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Agricultural and Water Harvesting Opportunities in Kenya, via a Crowd-Sourced, Citizen Science Hybrid Paradigm

Benjamin D. Branch
Purdue University, bdbranch@gmail.com

James Tindall
Purdue University


Rosemary Moki
Purdue University

Peter N. Baker
Purdue University, pnbaker@purdue.edu

Jai Xu
Purdue University, xu222@purdue.edu

See next page for additional authors

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Authors

Benjamin D. Branch, James Tindall, Rosemary Moki, Peter N. Baker, Jai Xu, and Elisa Bertino

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By Benjamin Branch, James Tindall, Rosemary Moki, Peter Baker, Jia Xu, Elisa Bertino

- This is potential joint collaborative research between the Purdue University and citizens of Kenya via the Global Engineering Program in the areas of agriculture in water harvesting. Specifically, in the rural part of Kenya, outside of Nairobi, lives can be greatly impacted. Libraries of tomorrow will have global capacity and responsibility to serve all aspects of global citizenry. Herein is one possible Kenyan example.
- In partnership with the Tinmore Institute, an International Food, Water, and Energy Security team of experts, such international collaboration with Purdue's Global Engineering program could be quite successful within the areas of agricultural and water security sustainability. Moreover, Purdue's expertise and reputation as a global leader in research and scholarship can be further demonstrated.

- Ms. Rosemary Moki, a local Kenyan community organizer, the local expert whose passion to assist her fellow citizens in agricultural and water harvesting as life supporting development in her region.
 - Opportunities include water harvesting, agricultural crop development, biodiesel development.
- Such is a subset of examples of how international development could be generated and sustained for global impact and demonstration of intellectual knowledge transfer around the world. The GLOBE program a US federal agency, may be interested is such knowledge transfer.
- The problem:** Lack of food and water security in rural Kenya
 - The solution:** A new collaborative based of global data science implementation of a crowd sourced, citizen science paradigm

Challenges:

1) Big data management 2) remote location of global research
However, a next generation library will need a robust **GIS and data curation capacity** to be empowered as a data service providers anywhere in the support of human interest. Proper research is a global skill that should be open and accessible for benefit of human development. Research with borders is congruent with data with border paradigms as defined by the Research Data Alliance.

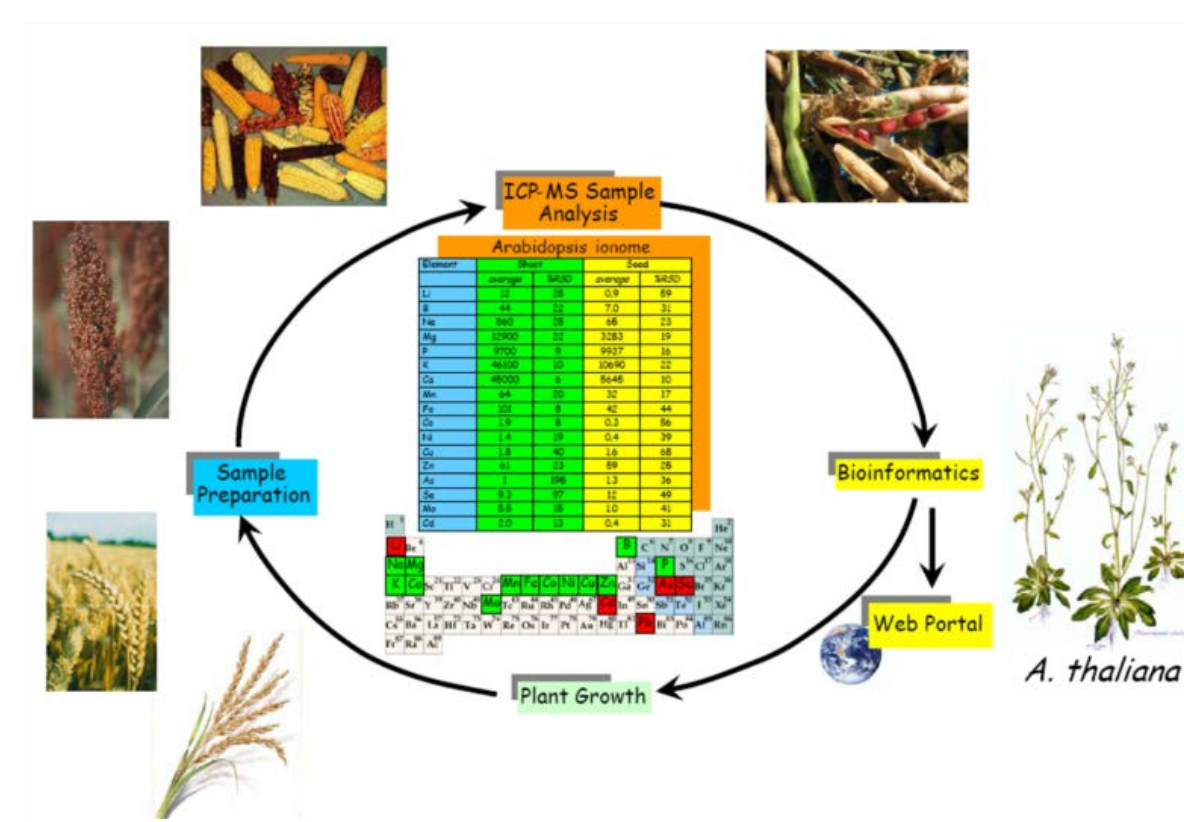
A crowd sourced, citizen science hybrid paradigm may involve two critical factors.

