of strategy? The answer to this is the adaptation of Computer aided River Management (CARM) system for Pahang River. The feasibility for its implementation required sound hydrology study and development of technology infrastructure.

Watershed management: The subject of watershed management is broader, here in this study discussion include shydro informatics tools would help to understand the river flow phenomenon and to develop different scenarios to made decision for best options during the hours of calamity. Decision taking in case of Pahang River is suggested by the concerned authorities under the consultation of field experts having good command over CARM, in other cases for example Red River Basin, public demanded its participation in making decisions for flood management at both of local and watershed scales. This

kind of situation may arise due to social conflicts with the government bodies and managers would have to face state that is more crucial. It can be concluded that public consultations in the basin will result conflicts among social, and damages to environmental values associated with flooding[7]. Another issue for watershed management is land sliding which is mainly impacted by land use pattern especially agricultural lands[8]. In watershed area of Pahang River, most of this falls under forest covered. It shows the importance of this issue and it must be a vital part of computer aided river management system.

River water quality: River water pollution is a great concern all over the world. This pollution is a result of environmentally degrading activities, which directly affect the river water quality. In Malaysia, the main sources of chemical, organic, and thermal water pollution are the effluents of palm oil industry, percolation of uncontrolled solid waste disposals and untreated wastewaters of human settlements[9]. The threat of deteriorated river water quality is associated with the human activities and then propagation of these pollution agents through rainfall runoff or due to direct diversion of effluents in the river. Water pollution would also consider the bacterial impact on human bodies and there is dire need to control the bacterial pollution of water bodies[10]. Water pollution model and its integration with CARM will open new horizons of improved river management system.

Sedimentation and soil erosion: Factors contributing to floods include, sedimentation, surface sealing due to urbanization, deforestation and increased inflows[11]. Danger of flood increases due to deposition of sedimentation in the bed of river and this sedimentation caused due to soil erosion as shown in figure 2.

Figure-2
Siltation in river due to heavy soil erosion

The siltation along with other contaminants such as ammonia-N also caused to pollute ChiniLake due to strong river current from Pahang River which surge into the lake through Chini River during monsoon season[12]. This indicates that siltation control must be an important part of river management strategy. CARM system provides integrating opportunities for models related to siltation.

CARM Platform Design

In case of Australia CARM can use existing and new monitoring data, including rainfall measurements and forecasts, river flows and levels and these can be used in hydrodynamic river simulation model through DHI's software "MIKE 11". Real time water level and flow measurements are prominent features for automatic update for model input data to demonstrate real river behavior[13]. Similarly, CARM system development through locally modified simulation model and improved real time monitoring network will be a breakthrough in Malaysia and prove to be an example of best practice. Real time measurements and accordingly optimized operations of river management elaborated in figure 3.

CARM adaptation and benefits: Possible ways of action for the implications of computer aided river management are required to identify according to localized environment. Under these conditions a process of simulation is performed to focus on all significant tributary inflows below the headwater storages, make full use of existing and new monitoring data, including rainfall measures and forecasts, river flows and levels[14].

Big water managing system: Pahang River is big water, and it is essential to take advantage of technology tools to develop and implement its improved and computer aided management system. In this study review of Australia's CARM project is a special source of guidelines providing clues to improve existing management system and hydro-infrastructure. Keeping close eyes on the development process of Australia's CARM project,

an attempt made to develop Geodatabase for Pahang River. The future works for the same objective includes integration of models with this Geodatabase with expected output of intelligent decision support system for Pahang River basin. The role of this system will be like computer aided river management system with enhanced features of decision-making. Summary of developed geodatabase system for Pahang River basin provided under following sub titles.

Efficient water use techniques: In scenario of future demands for the development of CARM system for Pahang River can be judged through role played by Pahang River water. Pahang River plays active roles to the industry and community daily life as Pahang River delivers more than 120 mld of water, via the Public Works Department to meet the demand of domestic and industrial sectors, particularly in urban regions and it also provides water resources to the community and also agriculture industry particularly paddy[15]. Efficient water use techniques guarantee sustainable management of river assets, it is also obvious that technology based improvement in the system requires investment. Malaysia has advantage, in the sense of investment and RM 17 billion has been allocated during upcoming 15 years, for future river improvement and flood mitigation works in Malaysia[16]. Under this big budget, to manage a big water of whole Malaysia, particularly Pahang River is a bright side of the picture to secure the natural resources for future generations.

