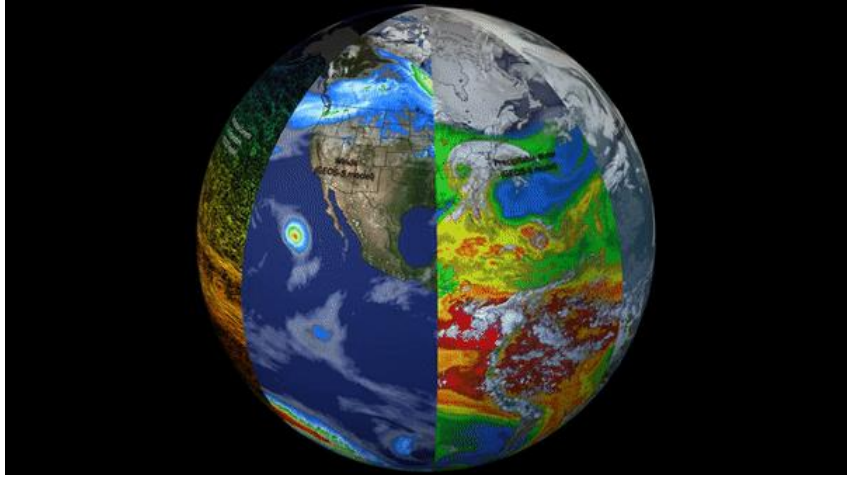


“Disrupting” Water Resources Management

A New World of Disruptive Technologies for Water Resources Planning and Management

Dr. Nagaraja Rao Harshadeep (Harsh)

Global Lead (Disruptive Technology)

Disruptive Technology

WORLD BANK GROUP

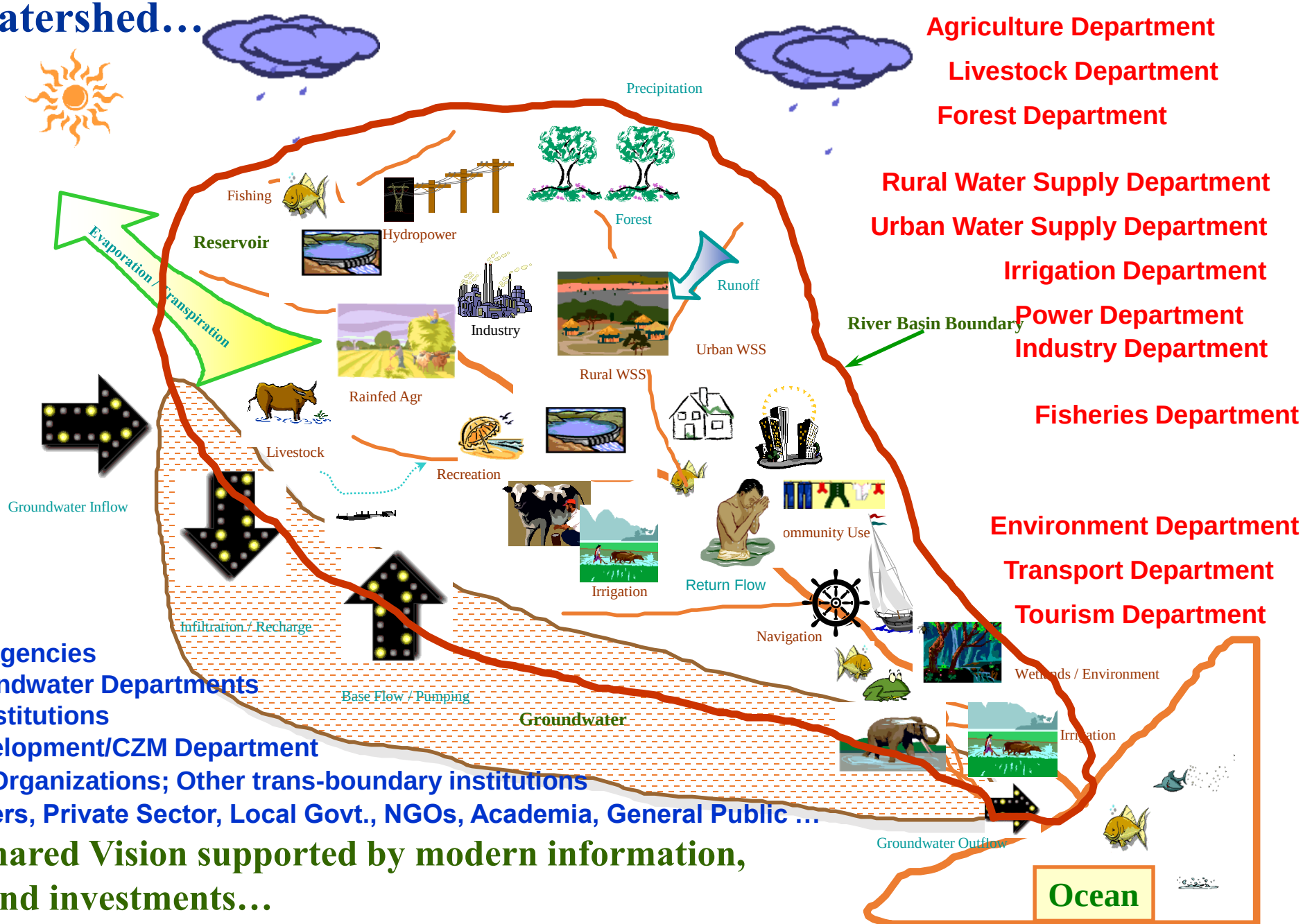
Environment, Natural Resources & Blue Economy

Economic and Social Commission for Western Asia (ESCWA)

March 3, 2020, Beirut, Lebanon

Multiple sectors, multiple institutions, linked by water and natural resources…

A Typical Watershed…



Agriculture Department
Livestock Department
Forest Department

Rural Water Supply Department
Urban Water Supply Department
Irrigation Department
Power Department
Industry Department

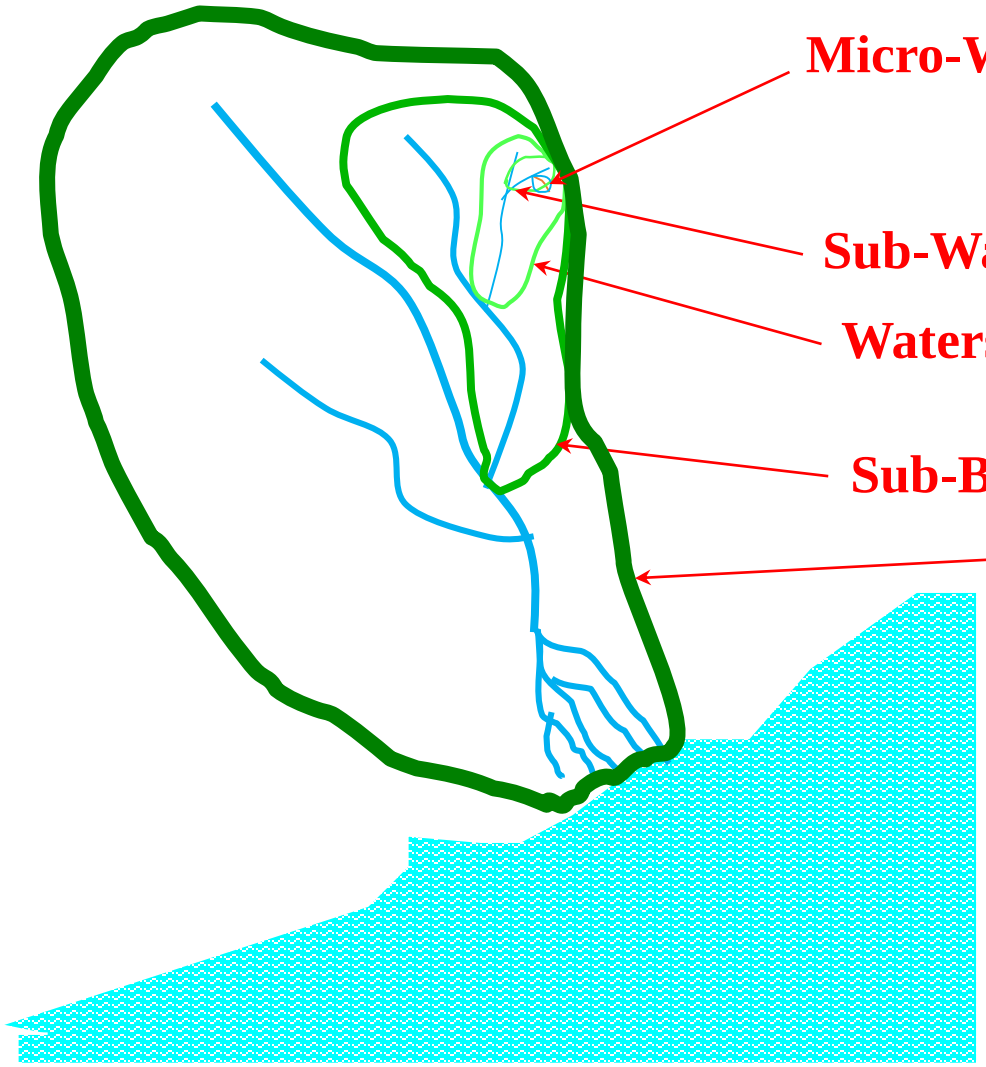
Fisheries Department

Environment Department
Transport Department
Tourism Department

Central & State Agencies
Surface & Groundwater Departments
Investment Institutions
Ocean Development/CZM Department
Basin Organizations; Other trans-boundary institutions
Farmers, Private Sector, Local Govt., NGOs, Academia, General Public …