- 1) **Low cost data ingestion mechanisms such as Wi-Fi enabled smart phones or tablets with a robust data repository and**
- 2) **A citizen science hybrid, its expertise should assist a local rural community (with its indigenous humanity not removed). In addition, low cost sustainable paradigms should lead a community towards agricultural and water security autonomy.**

Global Citizenry Knowledge and skill transfer

- Data science
- Geographical information systems support and learning
- Community data repository skills
- Agricultural big data training at low cost
- Ionomics learning and concept transfer development
- Food an Water Security Knowledge sharing

Purdue Ionomics Information Management System (PiIMS)



Global Ionomic Training and development using Purdue's Ionomic Information Management System

Here, Purdue students learn how to improve the world and address global issues of food and water security and its many implications

Geographical Information Systems (GIS)

GIS is useful during the mapping of various conditions over spatial and temporal scales. Aspects of climate or weather may be observed as well as local phenomena. Local conditions include such parameters as rates of soil moisture, temperature, drought conditions, pollution, air quality and nutrient loads. Moreover, different crop solutions can be documented and indicated on a map with such justification.

Wi-Fi enabling of a crop field provides real time monitoring capabilities that may yield researchers better data for enhanced predictive models. If the GIS data collection is well constructed then, such data may be easily visualized for long term or season assessments. Moreover, in the case of crop disease, GIS data may be useful in predictive models if spatial and temporal scales are planning in advance for possible modeling use.



Step 1:

Data Curation Profiles (DCP) Allows a need assessment to customize and implement data workflow design
www.DataCurationProfiles.org



Step 2:

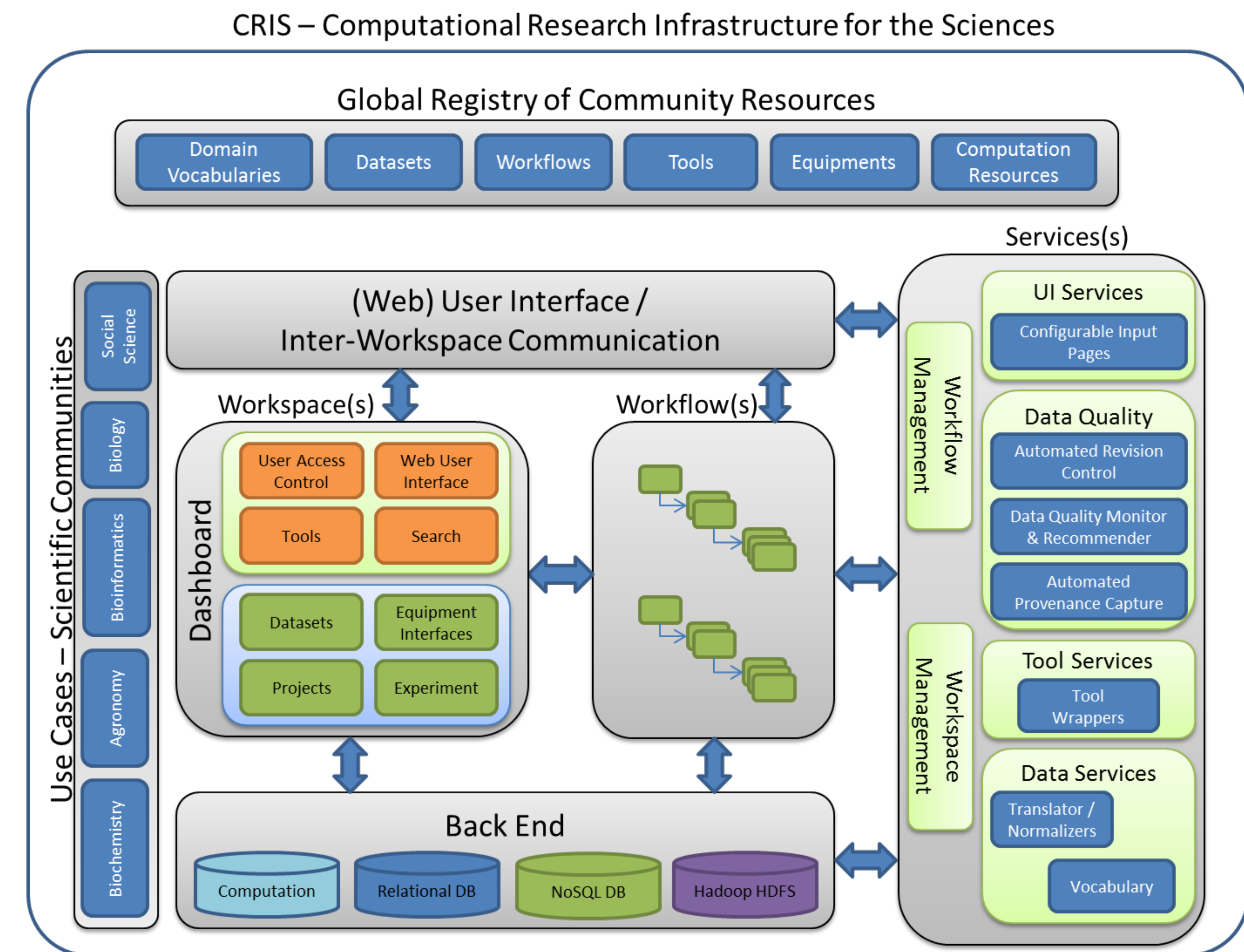
Interaction with Citizen's voices and needs and Research capacity of food and water security experts for low cost design and implementation



