Sector	**Water Resources**
Subsector/ Category	Planning
Technology	Surface water mapping and modelling
Scale of Application	National
Availability	The US Geological Survey (USGS) is a major developer of hydrological models since the 1960's, providing a wide range of models, depending on the degree of sophistication required. NASA also provides a Global Change Master Directory (GCMD)of a wide range of models, for example, the Surface Water Modelling System (SMS) is a comprehensive environment for one-, two-, and three-dimensional hydrodynamic modelling provided by the US Army Corps of Engineers (NASA, 2013).

Technology Characteristics

Introduction

Mapping of water is a prerequisite for water availability, accessibility, fair utilisation and management. Services for digitizing and mapping exist locally and can be procured. Effective data regarding surface water availability for watershed management demands application of geospatial techniques such as remote sensing, image processing techniques and GIS. It involves a range of data sets, sophisticated equipment and skills such as, digital terrain model, soil, stream flow, field staff and water engineers, software etc.

Surface water includes streams, rivers, ponds, lakes and other exposed inland water bodies. In Guyana, numerous rivers flow into the Atlantic Ocean, generally in a northward direction. There are fourteen major river basin: Waini, Pomeroon, Essequibo, Potaro (tributary of Essequibo), Mazaruni, Cuyuni, Supenaam, Demerara, Berbice, Canje (tributary of Berbice), Boerasirie, Mahaica, Mahaicony and Abary. The Essequibo, the country's major river, runs from the Brazilian border in the south to a wide delta west of Georgetown. Since the late 1960's, hydrologic data collection has decreased significantly. Measuring equipment, such as, stream gauges needed to be repaired or replaced and efforts are underway to install modern telemetric gauges throughout the country (WRA, 2009). Hydrographic surveys are done by the Geodetic Section of the GL&SC to determine the topography/bathometry of conservancy bed, river bed and ocean bed. This service has been halted due to the need for improving the current hydrographic stock of equipment (GL&SC).

Guyana has an extensive network of rivers and streams that have many rapids and waterfalls, with an absence of naturally occurring lakes. Surface water (which is extracted from shallow reservoirs, streams, or drainage canals) is primarily used for agricultural and industrial purposes. Only about 10 percent of the country's drinking water comes from surface water. Guyana faces the typical water pollution problems of developing countries in tropical regions. Biological and chemical contamination of surface water varies in magnitude according to location but is increasing with population growth and land use demands.In Georgetown and in populated areas of the coastal lowlands, surface water contamination occurs from inadequate waste disposal and from chemicals used in the production of rice and sugarcane. Chemical contamination of surface water occurs primarily near manufacturing areas, especially along major rivers within mining districts (FAO, 2015). According to an assessment by the United States Army Corps of Engineers (1998), "surface water is laden with sewage, particularly in heavily, populated coastal areas". Another concern cited, is the improper disposal of sawmill waste which raises biological oxygen demand levels and endanger aquatic life in rivers. As a result, surface water, if not monitored properly, could develop into a major health hazard.

Institutional /Organizational	The Hydro-meteorological Service, Ministry of Agriculture undertakes responsibility for the hydrological resources, including surface water. The Guyana Lands and Surveys Commission also has some responsibility in terms of executing hydrographic surveys. Other collaborating agencies are, the Environment Protection Agency, the Guyana Water Inc. and the National Drainage and Irrigation Authority.
Adequacy for Current Climate	Not climate dependent. Mapping of water resources is a useful tool that will improve water resource management, particularly in a fast changing climate.

Size of Potential Beneficiary	The general population will benefit from this technology, including, professionals, academics, research institutions, water managers and communities.
Disadvantages	• Require specialized skills in GIS technology and modelling; • Changing pace of models and the need to keep updated for compatibility with newer versions; and • Maintenance of equipment and operating cost will be high due to the higher risk of wear & tear, and loss.
Endorsement by experts	This is a mature technology applied in many countries and by research institutions. It is also a dynamic technology, constantly improving to address the changing needs and provide optimum results. The USGS is a leading resource for this technology. In addition, the Caribbean Region, through the CARIWIN project, three pilot countries have benefited from training and capacity building in Integrated Water Resource Management, which include the testing, developing and disseminating new tools and information products including, hydrological data and measurements, flood analysis, climate change, watershed and groundwater modeling, GIS and water resources, hydrometeorology and water quality.
Capital Costs	
Cost to implement/Operate/Maintain	*Implementation:* • The initial investment cost will be high, taking into account data logging equipment which may be needed, computers, open source or software license, establishment of a data management system, procurement of expert/consultancy services and training; and • Many of the software developed by the USGS for ground, surface and water quality modeling are available for free download. Other software can be accessed through the NASA- GCM directory surface water modeling. *Operation/Maintenance:* • Include ongoing training, data collection, repair and maintenance of equipment, software subscriptions and the procurement of technical services; • Maintenance of field equipment will be high due to the rapid wear and tear from the external environment and risk to malfunctions; and • Security field equipment and logistic costs for data collection.
Development Benefits – direct/indirect benefits	
Adaptation benefits	This technology will reduce vulnerability risks caused by climate change, increased economic activities and population growth. It is important to assess and reduce water-related risks and vulnerabilities in sectors such as agriculture, energy, health, environment, and urban water utilities as part of overall development planning. Because some of the most serious climate change impacts are the effects on water and its various uses, adaptation is a vital component of water policy. Some of the multiple uses of surface water include, irrigation, livestock, fisheries, hydropower, manufacturing, mining and transport. (UNESCO, 2011)
Economic benefits	• Employment opportunities for technical experts and community support workers;

	• May spur investment in surface water assessment and protection services; and • Stimulate investment in enterprises such as hydropower and agriculture.
Social benefits	• A more informed population as a result of the awareness of the status of water resources and the impact of a changing climate on these resources; • Decision makers and communities can use data to plan for better water management; • Improve access to/availability of water, particularly for household use; and • Promote overall health and wellbeing of communities.
Environmental benefits	• Provide data on the impact of economic activities on, and the status of surface water flow and quality; • Strengthen response to flooding and droughts; • Improve water quality/flow of rivers/creeks/falls/lakes; • Promote ecosystem health; and • Strengthen water security.
Local Context	
Status of Technology	Not available in Guyana.
Market potential	This technology is advanced and is widely used around the world by governments, universities, scientific institutions and service providers. It has significant market potential in the professional expertise services for the many impact sectors. There is also potential to provide capacity building services to institutions in the Caribbean Region.
Acceptability to stakeholders	Has high acceptability among water resource managers, researchers and users. It will be particularly useful in the scientific community and for IWRM programs.
Opportunities and Barriers	*Opportunities:* • Contribute to a database of a water resource information; • Build local technical capacity; and • Contribute to improved water management. *Barriers:* • Lack of institutional /technical skills to deploy the technology; • Retention of technical staff ; and • May be slow to implement due to the initial investment needs.
Time Frame	Medium to long term

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