…Need for Shared Vision supported by modern information, institutions, and investments…

Scales



Micro-Watershed/Micro-Catchment

Sub-Watershed/Sub-Catchment

Watershed/Catchment

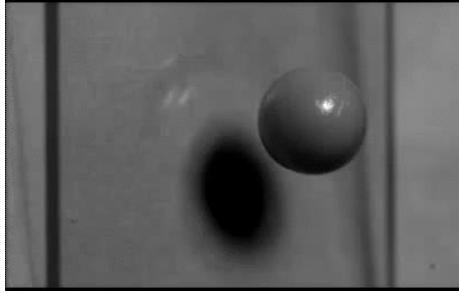
Sub-Basin

River Basin

Transboundary Water Contexts:

- River Basins
- Lake/Inland Sea Basins
- Groundwater Aquifers
- Marine Areas
- Precipitation-sheds

What's Broken?

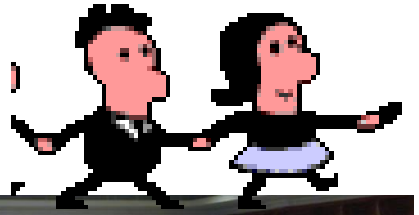


Information

- Data coverage and quality
- Widespread use of modern analytical tools
- Public access to data, tools, and knowledge products

Institutions

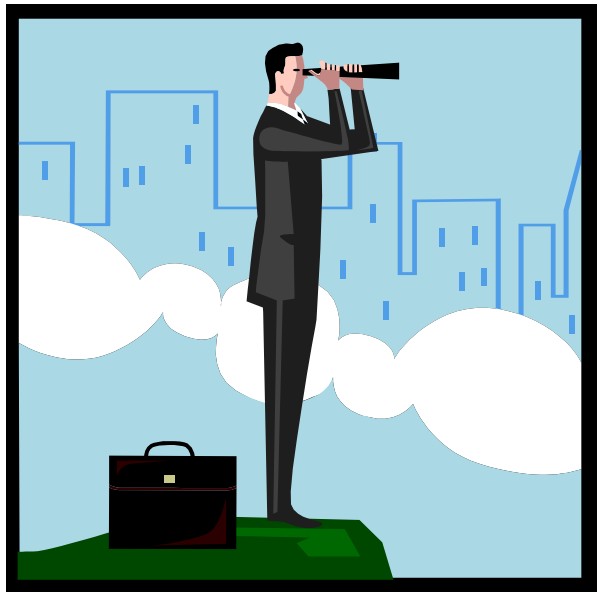
- Technical capacity
- Meaningful stakeholder involvement
- Decision making
- Collaboration/ Partnerships



Investments

- Infrastructure deficit (storage, power, transport, agriculture, sustainable land management, …)
- Inadequate monitoring and forecasting systems
- Poor office infrastructure and equipment
- Investment coordination

Modernizing Approaches to Address these Challenges…
The 3 Is…



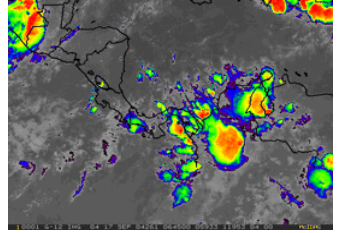
Information & Analysis

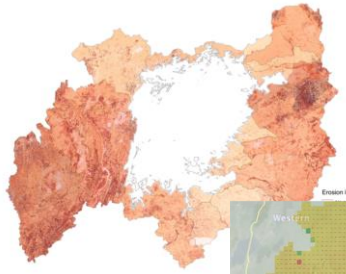
Institutions & Policy

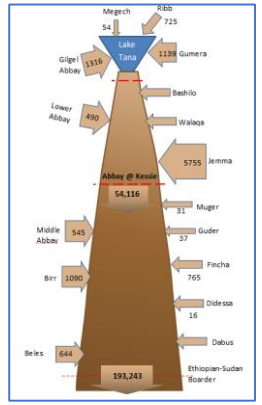
Investments & Operations

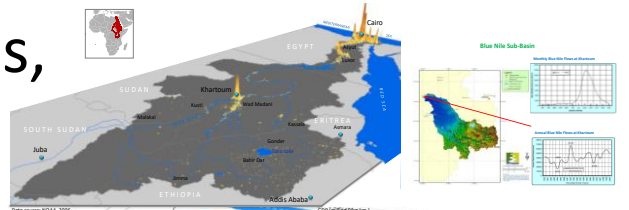
Information & Analysis

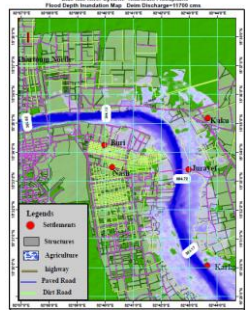
- **Resource Information Base** (standards; harmonization; data rescue; monitoring; comprehensive spatial, temporal and other databases; improved use of satellite data; documents)
- **Knowledge Products/Special Studies** (maps, Atlases, interactive toolkits, surveys)
- **Access and Outreach mechanisms** (data services, publications, web portals, Apps with public access to open data services, technical/ success stories, multi-media documentation)
- **Analytical Tools** (models/Decision Support Systems for planning/operations support in an integrated systems context)

