Designing Applications to Foster the Health of Terrestrial and Wetland Ecosystems in the Coastal Zone of West Africa

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Earth Observation (EO) System Design and Implementation

EO System Operation, Data Retrieval, Calibration & Validation

EO Data Correction and Processing

Earth Science Modeling and Assimilation of Earth Observations

EO Data Discovery & Visualization: Providing interface to find and explore data

EO Data Transformation: Creating data interface based on user needs

Knowledge Integration: Combining physical, social, economic and other data

Decision Support: Providing recommendations for action

Designing a Decision Support Tool to support Integrated Water Resource Management and Biodiversity in Lake Nokoue, Benin

US Co-Investigators: Space Enabled Research Group @ MIT Media Lab, NASA Goddard Space Flight Center, Blue Raster

Benin Co-Investigators: Green Keeper Africa

Additional Scientific Input: National Institute of Water, Benin
Inclusive Design of Earth Observation Decision Support Systems for Environmental Governance: A Case Study of Lake Nokoué

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Earth Observation (EO) data can enhance understanding of human-environmental systems for the creation of climate data services, or Decision Support Systems (DSS), to improve monitoring, prediction and mitigation of climate harm. However, EO data is not always incorporated into the workflow for decision-makers for a multitude of reasons including awareness, accessibility and collaboration models. The purpose of this study is to demonstrate a collaborative model that addresses historical power imbalances between communities. This paper highlights a case study of a climate harm mitigation DSS collaboration between the Space Enabled Research Group at the MIT Media Lab and Green Keeper Africa (GKA), an enterprise located in Benin. GKA addresses the management of an invasive plant species that threatens ecosystem health and economic activities on Lake Nokoué. They do this through a social entrepreneurship business model that aims to advance both economic empowerment and environmental health. In demonstrating a Space Enabled-GKA collaboration model that advances GKA’s business aims, this study first considers several popular service and technology design methods and offers critiques of each method in terms of their ability to address inclusivity in complex systems. These critiques lead to the selection of the Systems Architecture Framework (SAF) as the technology design method for the case study. In the remainder of the paper, the SAF is applied to the case study to demonstrate how the framework coproduces knowledge that would inform a DSS with Earth Observation data. The paper offers several practical considerations and values related to epistemology, data collection, prioritization and methodology for performing inclusive design of climate data services.

Keywords: Earth observation, water hyacinth, climate data services, decision support systems, design
System Functions: Actions taken to achieve system objectives; System Forms: Approaches to pursuing Functions

1. Understand System Context
2. Analyze System Stakeholders
3. Understand Desired Outcomes & Objectives
4. Select System Functions
5. Assign Functions to Forms
6. Monitor and Evaluate Systems

Context: Environmental factors that influence a program by creating opportunities, imposing constraints or imposing uncertainty

Needs: Stakeholder problem or gap in desired state; Outcomes: End state that the Primary Stakeholder desires to attain; Objective: High level description of what program will do

Stakeholders are the people, groups and organizations that impact a system or that are impacted by a system.
Ecotechnology firm Green Keeper Africa is a co-Investigator focused on invasive species management in Benin (SDG 15.8). Photo from August 2019 visit.
Lake Nokoue
Water Hyacinth Coverage in Lake Nokoue, Percent Anomaly in Growing Season

Percent Anomaly

Year

January
November
December
Zero Anomaly
Analysis of deforestation due to mining in Southwestern Ghana

US Co-Investigators: Space Enabled Research Group @ MIT Media Lab, NASA Goddard Space Flight Center

West African Co-Investigators: Ghana Statistical Service, Ghana Space Science and Technology Institute
The Ghana Space Science and Technology Institute is also a Co-Investigator on the project. They are contributing to the develop methods to map mining and mangroves.
The large footprint of small-scale artisanal gold mining in Ghana

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HIGHLIGHTS

• Land conversion in due to artisanal gold mining that of urban expansion.
• New mining extent (2005 and 2019) was dominated by artisanal mining (~89%).
• Over 700 ha of artisanal mining was detected in protected areas.
• This mining is degrading and destroying forested ecosystems.

GRAPHICAL ABSTRACT
The analysis used Landsat 7 and 8 Imagery (Bands 4 to 7). The observational period was 2008-2017. Land was classified into four classes: Water, Urban, Mine and Vegetation.
Supervised Random Forest Classification

- Landsat 7 and 8 Imagery
- Used bands 1-7
- Observation period: 2007-2017
- 4 landcover classes
  - Water
  - Urban
  - Mines
  - Vegetation
Accuracy Assessment Using Worldview Data