Development of a web based information technological working interface for the Nilwala river basin to enhance resource mobilization

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Abstract
Problematic issues related to research and development activities on Nilwala river basin have been raised due to socio economic, political, environmental, cultural, national, regional and local level factors. Hence, policy makers, developers, administrators, in the government and non governmental sectors have massive set of information and data to be processed before taking decisions. Presently, it is a time consuming and costly effort. Hence, the study discusses the development of the web base electronic working interface for efficient decision making through coordination among different governmental and non governmental institutions to enhance sustainability of the Nilwala basin.

An interface will be developed to coordinate different organizations involved in research and development of Nilwala river basin. A web page having a common format will be developed for each governmental and nongovernmental agency, which provides facilities to incorporate their organization profile, their activities, jurisdiction etc. Each of these web pages will be categorized and linked into sectoral programs like Archeological, Administrative, Agricultural, Environmental, Livestock and Fisheries, Religious, Tourism, etc. These programs will be listed in a simple web page where it will be named as a Common Information Technological Platform or Interface (CITI or CITP).

Data (daily, monthly and yearly updated) provided here will be monitored by the department of Agricultural Engineering with the assistance of relevant organizations. Furthermore, any type of data will be purchased through the internet. Comments will be entertained through the internet for any organization relevant to their activities. This will provide the facility to share knowledge effectively and efficiently among the community having different disciplines.

The study will help to improve the quality of decision making through data sharing and it will strengthen the stakeholder participation. Further, it will enhance the research and development work through appropriate project identification and formulation towards the economic development of the Nilwala River Basin.

Background
Watershed management projects focus mainly on problems caused by deforestation, declining soil fertility and productivity, erosion including landslides and sedimentation, flooding, reduced downstream water quality, and non-dependable water supply, etc. Alteration of hydrologic behavior generates continuous impacts on soil erosion, nutrient leaching, water quality, and spatial and temporal distribution of water. In order to maintain the sustainability of the watershed eco-system and human activities on agriculture, forestry, land uses, and other structural and nonstructural interventions, integrated approach is highly recommended to achieve effective decision making in development activities. Otherwise, inappropriate planning can lead to incorrect priorities resulting in waste of resources as well as the degradation of natural eco-system. The Nilwala river originates at Panilkanda at an altitude of 1,050 m and after traversing 70 km the river flow is discharged into the sea at Matara. The area of the river basin is 1,073 km². The river flows across two distinct zones. The upstream up to Bopagoda traverses a hilly terrain with a steep longitudinal slope and the river bed in this zone is rocky with fairly high-flow velocities. The longitudinal slope decreases towards downstream. Bopagoda is located 36 km upstream of the sea, the longitudinal slope is about 0.4 m per km. In the upper part of the basin, floods do not cause any considerable inundation along its major course due to very narrow floodplains. However, flash floods are a recurrent feature in its tributaries. The longitudinal slope of the downstream of the river is 0.25 m per km at Kadduwa which is located 18 km upstream of the sea. The average slope of the river bottom is almost zero along the last 13 km of the river where a broad valley is located. This lower basin which
extends inland up to about 12 km from the coastline is subject to severe flooding with southwest monsoonal rains experienced from May to June and with convectional and cyclonic activities from October to November. The intensity and duration of floods vary from time to time depending on the location.