Step 3: Knowledge transfer

Educational concepts of ionomics and GIS may be spread a, discuss and demonstrated on a sustainable basis.

This CRIS framework may provide a best example of an internationally supported data repository implementation for such research.



Next Generation Global Library Data services

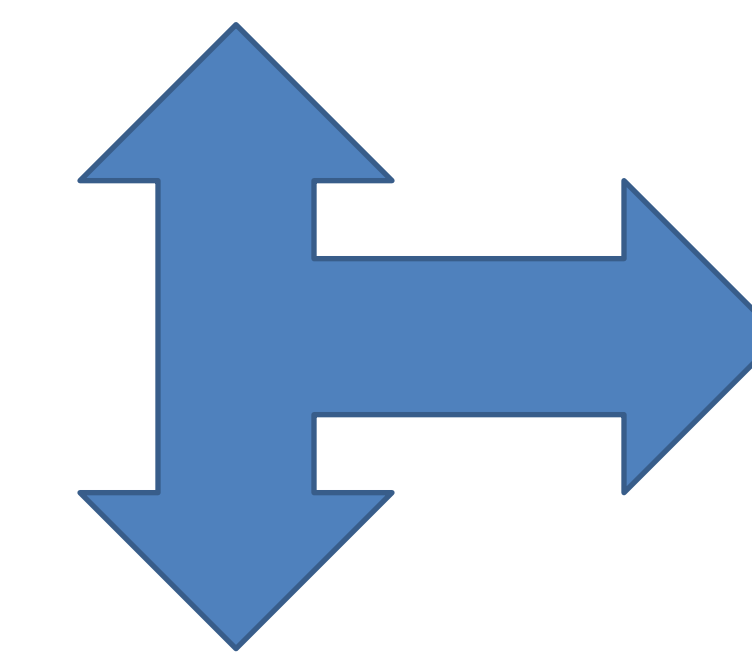
- Communities may learn to engage in a data science and practical skills that address agriculture and water harvesting skills that may better lives. Of their food and water security issues.
- Such a paradigm a hands-on data science and with practical community empowerment may influence educational policy worldwide.

Possible International Toolset

- Such may include smart phone or tablets as data ingestion points in a Wi-Fi enabled region of study
- Some low cost solar power source for Wi-Fi infrastructure and data distribution to database

