GIS APPLICATIONS TO ENHANCE THE EXISTING WATER SUPPLY SYSTEM OPERATED BY NATIONAL WATER SUPPLY & DRAINAGE BOARD

BY

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DECALRATION BY THE CANDIDATE

I do hereby declare that work described in this thesis was carried out by me under the supervision of Prof. G.M. Bandaranayake and report on this thesis has not been submitted in whole or in part to any University or any other institution for another Degree/Diploma.

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LIST OF ABBREVIATIONS

NWSDB	-	National Water Supply & Drainage Board
CBO	-	Community Based Organization
O&M	-	Operation & Maintenance
GIS	-	Geographic Information System
ESRI	-	Environmental Services Research Institute
PS	-	Pradeseya Saba
OWD	-	Otay Water District
GPS	-	Global Positioning System
DSD	-	Divisional Secretariat Division
HTML	-	Hyper Text Markup Language
SQL	-	Structured Query Language
DBMS	-	Data Base Management System
LAN	-	Local Area Network
CIS	-	Consumer Information System
AWWA	-	American Water Works Association
DGM	-	Deputy General Manager
AGM	-	Assistant General Manager
RSC (WN)	-	Regional Support Center (Western North)
SCADA	–	Supervisory Control and Data Acquisition
WSS	–	Water Supply Scheme
USGS	–	United States Geological Survey

OIC	–	Officer In Charge
DI	–	Ductile Iron Pipe
PVC	–	Polyvinylchloride Pipe
GND	-	Grama Niladari Division

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ABSTRACT

Water is an essential entity to health of the people. More child die each day due to dirty water or poor hygiene is avoiding Humanities must have clean water for drinking without water they fall ill and die. People also need fresh water for cooking, washing, and sanitation. Approximately 80% of Sri Lanka's population has access to safe drinking water, which is comparatively advanced in South Asian Nations. Water utilities in developing countries face a challenge in maintaining the existing supply and extending the supply of pipe borne water to rural areas in face of growing demand.

Water supply facilities are not available for more than 30% of the world population. Nearly 40% of Sri Lankan populations have been providing organized water supply facilities and 59.4% is dependent on other sources such as wells, tube wells, streams and rivers etc., including About 10% dependent on unprotected sources such as lake, stream etc. . The Government of Sri Lanka has given priority to provide safe drinking water supply for all in 2025 and 60% piped water supply coverage by 2020. It provides drinking water to 1.5 million families in the urban/semi urban parts of the country and to expect to expand the piped water supply coverage up to 60% in year 2020.

Major constraints on the expansion of coverage are, Lack of capital to the water board due to poor cost recovery where only 1/3rd of the total cost of water is recovered from the consumers. Therefore, innovative methodologies are required to identify the cost of providing water supply facilities and implement a cost recovery system in order to meet the challenges in the water sector. With the increase in worldwide water demand over the last few decades, water utilities face problems of supplying the quantity of demanded water. The field of water demand analysis is becoming increasingly important, due to the problems that water utilities are faced with, when supplying the constantly increasing water quantities.

When water is supplied by water board there are two types of demands. (a) Feasibility Study stage design Demand done by water board. (b) Actual water demand for consumer's water usage.

In Sri Lanka initially demands made by people will be changed due to many reason such as changing populations, urbanization and natural disaster. Thus actual water demands will be changed. But water board has to be spending a high cost but benefits will be low then cost benefit analysis indicates loss of money. To minimize this bad effect understanding of real demand is necessary. This study attempt to analysis this accept using GIS according to the study.

GIS are computerized systems for the storage, retrieval, manipulation, analysis and display of geographically referenced data. When it was first developed in the 1960s, the GIS were primarily used in the public sector. The industry then made vigorous progress in the 1970s and 1980s, during which the United States has played a leading role. Since then, research on both methodology and application of GIS has grown rapidly all over the world and GIS have now developed into an ever increasingly important and versatile tool for many different research fields covering natural, social, medical sciences and engineering

CHAPTER ONE
INTRODUCTION

1.1 National Water Supply & Drainage Board

The National Water Supply & Drainage Board (NWSDB) was established in January 1975 by an Act of Parliament which presently functions under the Ministry of Water Supply & Drainage is the principal authority providing safe drinking water and facilitating the provision of sanitation in Sri Lanka. In accordance with the Board Act, several major Urban Water Supply Schemes operated by Local Authorities were taken over by the NWSDB to provide more coverage and improved service. Consumer metering & billing commenced in 1982. Rural Water Supply & Sanitation programmers including deep well programmers are also being implemented by the NWSDB.

During the past 36 years, the organization has considerably expanded its scope of activities. It is one of the largest public sector institutions and at present more than 40 years of operation and the employee capacity exceeds more than 10,000 of all categories. In addition to the main pipe born water supply through its network of large scale water purification and distribution system, to keep in line with the Millennium Development Goals, the institution promotes and facilitates the Rural Water schemes landside operated through Community Based Organizations to increase the water supply coverage for rural areas which are not covered by the main distribution network. Also the NWSDB has the facilities to promote the ground water utilization for various purposes.