Geodatabase for Pahang River basin: The geodatabase for Pahang River basin consists of satellite imagery, digital elevation model, land use map, geological map, and GPS surveys conducted to investigate on site salient features of river. The advantage of this geodatabse developed using Arc GIS, is that it integrated with models of river hydrology to generate updated mapping and quick analysis to develop a sense of optimised solution during any disaster related to flood. Some of maps (figure 4, 5 and 6) generated using geodatabase, showing geological features, overlay of GPS survey over satellite image and land use map of Pahang river basin provided as under.
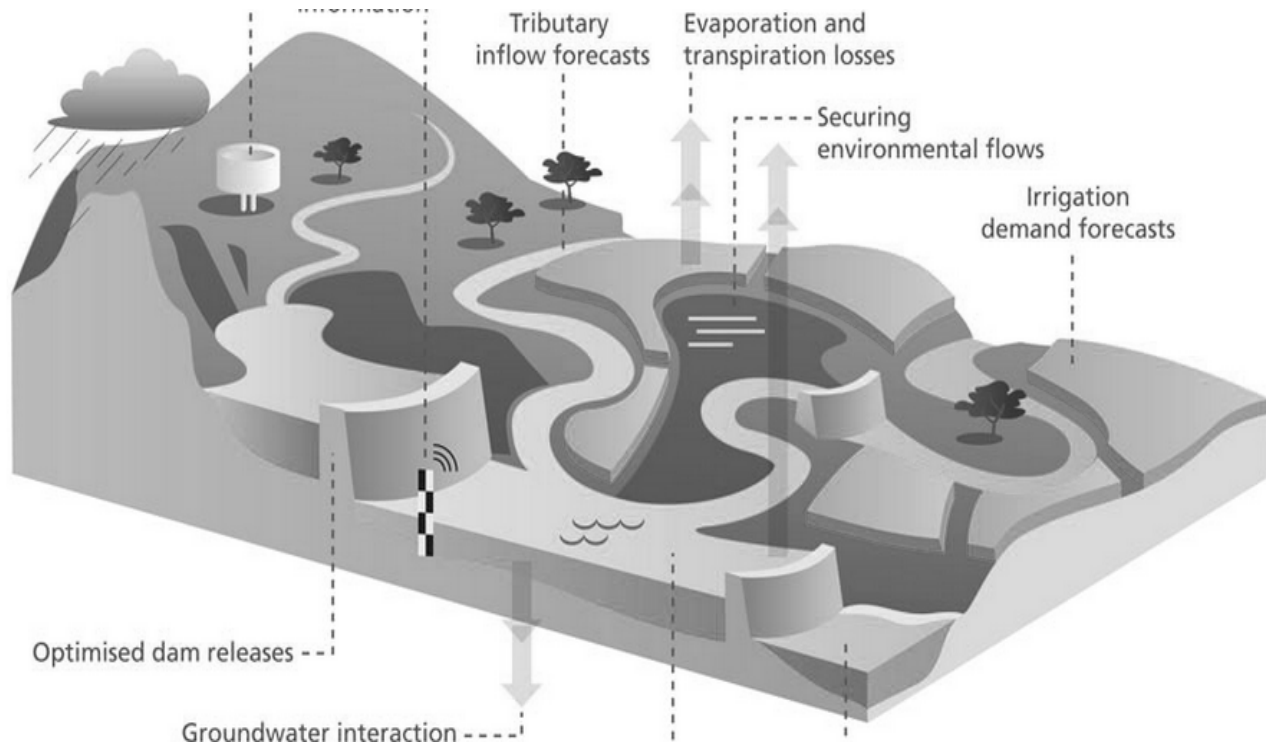
Figure-3
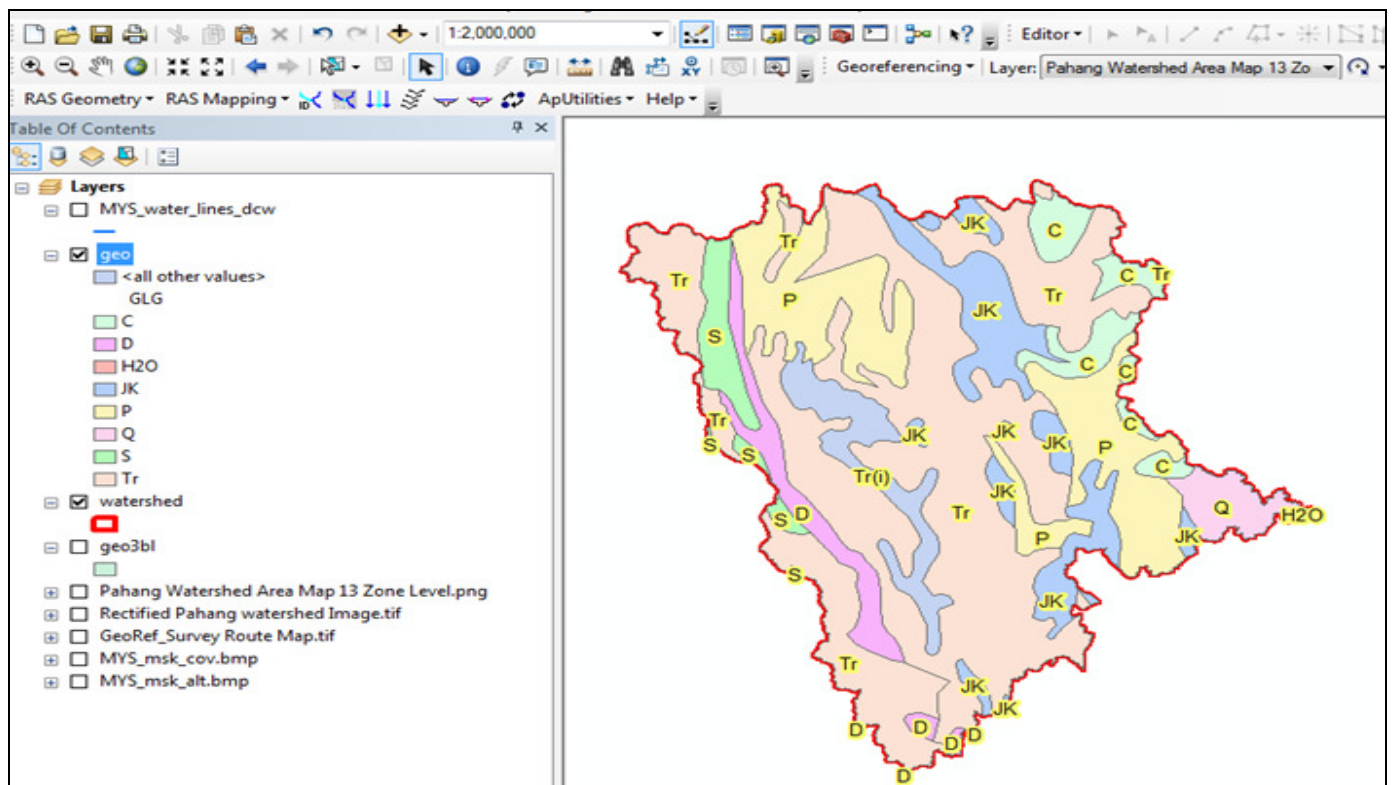**Real time measurements to optimize river operations**

