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Research Article

Co-opting Surface Water Management in Land-use Planning: A Review

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Abstract

Background/Objective: The paper reviews water systems management and land use planning at the global scale. Methods/Statistical Analysis: The sources of data for this paper are purely secondary. Findings: From the review, it was deduced that there is substantial literature on water systems and land use planning. In addition, it was inferred that, so far much attention has been given to the relationship that exists between urban development and surface water quality. Applications/Improvements: This study concluded by emphasizing the need for attention to be given to the institutional aspect relating to the issue of integration, by looking at the loopholes of the frameworks for the management of surface water and land use planning which over the years have received little attention.

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1. Introduction

In order to meet-up with one of the requirements of the Millennium Development Goals (MDGs) of attaining environmental sustainability, it is indispensable to efficiently integrate surface water management in land use planning. The term Surface water in general, as opposed to atmospheric or ground water, is

often described as the water that comes from sources that manifest on the surface of the Earth. (1) gives an explanation of what constitutes surface water as distinct and important factors of surface water bodies like rivers; canals; reservoir or transitional water etc. Going by this explanation, surface water can assume varied shapes as a result of peculiar physiographic nature of a, particularly given environment. At present, people are becoming more aware that flooding, drought, and water pollution, are things of concern and turns out to be significant hindrances to sustainable development (2); (3); The destruction and the diminishing of enormous water bodies in our urban areas is linked to in most cases water challenges due to haphazard development (residential, commercial, industrial, agricultural etc. that manifest or takes place during rapid urban expansion. A Large number of researchers have in the same way emphasized that the modification of surface land for agricultural activities as well as other urban development such as industrial, residential, commercial etc. amounted to surface water crises (4);(5). (6), opined that controlling surface water demands planning the land that absorbs it. Therefore, this paper reviews water systems and land use planning at a global scale, so as to gain a broader understanding of the subject matter as well as to identify a gap in knowledge so as to suggest an area for further investigation. Findings of the review were later streamlined to surface water and land use planning.

2. Methodologies

The sources of data for this paper are purely secondary. The objective of adopting this method of data collection was to fish-out manuscript of studies that examined the issue of integration with particular reference to surface water and land use planning as well as to obtain reading materials for this review. Also, an electronic search was undertaken for the years between 2000 to 2016 by the use of Google search engine in which the following search terms were included: (a) integration AND (b) surface water AND (c) land use AND (d) planning. Additionally, a lot of studies were found via the manual review of reference lists of past studies. Also, studies that were undertaken of recent, that were related to the subject matter were identified via the following databases: Science direct, Springer, Tailor and Frances online, Sage, Emerald, Wiley and Francis online library, Scopus, Digital Library and Web of science. Specific studies for this review were deemed eligible having satisfied the following criteria (i) if the study focuses on surface water and land use planning (ii) peer reviewed. The integration of surface water was drawn from worldwide literature, with no restriction to a particular case study area.

3. Results and Discussions

2.1 Water Systems and Land Use Planning

Globally, there has been several studies conducted in relation to water systems (surface and ground water) management and land use planning; (7) examines the integration of surface water in Town planning in Wuhan China. The study reports that based on the principles of International Best Practice, water planning, and design require considering innovative spatial concepts and techniques of incorporating water systems in land use planning. The study also reveals that multifunctional land use plays a critical role in offering good opportunities in order to manage water challenges and at the same time enhance the quality of space. (8) agrees that there are several interfaces between water and land use planning. The study states the connections that exist between the involved processes and further suggested modalities for future incorporation. (9) examined GIS and web-based decision support system for regional water resource control and planning. The study reported that a GIS Web-based Support System warrants policy makers to enhance strategic control and planning of water endowments. (10) studied urban waterfront spatial planning in relation to waterway governance. The study reveals that the organization and techniques of water governance and waterfront spatial planning and design are always been enhanced and enriched as shown at all strata of the society and at a different orientation of practices.(11) examined IWSM in Murray-Darling basin in Colorado. The study highlights the merits of integrated cyclical water management used as an opportunity for aquifer storage and water banking.