The NWSDB is presently operating 312 Water Supply Schemes which cover 39% of the total population with pipe borne Water Supply, 12% of the population is served with hand pump tube wells. NWSDB hope to increase the coverage with pipe borne water to 50% by 2020 so that the United Nations Millennium Development Goal of 85% safe drinking water coverage can be achieved by that year. The NWSDB is also in charge of the sewerage system in Colombo & suburbs. According to the NWSDB web site, the following are the primary and secondary functions of the organization.

The Primary Functions are Investigation, planning, design and construction supervision of water supply and sewerage projects with local funds and donor assistance. Carry out

feasibility studies, cost estimation & Environmental Impact Assessment for such projects, Operation and maintenance of water supply and sewerage schemes to provide satisfactory service to customers, Billing and collection through affordable tariff setting.

Secondary Functions are Human Resource planning and development, Research and development for service improvement utilizing innovative techniques, Budgeting and financial control, Publicity and consumer awareness programs on effective use of water and reduction of non-revenue water, Corporate Planning and Strategic Management, Laboratory services for water and wastewater quality monitoring and control, Technical assistance to Community Based Organizations (CBO's), Local Authorities, State Agencies and Private/ Public sector institutions, Ground water investigations, deep drilling, Tube Well / Hand Pump installation, Consultancy services on water supply and sanitation, Project formulation and management, Coordination with sector actors and stakeholders, Information management and reporting.

One of the largest water supply networks maintained by NWSDB is the Greater Colombo (GC) water network which is in the Western Province of the country. Extent of the GC area is around 412 sq. km. and it consists of five water manager zones. Presently there are around 400,000 water connections in this highly urbanized area and this number is increasing rapidly. Efficient management of this large water network is essential for providing water to the consumers without disturbances. Large scale maps of water network and base map details are extremely useful in this connection. NWSDB has produced first set off the water features and base map details in nineteen eighty three.

Mapping section was established in the year 1980 in NWSDB with the objective of preparation and updating of maps specially the water distribution network carried out manually by the technical staff.

In the year 2000 was a new area GIS and Mapping Section since ADB assisted 3rd Water Supply & Sanitation Project came under operation of NORAD funding. The new methodology of GIS Technology was introduces for water utility mapping in a fully equipped computerizing environment adding more value and convenience for using, keeping, storing, changing and reusing information. As the initial step, on our request

the Survey Department prepared the digitalized base maps with one meter accuracy in the city of Colombo and suburbs, approximately 350 square kilometers. After 2005, water utility and sewerage GIS were developed in the NWSDB. At present our total GIS coverage is around 900 square kilometers for water.

The main distribution line covers a considerable part of the country including main cities, urban and sub urban areas. In order to increase the main water supply coverage, NWSDB is consciously expanding the system through various new projects. At present, the NWSDB has a consumer based of around 1.6 million.

NWSDB is operated with a self- financing commercial model with its own income from direct billing to the consumers for the water consumption and sewerage facility utilization.

With the model of the efficiency of the operation of existing water supply system, regional officers Setup Island wide handle the consumer care services. In addition to policy level decisions and setting strategies, Head Office located at Rathmalana is coordinating the operations of the regional offices and monitoring the progress of the activities. The demarcation of the operational areas controlled under Regional Support Centers. (Https: //www. waterboard.lk)

1.2 Consumer Services and Operation & Maintenance Activities of NWS&DB

The Operation & Maintenance Manager's report to the DGM through the AGM and all RSC functions are monitored by the Additional General Manager for western Zone. The RSC provides services to the regional offices only within their capacity, any additional help as necessary is obtained from the head office through the respective Additional General Manager.

Mainly the Operation & Maintenance activities of the regional offices can be sub divided in to two major categories as filed operations and commercial operations. The commercial operations include activities directly involving with consumers, billing and collection, complaint, handling, consumer relation management etc. usually happening in official level.

The field level operations include activities to maintenance the distribution network in healthy condition (e.g. emergency and regular maintenance work such as leak repairs, flushing of distribution lines, maintenance of the assets such as pumps, values, water treatment facilities etc.) and filed activities originated from commercial operations such as providing new water service connections, defective meter replacement, changes to service connections, disconnections, etc. some maintenance activities such as leak repairs, service breakdown etc. are to be attended at any time of the day require availability of twenty four hours a day services.

In order to provide enhance the efficiency of existing water supply services to satisfy the consumer needs, field staff needs to be highly committed and it is understood that use of innovative technology can definitely improve their performance, optimizing the use of available resources. (Https: //www. waterboard.lk)

1.3   Significance of the Research

Major aspects of a water supply system is sufficient water with good quality, sufficient pressure, minimum operation & capital cost, durable system with less breakdowns, easy expendability with minimum investments, satisfy the consumers' expectations.

Water resources are becoming scarce nowadays as a result of increasing population, and contamination in potable water resources. So, effective usage and operation of water sources is gaining importance. In this sense, water distribution networks should be operated efficiently; an adequate operation should be based on a correct model.

Although new water distribution systems are designed by means of mathematical models nowadays, a great majority of existing water distribution networks have not been modeled. In order to simulate such networks in operational studies, their models should be built. Such models are established by using city maps and network plans, and sometimes by using verbal knowledge of administration staff.

In some situations, actual case may be different from network plan drawings. From the construction of network to modeling stage, there may have been changes in networks. Such changes can occur in two ways; first changes came up with time, like aging of pipes; and second non-recorded (new furnished pipes or consumer connections) or

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