**Impacts on the river basin**

During 1940s forests cover was about 50 percent of the total land area of the river basin and it was declined up to 36.6 percent during 1950s. This is mainly due to tea and rubber plantations, shifting cultivation and home gardens. Forest cover of the headwater areas was reduced from 36.6 to 23.2 percent due to the rapid development activities, encroachments and large-scale logging operations which took place after 1970s. Forest cover has been continuously disturbed and reduced up to 18.1 percent around 1980s due to expansion of tea, rubber and cinnamon plantations. This unplanned expansion was visible after 1950s and it was mainly due to tea smallholdings, which occupied mostly the steep terrain of the upper watershed by the local people and migrants who encroached the forest land. This phenomenon emerged after the introduction of subsidy scheme and highbd tea clones for smallholders in 1958. Due to lack of coordination among institutions involved in the development of the basin, conversion of forest lands into other land uses has been accelerated. It caused soil erosion and increment of surface runoff during heavy rains. Thus, loss of top soil and depleting soil fertility can be observed in tea plantations where people depend more on chemical fertilizers. With respect to this environmental degradation, limitations can be observed for the agricultural land uses, due to limited rooting depth resulting from reduced water-holding capacity as well as the stoniness and acidity of exposed sub-horizons. Development of infrastructure facilities namely, roads and buildings with heavy disturbance to the land forms, aggravated the sediment supply into streams, with landslides resulting from the indiscriminate removal of the toe-support. Stream channels become silted due to high sediment supply from the watershed and frequent floods can also be observed which cause damage to rice fields. Lowering of the ground water table and reduction in groundwater recharge resulted drought conditions after periods of dry spells due to lowered well levels and diminishing flow in perennial rivulets, springs, and some of the first-order and second-order streams. Since the river bed is below the sea level at the outlet, tidal intrusion of sea water in to the estuary have been increased with low flow regimes where less fresh water is available to repel sea water intrusion. Domestic water supply is also severely affected during dry spells and in the recent past many domestic water supply schemes have been implemented to overcome this problem. Due to the aggravation of this situation Matara water supply scheme was relocated a few kilometers upstream in 1980s. These problematic issues related to research and development activities on Nilwala river basin are pressed by socio economic, political, environmental, cultural, national, regional even local level factors. Hence, policy makers, developers, administrators, in the government and non governmental sectors have massive set of information and data to be processed before taking decisions. Presently, it is a time consuming and costly effort. Hence, the study discusses the development of the web base electronic working interface for efficient decision making through coordination among different governmental and non-governmental institutions to enhance sustainability of the Nilwala basin.

**Decision making with decision support systems (DSS)**

Sir Lankan approach adopted for the natural resources management has to be changed with the recent technological development. These changes are related to the widespread use and availability of Geographic Information Systems (GIS) where it provides facilities to locate and quantify essential habitats and natural resources, threats to those resources, and potential restoration opportunities by analyzing spatially referenced data. Spatially referenced data has become essential in making well-informed and well-integrated decisions regarding natural resource protection in the context of rapidly transforming landscapes. Manual processing of large volume of data is very expensive and time consuming. Thus, decision support systems have been developed to overcome this situation and these systems help users to manage the complexity by automating the process of analyzing the relevant data, while allowing the resource manager to focus on the task of comparing alternative management objectives and solutions. Decision Support System is described as software that combines with the facilities
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provided in GIS technology to automate and summarize the results of spatial analyses, allowing managers easily to integrate biological, physical and chemical data with other demographic, social, geological, and hydrological data while in the phase of decision making process. Furthermore, the decision-making process becomes more transparent, quantifiable, and easily repeatable, while enhancing the objectivity of decision-making where public trust and support can be easily achieved.

Objective
Development of a web based Information Technological Interface or digital interface as a decision support system for the management of Nilwala Ganga watershed.

Methodology
As the first phase of this research project, an interface has been initiated to coordinate different organizations involving in research and development of Nilwala river basin. A web page having a common format has been developed using web publishing tool available in Windows Office 2003 for each governmental and nongovernmental agency. This provides facilities to incorporate organization profile, activities, jurisdiction etc. Each of these web pages are categorized and linked in to sectoral programs namely, Archeological, Administrative, Agricultural, Environmental, Livestock and Fisheries, Religious, Tourism, etc. These programs are listed in a simple web page named as a Common Information Technological Platform, Interface or Digital interface (CITI or CITP).

Web Interface
The home page of the working interface or digital interface (Figure 1) comprised of four main icons linking home page to about us, contact us, digital interface and Nilwala Today pages. Page named as about us contains the basic information of the web hosting agency and a brief description of the facilities available within this electronic working interface. Contact information and location is given in the page named as contact us.

Digital Interface
Digital interface provides links to different sectoral programs namely, Agricultural sector, water sector, industrial sector, fisheries sector and resource exploitation sector of the Nilwala basin (fig.2). Nilwala today is a summary view of daily updated information about Nilwala river basin and it consists of several interesting features.