2.2 Relation between Land uses and Water Quality

While some researchers focused on issues of water systems and land use planning in general, others concentrated on the relationship between urban development (e.g. industrial, agricultural, residential and commercial) and water quality.(12) used linear regression analysis to buttress the relation that exists between urban development (industrial, residential agricultural and commercial) and water quality. (13) also, agree that urban developments have an impact on water quality. In their study, they found that urban expansion e.g. residential and industrial uses had a magnificent effect on Wuhan's china surface water and its immediate surroundings. Data for this study was generated through land use surveys of the city. Additionally, land use changes from 1993-2004 were measured and analyzed. studied the quality of surface water based on land use in an(14) area with small farms and thick vegetation cover. They assert that water deterioration in quality was seriously linked to agricultural activities. Furthermore, the study found that surface water quality was adversely influenced by the practice of agricultural activities at the riparian zone.

Another study conducted by (15) examined the land use effect on water quality in the urban dominant area of Mato Grosso in central Brazil. They affirm to the assertion that a strong connection does exist between land use and surface water quality. (16)observed that the critical parameters resulting to environmental pressure on the surface water in Kizillmark basin are mainly non-point source pollution, emanating from a wild spread of animal breeding, dumping of solid waste, and enormous salinity as a result of domestic and industrial waste in the water. In this study, water contamination loads and water quality of rivers were displayed on maps using GIS. (17) Similarly, strongly agreed that relationship really exists between urban development and water quality. The study employed Pearson correlation analytical method to ascertain the relationship. The study found that land use plays different roles in pollution flow processes. It was also discovered that residential use has a positive link with most water quality indicators, particularly heavy metals. This was crucial to land uses in Non-Point Source pollution control areas. The study proposed a strategy for the regulation of land uses in order to assist in enhancing surface water quality in urban areas that are the same with Han-yang, china. (18)similarly used multivariate statistical technique and Geographic information System (GIS) to study the effect of land use on the quality of surface water in Dongxiang river basin, southern china. They found that the eighty-three sites partitioned into three different groupings of land use types such as forestry, agricultural and urban demonstrate that water quality factors show significance variation between the urban and the forest sites. The portion occupied by the forest was linked with oxygen but in a dissolved form which is adversely linked with water temperature, permanganate index, electrical conductivity, nitrogen, and phosphorus. Whereas, the area dominated by the urban land use was greatly linked with ammonia and nitrogen concentrations. Forestry and urban land uses have a great effect on the quality of water in the dry period than in raining period. (19) in the same way, employed multivariate statistics in the arid and semi-arid region to show the link between land uses and the quality of surface water. The outcome of the study reveals that urban land use and some Non-Point Sources such as range land use might explain the higher chemical quality of water in the semi-arid region. These findings confirm that one of the greatest factors of water quality predicament is connected with urban land use (industrial, and residential) due to human engagements, Hence, the relationships between water systems and land use require efficient coordination. The study went further to stress that, the effects of different land uses (e.g. industrial, residential, commercial etc.) on river quality suggest that the established land-water relationship is important enough to planners and decision makers in evaluating water and land use plans and facility collaboration. (20) also found a clear linkage between quality of water and land uses. In this study, both sectional and longitudinal studies were carried out to find out the impacts of land use on the quality of water in Utapao River. Furthermore, data was manipulated from maps provided by the land department,

correlation, and regression analysis was undertaken to show the relationship between urban development (industrial, residential, agricultural etc.) and water quality.