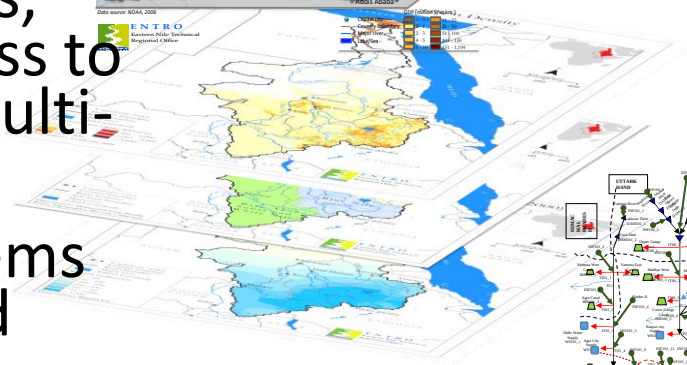


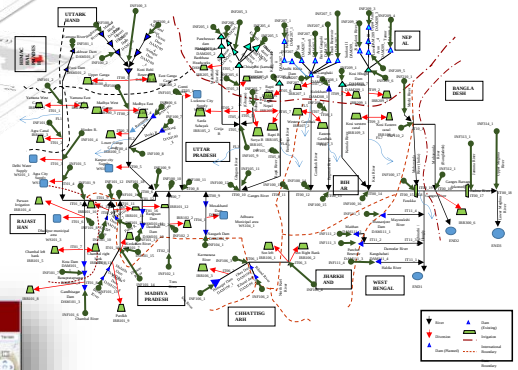


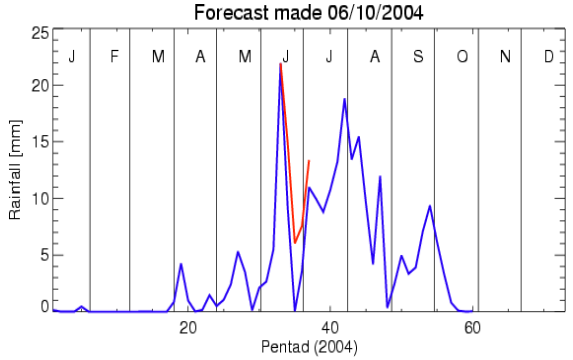


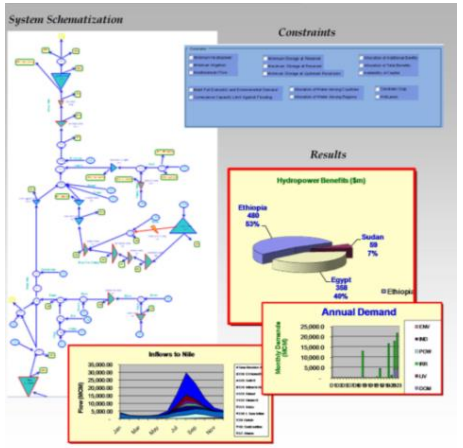


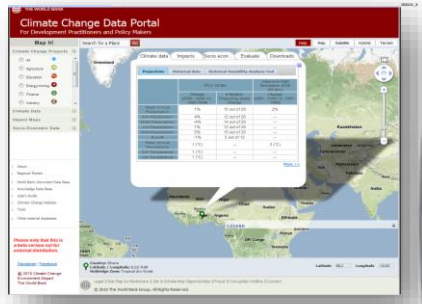






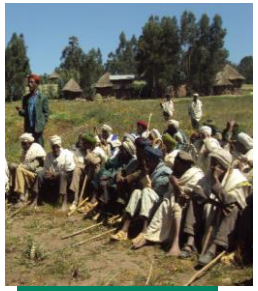


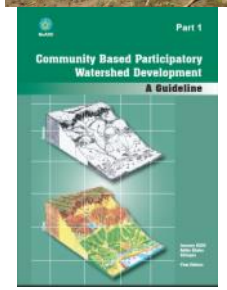




Institutions & Policy

- **Strengthening Institutions** (office modernization, stakeholder participation, capacity development and training incl. distance learning, improved links with academia, internships, visiting experts, professional networks/ communities of practice; forums, competitions)
- **Strengthening Policies** (streamlining institutional design/policy/mandates, improving synergy, economic instruments, decentralization)
- **Innovative Instruments** (e.g. knowledge-driven facilitated diplomacy, policy instruments, incentive frameworks)



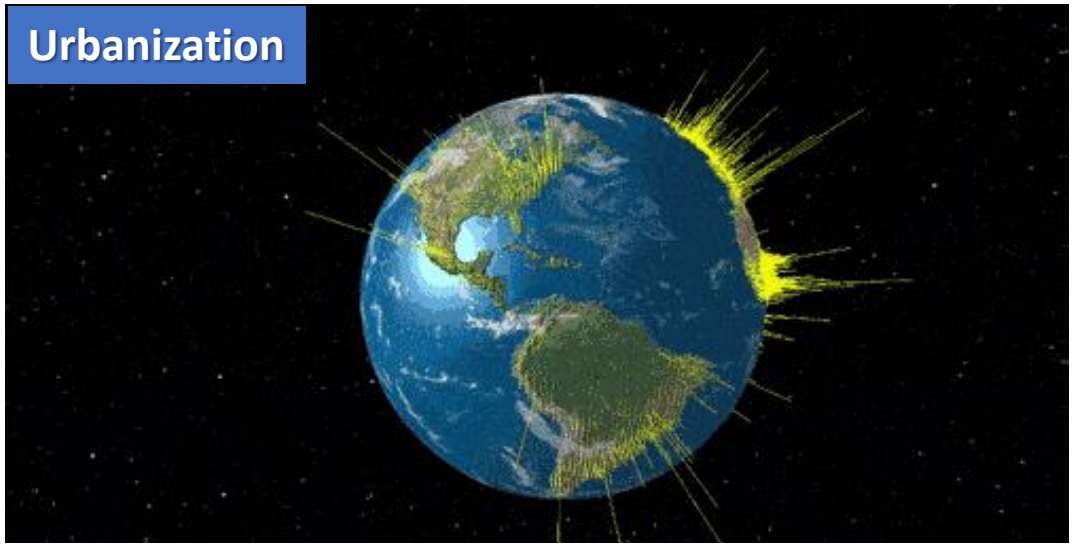


Investments & Operations

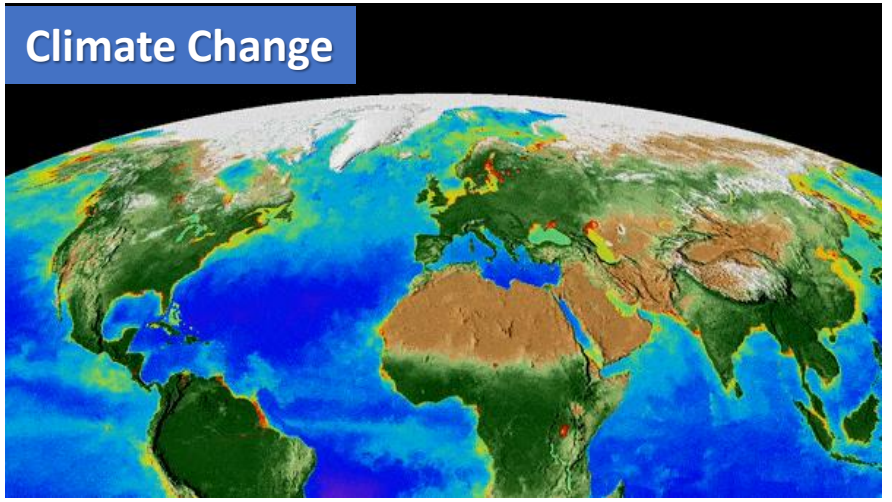
- **Preparation of a new generation of modern investments** (with adequate attention to technical, environmental/climate, social, economic, and institutional aspects) – upgrading existing infrastructure and building new infrastructure analyzed in a systems context and reflecting innovation and climate-smart development
- **Implementation facilitation, monitoring, and lessons** (adequate technical assistance, ownership, services, M&E)
- **Infrastructure planning and operational coordination**