Agricultural Sector
The link provided for agricultural sector, facilitates accessing in depth information about governmental and non governmental organizations involved in agricultural sector within the basin. Likewise several other links are available to represent other governmental and non governmental organizations involved in agricultural development work within the basin. Linkage provided by the department of agriculture helps viewer to get more information on cultivated crops within the basin namely, cultivated extent, expected production, cultivated date, harvesting date etc. Data can be viewed district level, AGA division level, AI division
Other available facilities
Nilwala today is a summary view of daily updated information about Nilwala river basin and it consists of several interesting features as listed below.

- **Thematic Map Section**
  This is where viewer can access thematic maps based on the spatial distribution of ground water table, infant birth weight, age groups and work force with respect to educational levels, spatial distribution of the population with respect to the education level and employment etc. These map data are available district level, AGA division level, GA division level even at village level.

- **Weather watch**
  This interface provides daily updated information on climate and weather conditions prevailing within the basin namely, spatial distribution of rainfall, temperature, relative humidity, sun shine hours, evapotranspiration, wind speed, wet bulb and dry bulb temperature etc.

- **Crime watch**
  Viewer can access current information about various crimes happening within the basin, spatial distribution of crimes and their preventive mechanisms etc.

- **Health watch**
  This is where viewer can access data pertaining to the overall health conditions of flora and fauna of the river basin. Spatial distribution of diseases outbreaks, epidemics, birth and death rates, infant birth weights are identified.

- **Telemarketing and transportation**
  This section provides current marketing information namely, price fluctuation and its spatial variations, ex stocks availability, contactability. Daily transport schedule can also be viewed to get day to day information regarding the transport facilities available within the basin.

- **Employment opportunity**
  This is where viewer can access employment opportunity available within the river basin.

- **Religious and cultural events**
  This section is dedicated to provide information regarding religious and cultural events takes place within the basin. Furthermore, it is a valuable opportunity to young professionals, authors, singers, artists to highlight their events and get the publicity to their work.

- **Sport news**
  This provides latest information on sports activities taking place within the basin.

- **Political news**
  This provides the current political interests, bills passed and other political activities happening within the basin.

**Expected outcome**
This digital interface provides a gateway to a large amount of well-organized data base developed for the Nilwala River Basin. Viewer can access data through a search engine and provided links. This will enhance the data information sharing within the same organization and as well as among different organizations.

- **Improve the quality of decision making through data sharing**
  Since this electronic working interface provides data sharing facilities, better coordination among different institutions can be easily maintained especially during decision making activities. It will improve the quality of decision making. This will provide the facility to share knowledge effectively and efficiently among the community having different disciplines.

- **Strengthening stakeholder participation**
  Stakeholder participation can be further strengthened during policy development, decision
making across sectoral interests such as industry, agriculture, irrigation, exploitation of mineral resources by getting direct feedbacks from them through the web using facilities provided within the electronic working interface.

- **Contribution to the research and development work**
  This electronic working interface can be used by the local as well as international research and development community to conduct research and development work in various ways to uplift the living standards as well as conditions of other eco-systems of the Nilwala basin. Furthermore, this will be a valuable opportunity to students, researchers and policy makers to optimize the financial and other resource usage.

- **Contribution to the economic development**
  Organizations dealing with production and marketing, can have their own E-business centers for rural level too. Price fluctuations could also be displayed on daily basis which will provide a better free market environment for rural production and marketing.

- **Contribution to project identification and formulation**
  Since every organization such as Departments of Agriculture, Irrigation, Survey etc. listed within the electronic working interface are providing their problematic areas of work within their web links, any body can search it and contribute to solve it by accessing all information relevant to that particular problem.

**Future work**
During the second phase of the project GIS technology will be used to develop the database and it will be linked to the common technological interface or the digital interface. After completion of the second phase of the research project quarrying and digital map generating facilities will be incorporated to view data, graphical representations, namely, tables, graphs, bar charts, forms, reports and even spatial distribution of viewer preferred agricultural parameters. Linkages provided by other organizations and institutions will also provide relevant information with respect to the various development aspects of the Nilwala river basin.

**References**