Figure-4
Geological map clipped for Pahang River basin
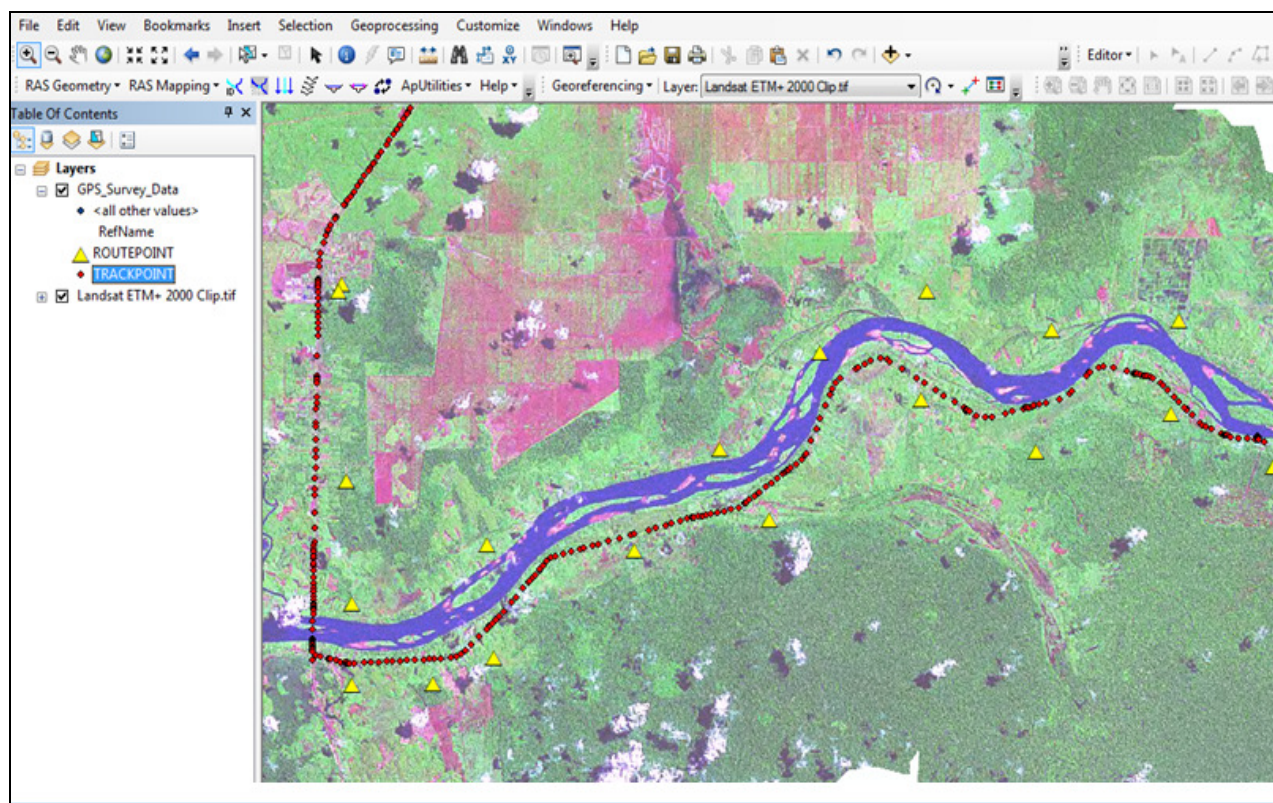
Figure-5
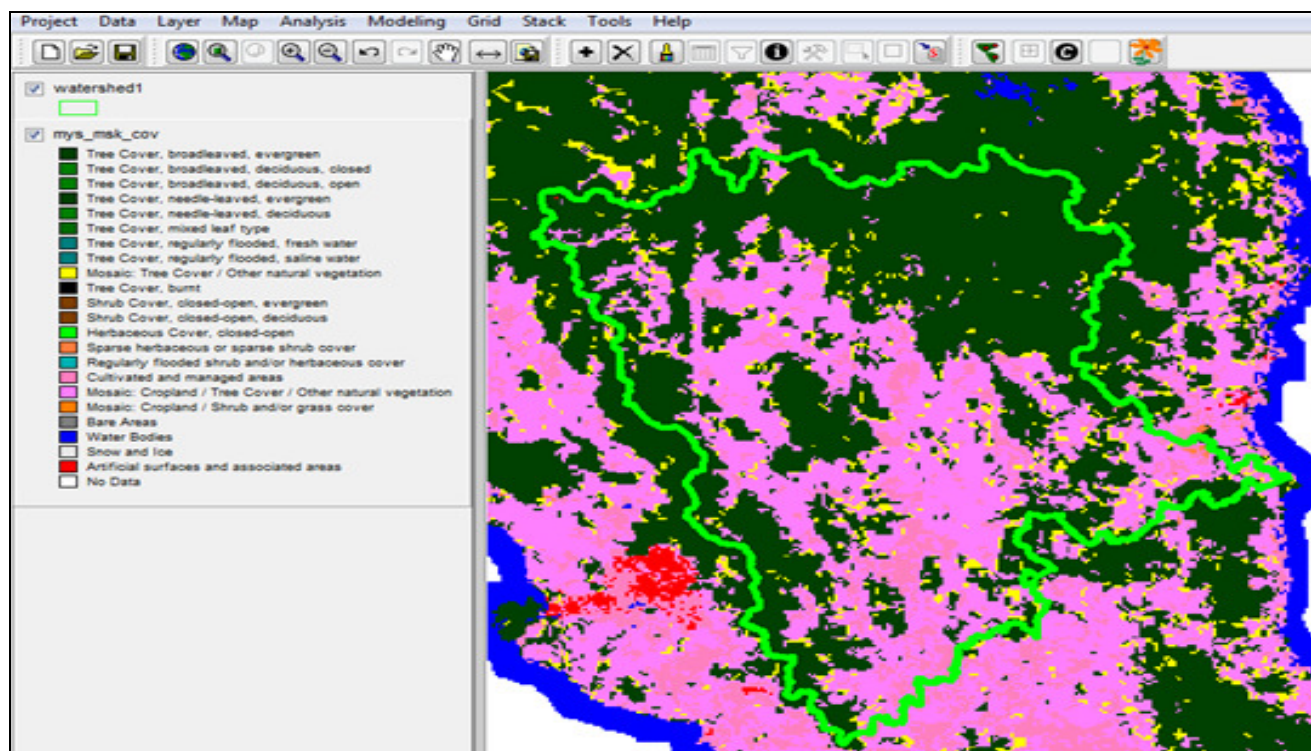**Real time overlay of GPS survey over satellite image**

Figure-6
Land use map for Pahang River basin

Conclusion

Pahang river management is not only a vital source of water but also an agent to take part for economic activities of area. Investing and adopting computer aided river management is demand based need. The feasibility to implement CARM for Pahang River is viable and would achieve through mutual efforts of all stallholders and researcher community. This study imitated research part of CARM implication by developing geodatabase. Future works as next phase of this study will carry out on hydrology model development and its integration with improved wireless monitoring network of Pahang River.

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