There are many ongoing changes…

Urbanization

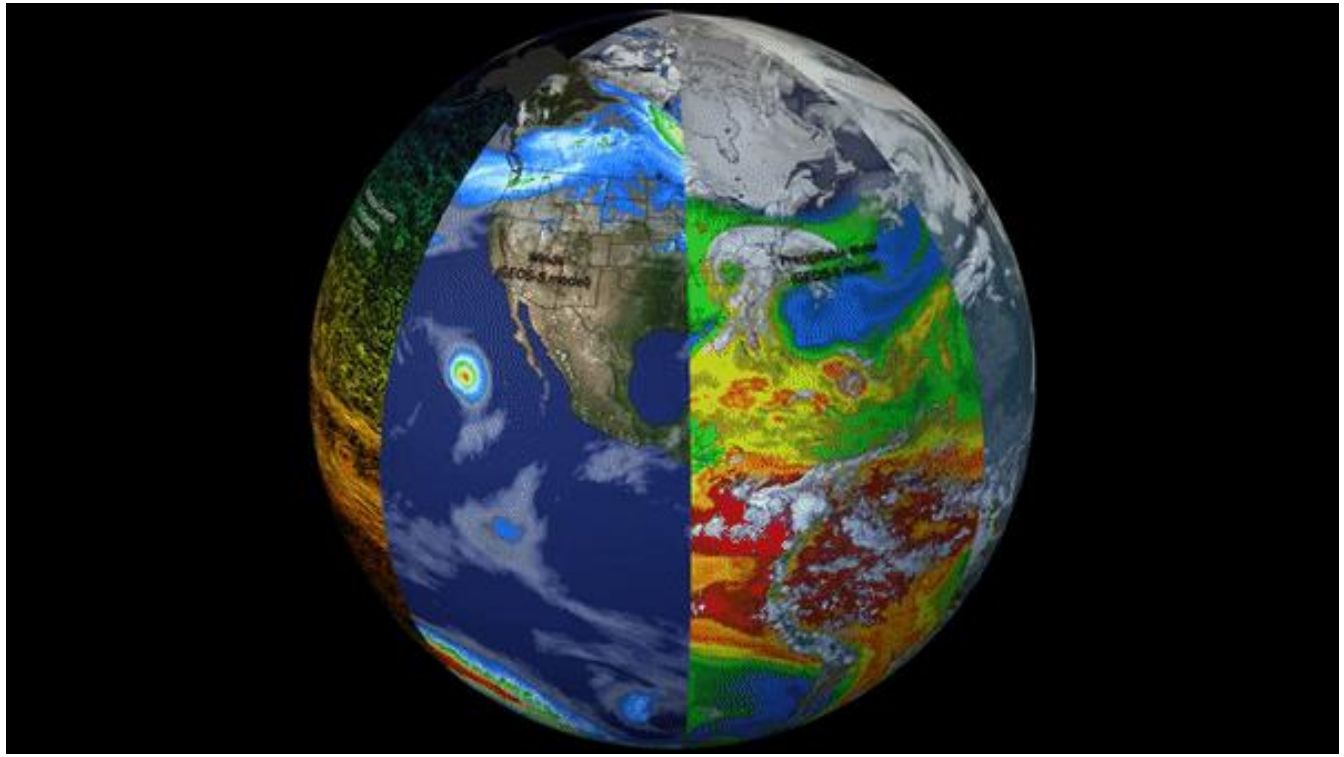


Climate Change



Rising Expectations

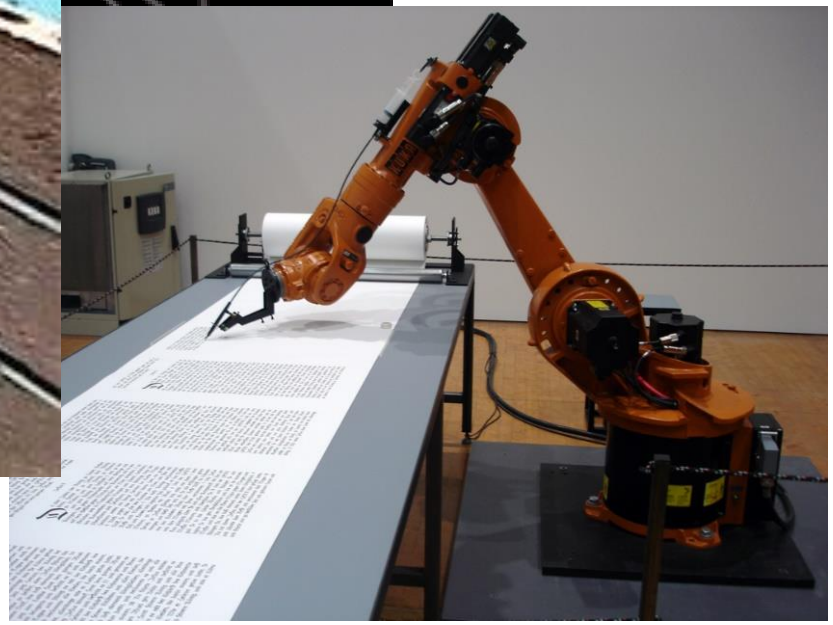
Disruptive Tech



"DISRUPT" DECISION SUPPORT

- ***Data Collection***: Monitoring/Surveys (in-situ sensors/IoT, Earth Observation, UAVs, crowdsourcing…); Digitization
- ***Data Management*** (telemetry, cloud services, open data services, Blockchain, …)
- ***Data Analysis*** (Big data, Geospatial/AI/Machine Learning, modeling, script repositories …)
- ***Data Access*** (open data APIs, data visualization, gamification, mixed reality-AR/VR, …)
- ***Outreach:*** Platforms/Portals/Apps/e-books/Competitions

“DISRUPT” PRODUCTION



- 3D printing/additive manufacturing
- Automation/Robotics/automated transport
- Advanced materials/nanotech/biotech/clean tech/ smart energy/ smart farms…

“DISRUPT” INTERACTION

- Social Media
- Knowledge/Learning Platforms
- Crowdsourcing, gamification, competitions
- Mobile money, Fintech
- Maker movement/DIY/Tech Incubators
- Sharing economy

All Companies will be Data Companies…

90% of the World's data has been produced in the last 2 years…

Two-thirds of the jobs todays kids will pursue haven't even been invented yet…

- **IoT can add US$2.7-6.2 trillion annually by 2025…**
- **Autonomous transportation could have a US$7 trillion annual revenue stream…**
- **Blockchain will deliver US$3.1 trillion in value by 2030…**
- **AI will add US$15 trillion to the global economy by 2030…**
- **AR/VR will disrupt a US$30 trillion industry…**
- **3D printing will disrupt the US$30 trillion manufacturing sector…**
- **Robots could disrupt the US$15.5 trillion construction industry…**
- **Clean energy tech could be a US$50 trillion industry…**
- **The sharing economy could be $335 billion by 2025…**
- **Nanotechnology is already a US$1trillion industry…**
- **Fintech eyes US$124 trillion of transfer payments…**

>$900,000 worth of applications in a smart phone today

	Application	$ (2011)	Original Device Name	Year*	MSRP	2011's $
1	Video conferencing	*free*	Compression Labs VC	1982	$250,000	$586,904
2	GPS	*free*	TI NAVSTAR	1982	$119,900	$279,366
3	Digital voice recorder	*free*	SONY PCM	1978	$2,500	$8,687
4	Digital watch	*free*	Seiko 35SQ Astron	1969	$1,250	$7,716
5	5 Mpixel camera	*free*	Canon RC-701	1986	$3,000	$6,201
6	Medical library	*free*	e.g. CONSULTANT	1987	Up to $2,000	$3,988
7	Video player	*free*	Toshiba V-8000	1981	$1,245	$3,103
8	Video camera	*free*	RCA CC010	1981	$1,050	$2,617
9	Music player	*free*	Sony CDP-101 CD player	1982	$900	$2,113
10	Encyclopedia	*free*	Compton's CD Encyclopedia	1989	$750	$1,370
11	Videogame console	*free*	Atari 2600	1977	$199	$744
	Total	**free**				**$902,065**

*Year of Launch

"Disrupting" Development

An Interactive Primer on Disruptive Technology in Development

World Bank e-book on Disruptive Tech (draft)
http://www.appsolutelydigital.com/dt/

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  - Economic
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  - Types of Disruptive Technology
  - Examples of Disruptive Technology
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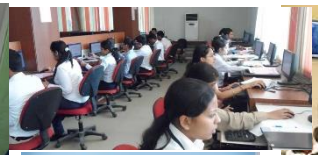
  - Rethinking Development
  - Disrupting our Challenges
  - Explore Global Resources at your Fingertips
    - Interactive Tech Application Explorer
    - Casestudies
- Looking Ahead
  - Regulatory Environment
  - Moving Ahead...

Disruptive tech could change Development

Making "smart development" wrt climate, water and natural resources, energy, food, waste, mobility, knowledge, services, networks..

Online Services

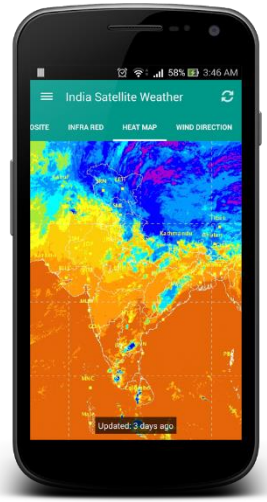
Green Energy



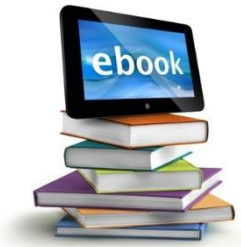
Broadband & Smartphone Access

Apps, e-services & e-learning

Planning



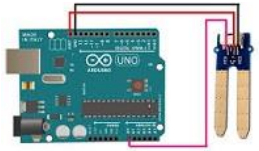
Access to a new world of Data, Information, Knowledge and Services



3D Printed Infrastructure

Sensors/IoT

(e.g. for soil moisture)



Drones/UAVs

(e.g. for monitoring, seeding, delivery)

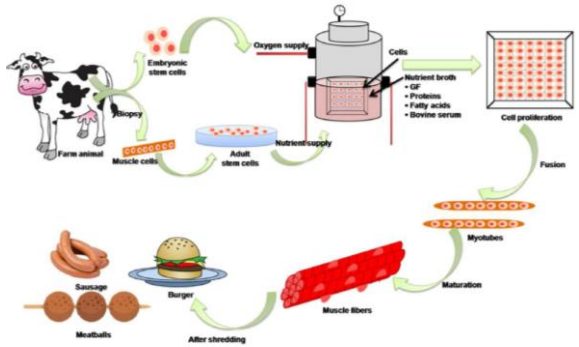
Sharing Economy

Fundamental Project Design Implications

Solar-covered Canals

The $325,000 Lab-Grown Hamburger Now Costs Less Than $12

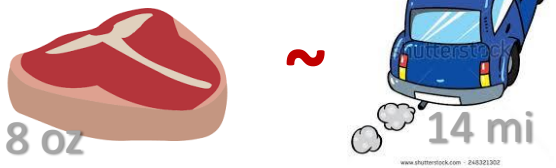
A real burger made without the cruelty and pollution is now within reach.



“Floto-voltaics”

Many multi-sectoral implications (incl. for the Amazon!)

A third of global agricultural water use is for fodder!



70% of agricultural land is used for pasture (~28m km^2)!