Crowd-sourced, Citizen Science Flowchart

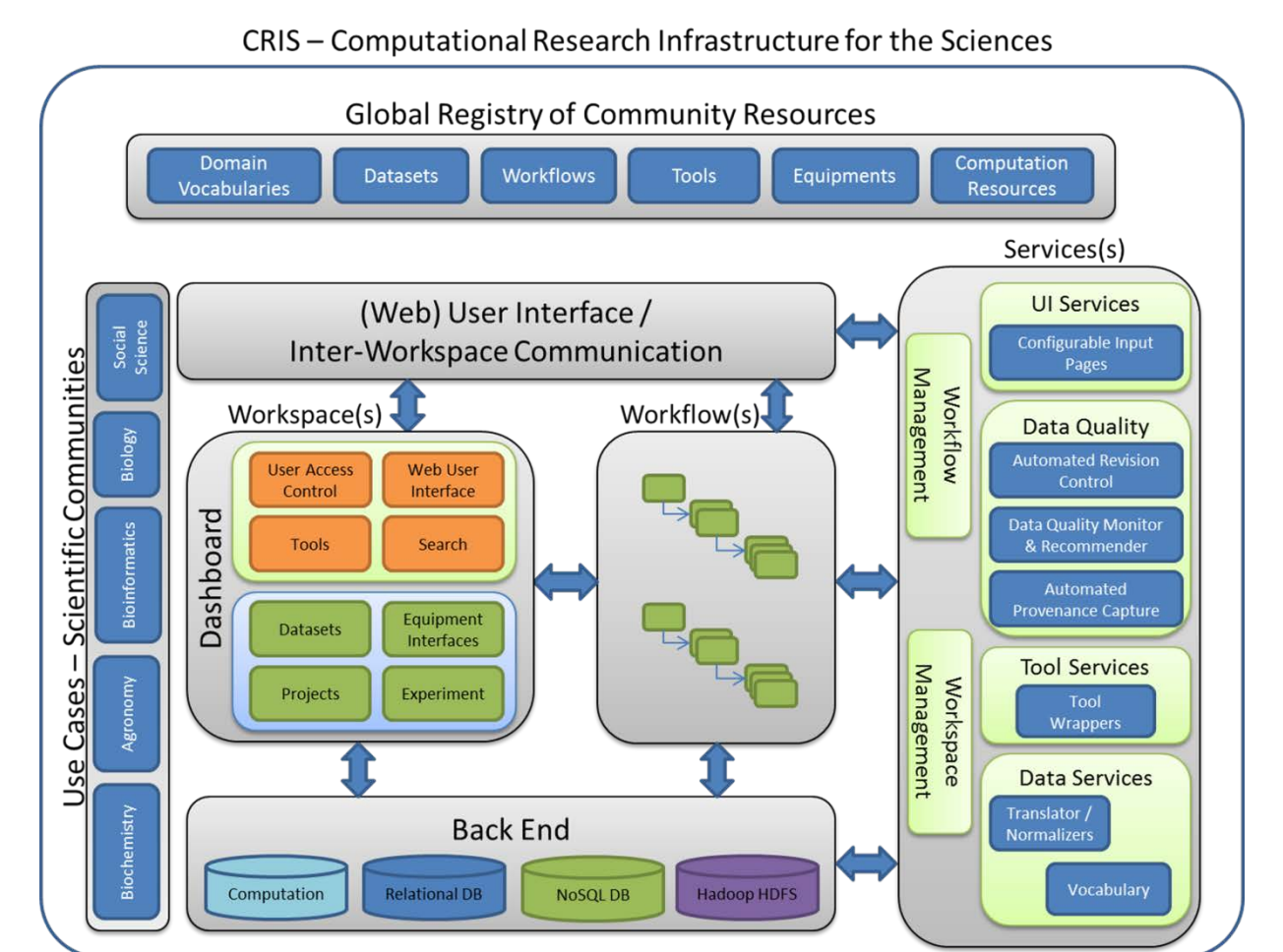
Data Ingestion tools, smartphones, tablets, etc.



GIS



Collaboration of Citizens, community persons, and Purdue scholarship and knowledge transfer



Areas of Collaborative Citizen Science Hybrid engagement

- Food Security
- Pest and Pesticide monitoring
- Building geospatial framework for governmental data sharing (metadata)
- Soil type identification
- Water security
- Food production forecasting
- Crop disease study
- Food contaminant study
- Drone use for crop monitoring
- Weather & Climate data
- Weather and Climate forecast
- Invasive Species Analysis

The combination of GIS and CRIS framework may add research value for agricultural researchers where that may lead to use of data models or simulations. Such is a big data dilemma may require more geospatially training.

Challenges

- Funding, with an Initial \$75K, such could be made sustainable on local scale
- Data storage
- Robust Interdisciplinary collaboration

Project Sustainability

- Such crowd sourced collaborative research may prove useful in poverty stricken communities.
- Ms. Rosemary Moki is able to link Kenya research from planning to successful implementation of collaborative projects with water harvesting as first priority
- Geospatial knowledge & skill transfer may become a global norm
- The Tinmore Institute, www.tinmore.com would be able to advance and guide Food and Water Security policy and implementation practices.
- The Cyber Center would be able to handle backend big data workflow and local community data science analysis and community data hosting
- Purdue University Libraries would be able to advise data curation profile or data needs assessment and lifecycle planning.