2.3 Watersheds.

Furthermore, many researchers focused on the planning and land use management of watersheds because of the important role they play in surface water storage. A watershed can be described as an area of land that is made up of particular types of rivers and streams which often drains into a single larger body of water, such as a bigger river, an ocean or a lake. Classical studies include that of (21) looked at a preference study in relation to land use scenarios connected to watershed found in a semi-arid region. The study shows that respondent will prefer an innovative management plan that pays attention to traditional farm and river quality. (22) applied GIS and Remote Sensing in examining the land use and land cover of Markina sub-watershed in the Philippines. The research plays a critical role not only in knowing the past and present trends of landscapes of sub-watershed but also gives an insight to areas that needs habitation for the evolvement of compatible mitigation measures and techniques towards proper management of watersheds. (23) also, agree with the need for the planning and management of watershed areas. In their study, they looked at the environmental management of watersheds distinction. The study reveals that for regional differentiation of watersheds, it is imperative not only to promote integration but also to conduct a distinction management according to planning requirement and economic laws. This study was achieved through the review of relevant literature.(24) looked at improving watershed management. The study reports that a well-improved watershed management results to remarkable economic, social and ecological benefits.

2.4 Storm Water

However, some researchers focused on the planning and management of storm water. Basically, Stormwater is pure rainwater. In urbanize settings, rain shower that drops on the roof of one's residence, or is collected on paved surfaces, for instance, roads, and footpaths etc. Some portion of it seeps down to become ground water while some portion of it still moves straight from streets and gutters to rivers, the harbors, and the oceans amongst others. (25) Studied urban waterlogging and storm water management. They concluded that there should be measures of planning if sustainable development is to be attained. (26)examined the management of storm water and Urban planning experiences from forty years of innovation. The study report that there is reservation about the dichotomy that inhibits action – “Is storm water to be handled by planning department or should be within the jurisdiction of water department?” .It

concludes that water specialists have the same opportunity to incorporate the management of stormwater approaches within a wide urban planning practice and hence, can facilitate the application of sustainable optional systems than applying traditional pipes or sewers. Empirical evidence for this study was derived from in-depth interviews with urban specialists from nine Swedish municipalities.

2.5 Integrated Water Resource Management

Other scholars pay attention to Integrated Water Resource Management (IWRM) concept that is directed towards the integration of water systems and land use management. (27) studied integrated land use and water management system ecology for the benefit of the poor in South Sudan. The study highlighted the interface between policymaking and socio-ecological systems for resource reuse. This study was achieved through the use of policy tool like the Integrated Water Resource Management. (28) similarly adopted the Integrated Water Resource Management (IWRM) in their study that examines integrated management of Karstic Water in Serbia; they report that the setting-up of integrated Karstic water management may often represent the reason for further elaboration of the overall system of environmental sustainability and management. The concept of IWRM is to a great extent acclaimed by a large number of international bodies (the World Bank, International Water Management Institute, the Food and Agriculture Organization), and regional bodies. They emphasize the need to integrate water resource management by realigning sectorial organizations along water boundaries.

Academic research on water systems and land use planning at the global level focused much on the impacts of urban development, for instance, industrial, agricultural, residential and commercial land uses on water quality. However, there are also studies carried out on the land use planning of stormwater as well as watersheds, because they serve as important elements when referring to surface water management. In addition, there is literature that covers the integration of water systems in land use planning, although in most cases the integration does not often appear to be effective. The inefficiency is manifested by the way and manner floodplain land uses in most parts of the world are allowed to flourish with various forms of physical developments, despite the risk associated with these marginal areas, particularly in the event of flood incidence. If the institutional framework for the management of surface and land use planning is efficient, these developments will have been halted as well as the regulatory bodies concerned will ensure that floodplain zoning as a non-structural approach to flood control is highly respected. Therefore, there is need for more attention to be given to the institutional aspect relating to the issue of integration, by looking

at the efficiency of the frameworks for the integration of surface water and land use management through examining the factors militating against effective integration, which over the years received little attention, because much attention has been devoted to the effect of land use or urban development on the quality of water.

4. Conclusion

The paper carried out a review of water systems and land use planning. It focused on surface water and land use planning. The link between land use and surface water quality was explored. Other elements that relate to surface water such as the land use planning of stormwater and watersheds have also been considered in the review. IWRM as a concept for the integration of water systems has also been explored. The paper concluded by recommending that more attention should be given to the institutional aspect relating to the efficient incorporation of surface water and land use planning because over the years attention has been on the impact of urban development on water quality.

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