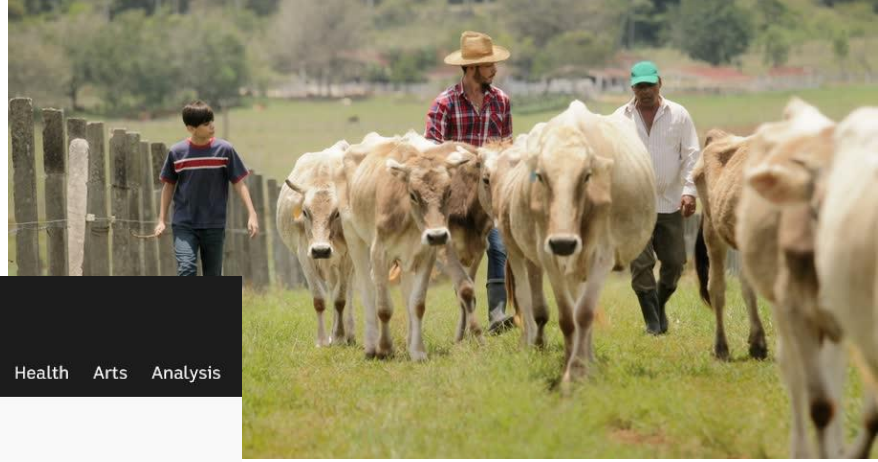
	Water Use	GHG Emissions	Land Use	Production Cost
ANIMAL-BASED	1799 gallons	16 pounds	260² ft	$1.05
LAB-GROWN	324 gallons	3.52 pounds	2.6² ft	$12

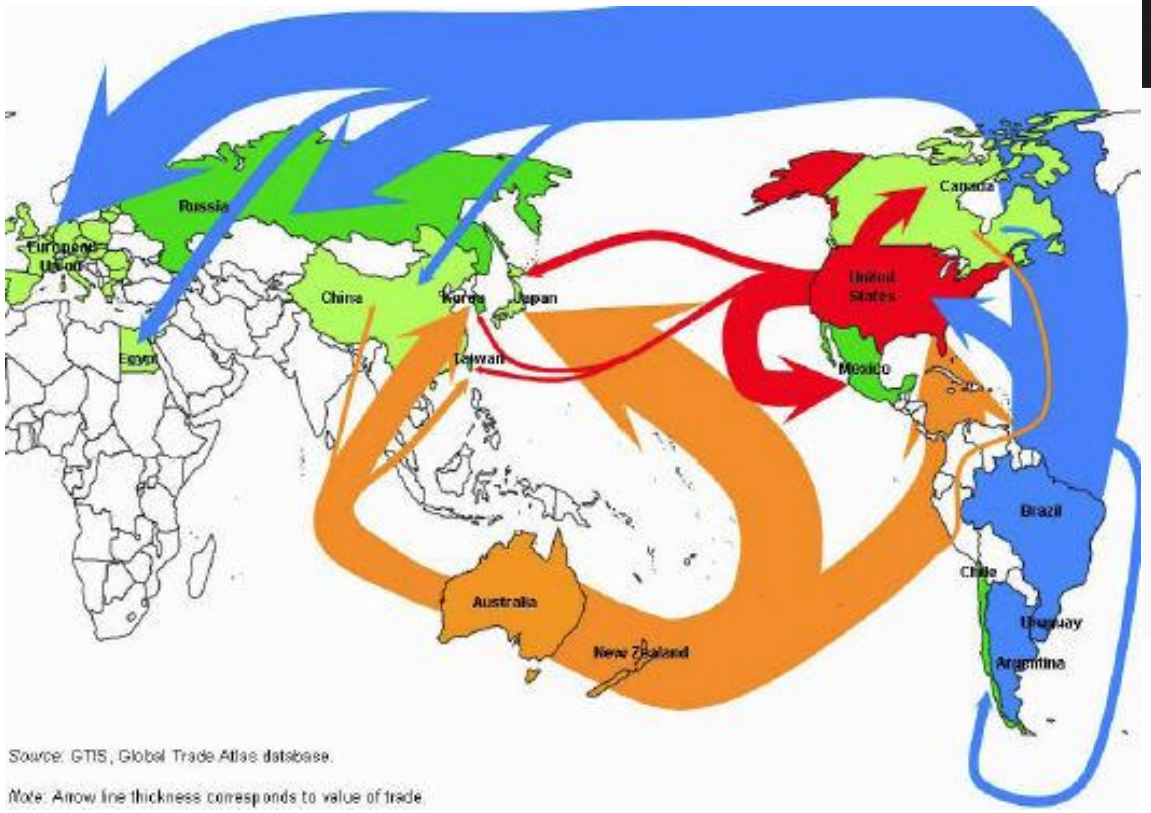
Usage, emissions, cost per pound of meat

SOURCES: CB Insights, Water Footprint Network, Business Insider, Forbes, Food Climate Research Network (FCRN), Quartz

Livestock:

- Supports 1.3 billion people
- 40% of global value of agricultural output





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'Cultured meat' could spell end of traditional cattle farming within decades, scientist behind lab-grown beef burger says

AM By the National Reporting Team's Dominique Schwartz

Posted 27 Mar 2015, 1:08am

The Dutch scientist who served up the world's first laboratory-grown beef burger says "cultured meat" could spell the end of traditional cattle farming within decades.

That is the confronting message Maastricht University Professor Mark Post has for the Northern Territory Cattlemen's Association, which is holding its annual conference in Darwin.

"I do think in 20, 30 years from now we will have a viable industry producing alternative beef and there will be a growing market for it and eventually a really large market," he said.

PHOTO: Professor produced for $80 a

USDA and FDA Announce a Formal Agreement to Regulate Cell-Cultured Food Products from Cell Lines of Livestock and Poultry

WASHINGTON, March 7, 2019 — The U.S. Department of Agriculture's (USDA) Food Safety and Inspection Service (FSIS) and the U.S. Department of Health and Human Services' (HHS) Food and Drug Administration (FDA) today announced a formal agreement to jointly oversee the production of human food products derived from the cells of livestock and poultry.

FSIS and FDA released a formal agreement to

Press Release
Release No. 0027.19

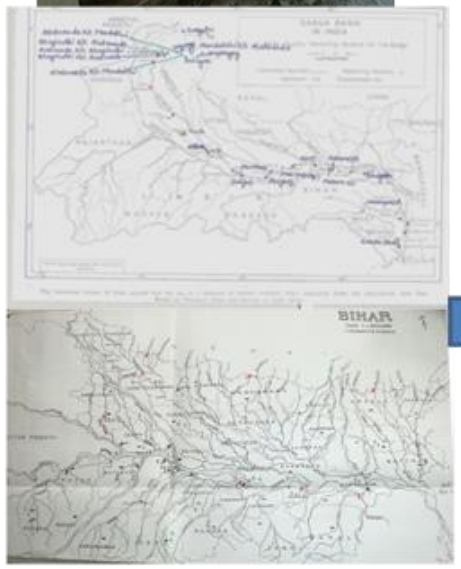
USDA Media and Consumer Inquiries:
USDA FSIS Office of Congressional and Public Affairs, Press (202) 720-9113

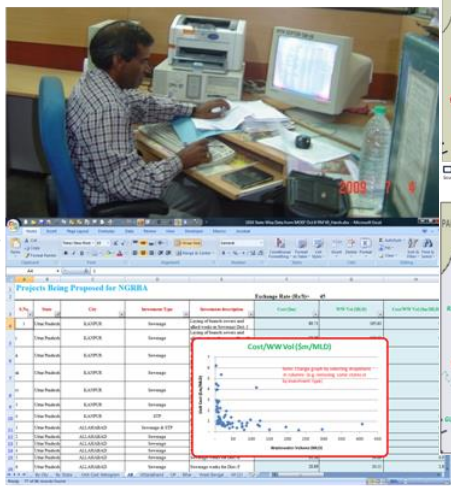
FDA Media Inquiries:
Megan McSeveney, 240-402-4514, megan.mcseveney@fda.hhs.gov

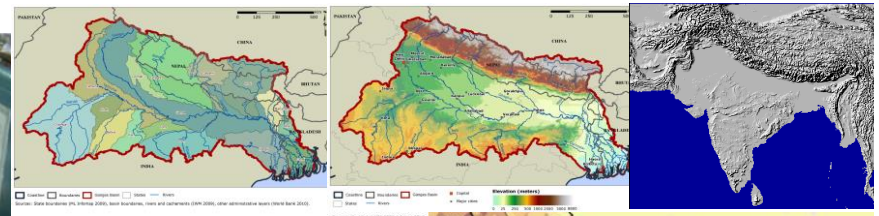
Data Rescue

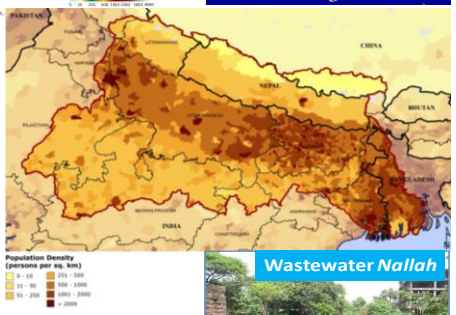
Digitizer

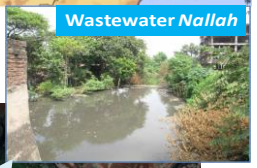
Scanner

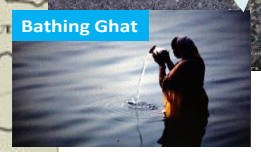


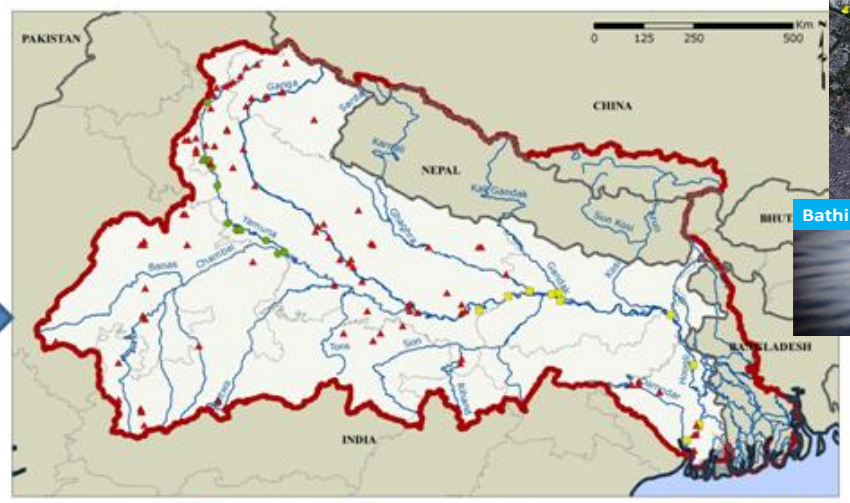


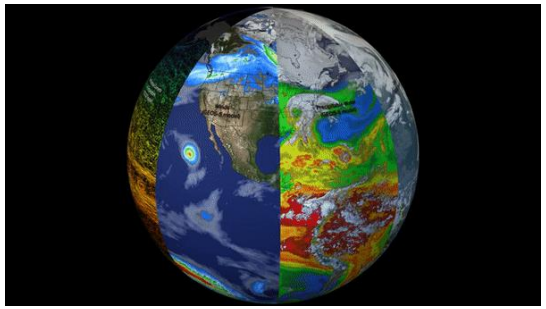




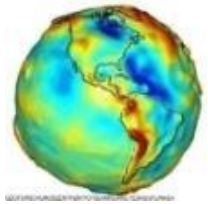


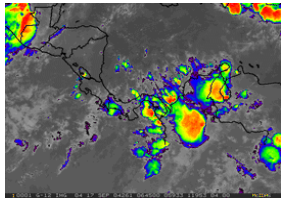




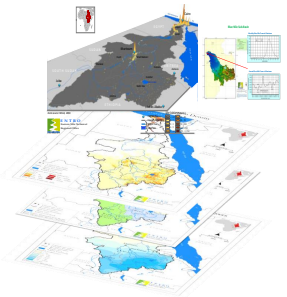


"Top-Down" Data Acquisition System





Satellite & UAV Earth Observation



GIS and other datasets
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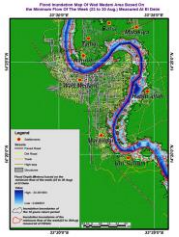
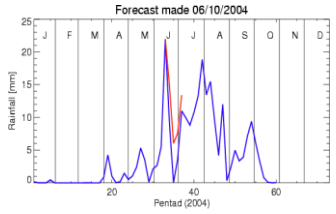




Data Management

Analytics/Models

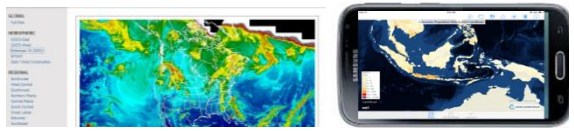
Big Data

Platforms

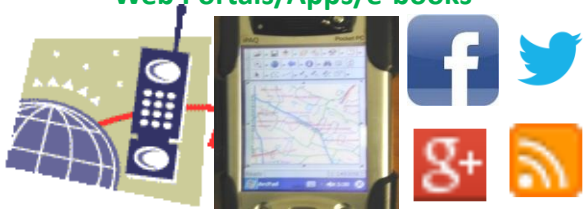
Cloud Services

Machine Learning/AI

Crowdsourcing



Web Portals/Apps/e-books



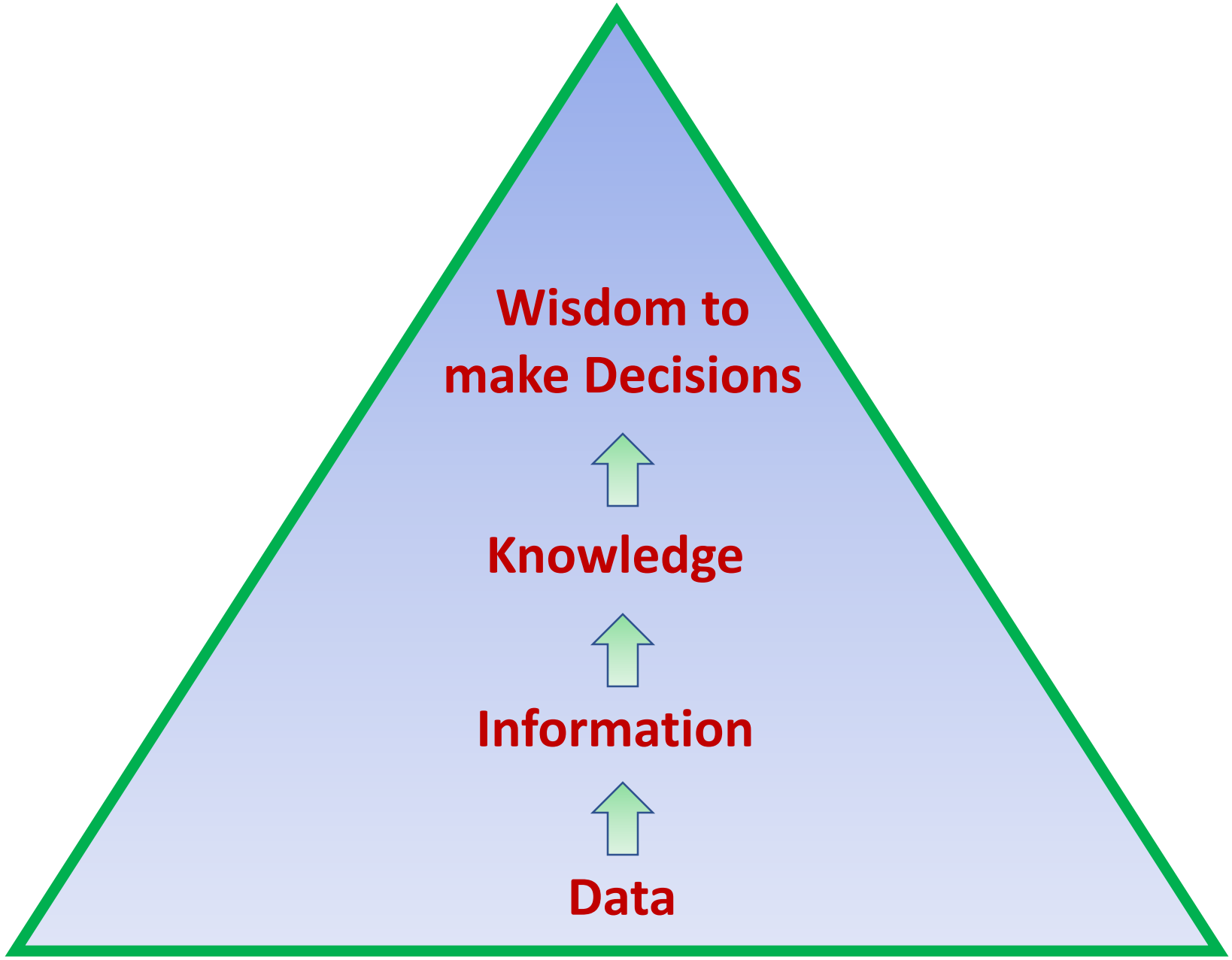
Stakeholder Alerts

Operational Control Rooms

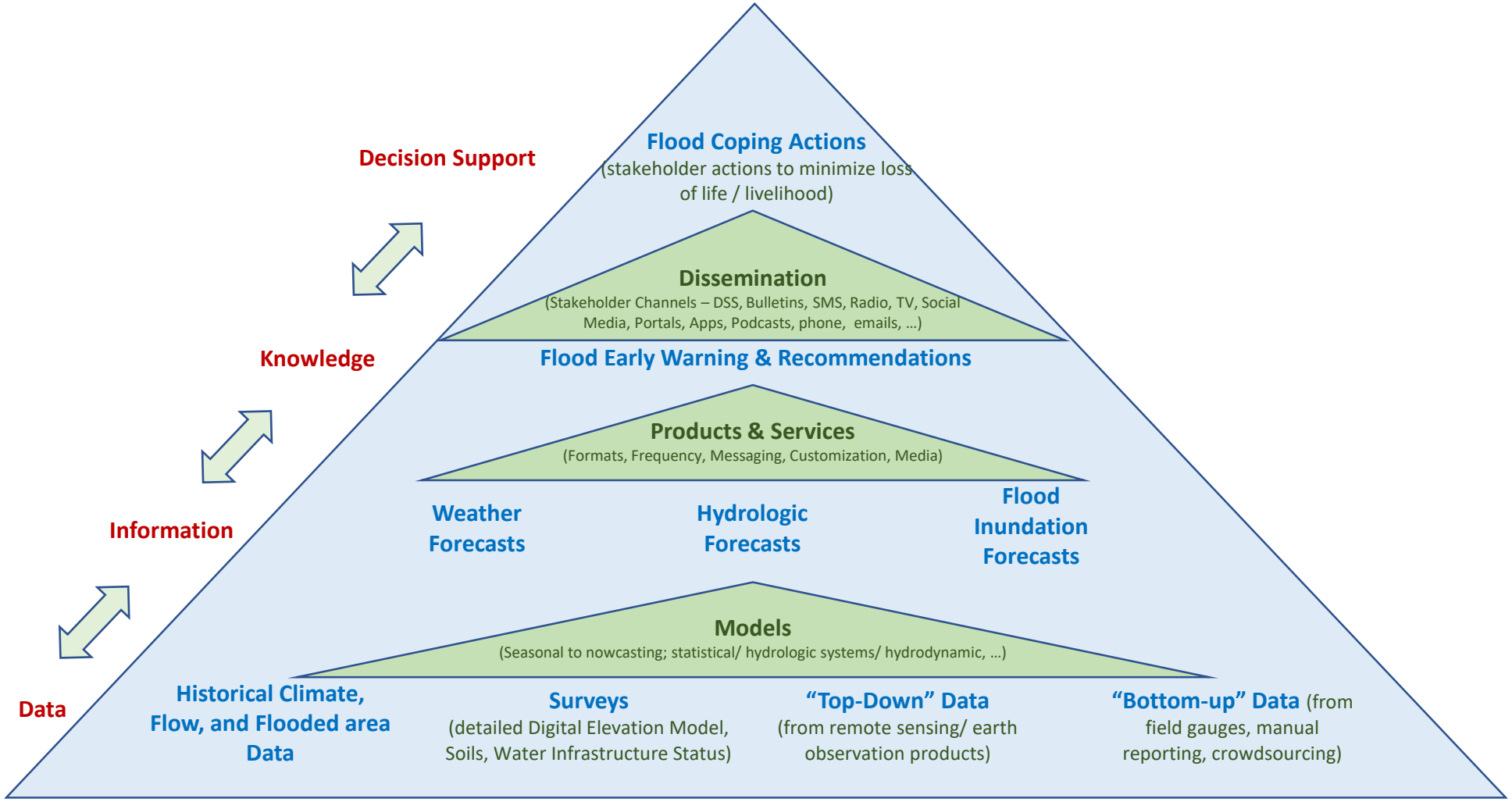
Manual Monitoring

Automated Monitoring

"Bottom-up" Data Acquisition System → IoT

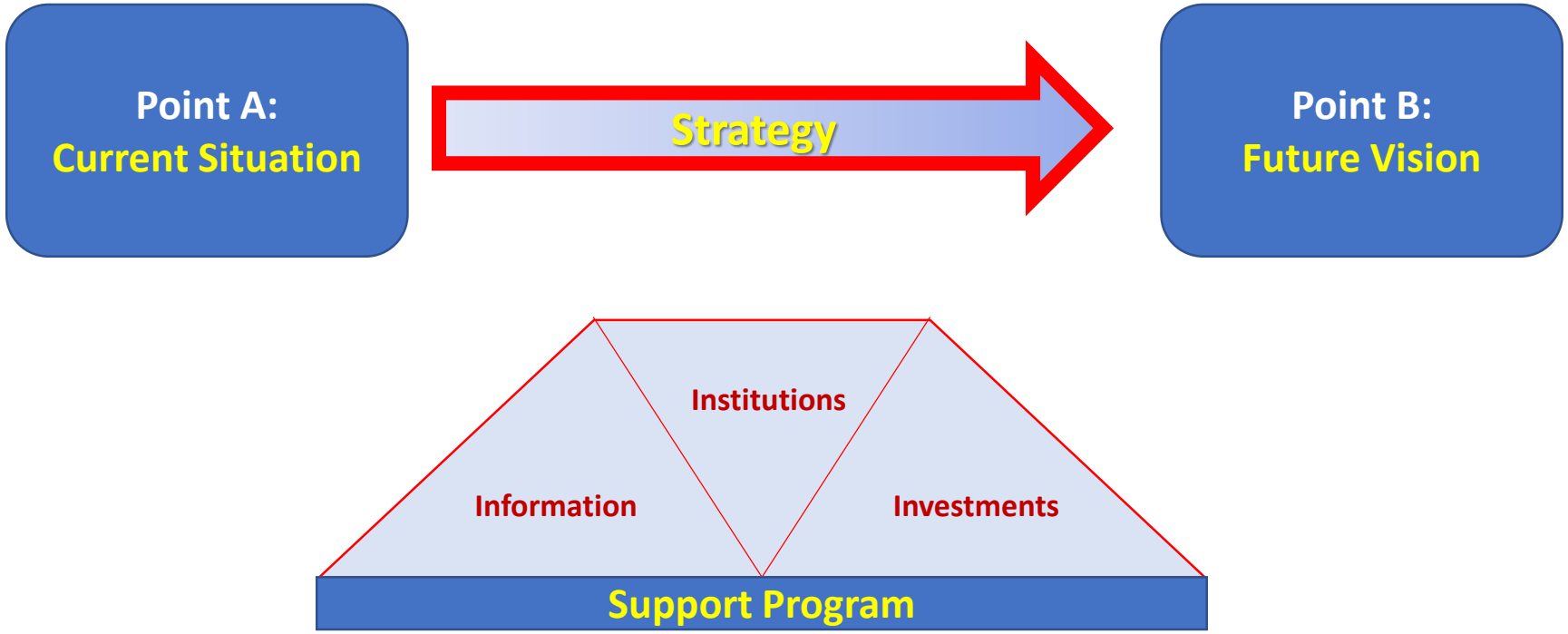

Wisdom to
make Decisions
Knowledge
Information
Data

Data Value Chain: Coping with Floods



Basin Planning

Envisioning the Future



Analytical & Stakeholder Tracks to Multi-sectoral Spatial Planning…

Decisions→

Stakeholder Identification

Understanding Basin Issues/Problems (Pt. A – where now?)

Shared vision for future potential (Pt. Bs – where could the Basin be?)

Selection of development options (getting from A to B)

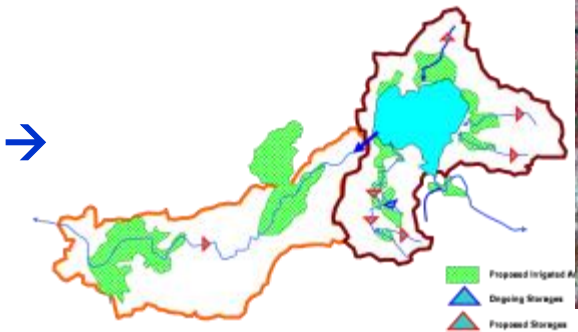
Agreement on Basin Development Plan

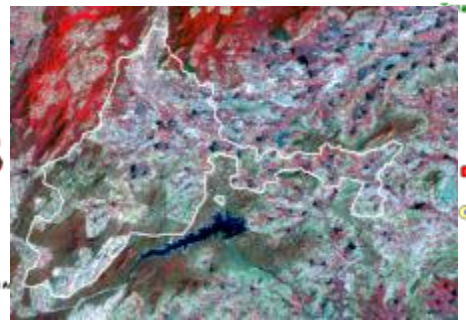
Investment Facilitation/Implementation/Supervision

Consensus on Additional Needs

Stakeholder Involvement →

Analytical →

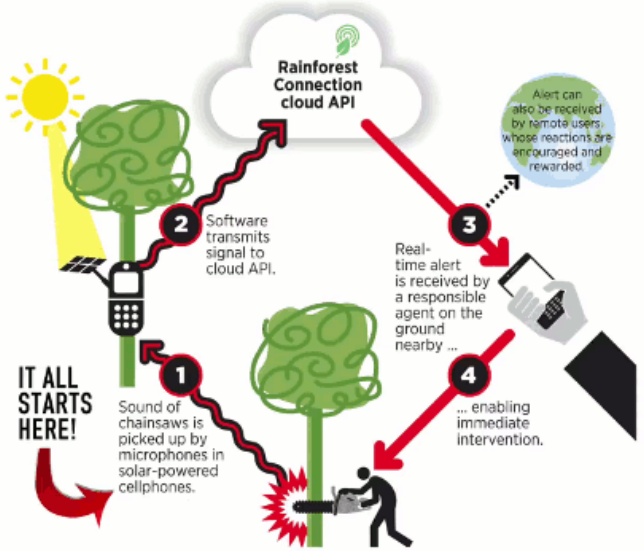




Big Data – on the ground…

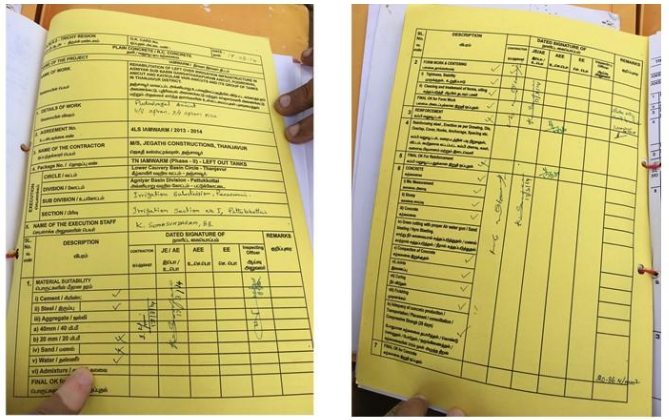
Wisdom of the Crowd

In-Situ Sensors: Now when a tree falls in a forest, you can actually hear it!

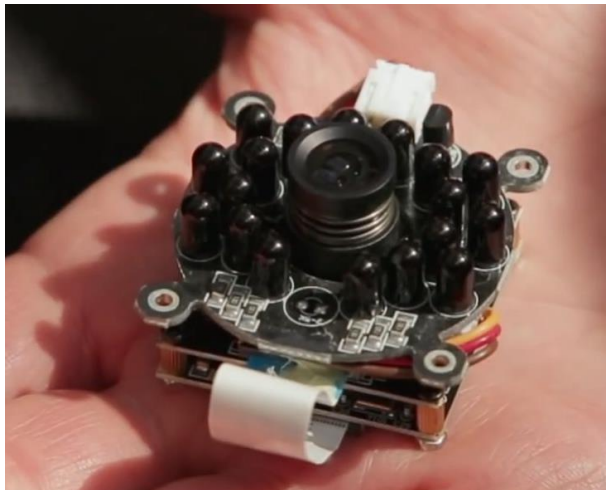


© Can Stock Photo - csp40143088

Figures 5 and 6. Illustration of "OK Card" for Pudirivayal Anicut, Thanjavur District



Citizen Science
Citizen Engagement
E-Surveys/Service Ratings
"OK Cards"



Representative Image: Flickr/ Climate

Competitions

Water Appathon
Water Hackathon
Data Jams
X-Prize
Internships
E-books, Designs, Products, Processes…

Biodiversity & Protected Areas

Data Standards, Access & Visualization

Monitoring Equipment

Policies & Institutions

ESIA Analytics

Groundwater Management

Drought Preparedness

Earth Observation

Pollution Management

Nature-based Infrastructure

Corporate Sustainability

Disaster Management

Watershed Management

Citizen Engagement

Climate Adaptation

Leverage WBG Infrastructure & Convening

Operational Basics & Recent Advances

Evolving Global Good Practices

Lessons Learned

Government Implementation Experiences

Private Sector Perspectives

Online courses, e-books

Professional Networking

Videoconference/Collaborative Digital Networks

Virtual Seminars on Key Topics from Global Experts

Virtual Desktop Participation; e-learning

Benefits of using emerging technology

- Cheaper, faster, better, …
- More participatory, information-based decisions
- Do things not possible before, smaller world…

Risks of using emerging technology

- Traditional jobs becoming obsolete
- Changes in decision making
- Privacy, Cybersecurity, Accelerated pace of change…

Towards a Mashreq Platform

A new world of “Disruptive Technology”

“Disrupt” decision making

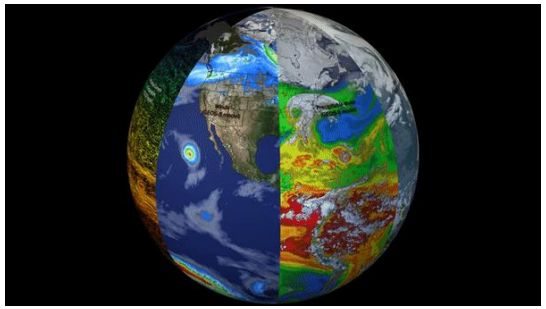
- ***Data Collection***: Monitoring/Surveys (in-situ sensors/IoT, Earth Observation, UAVs, crowdsourcing…); Digitization
- ***Data Management*** (telemetry, cloud services, open data, Blockchain, …)
- ***Data Analysis*** (Big data, Geospatial/AI/Machine Learning, modeling, script repositories …)
- ***Data Access*** (open data APIs, data visualization, gamification, mixed reality-AR/VR, …)
- ***Outreach:*** Platforms/Social Media/Portals/Apps/e-books/Competitions

“Disrupt” production

- 3D printing/additive manufacturing
- Automation/Robotics /automated transport
- Advanced materials/nanotech/ biotech/distributed energy/green tech…

“Disrupt” interaction

- Crowdsourcing, gamification, competitions (e.g. *hackathons*, *appathons*)
- Mobile money, Fintech
- Maker movement/DIY/Tech Incubators/OLC
- Sharing economy, Mobile learning



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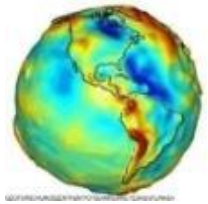

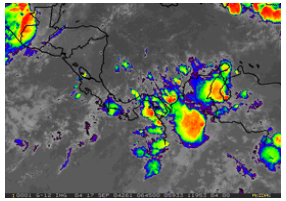

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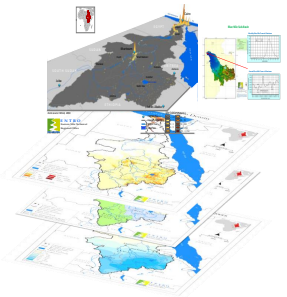

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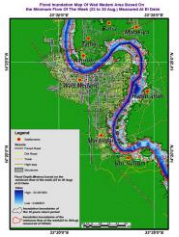

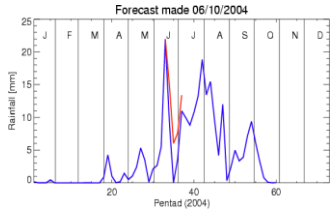

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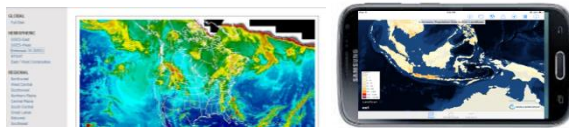
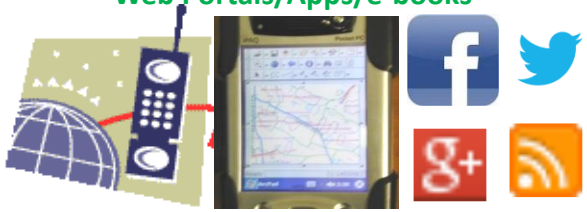


Web Portals/Apps/e-books



Stakeholder Alerts

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Manual Monitoring

Automated Monitoring

"Bottom-up" Data Acquisition System → IoT

Mashreq Data Portal

Not secure | spatialagent.org/Mashreq/

MASHREQ WATER RESOURCES PORTAL

All | Environmental | Social | Economic | Climate | Water | Disasters

Water Transition

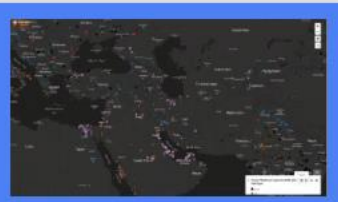
RICCAR

JRC Urban Explorer

Water Inventory

Fishing Watch

Aqueduct Food



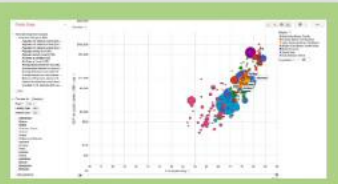
Power Plants

Watershed Delineation

NASA Disasters Portal

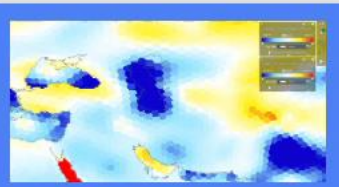
GEOGLOWS Streamflow Forecast

Climate Stations



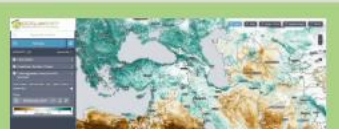
Motion Charts

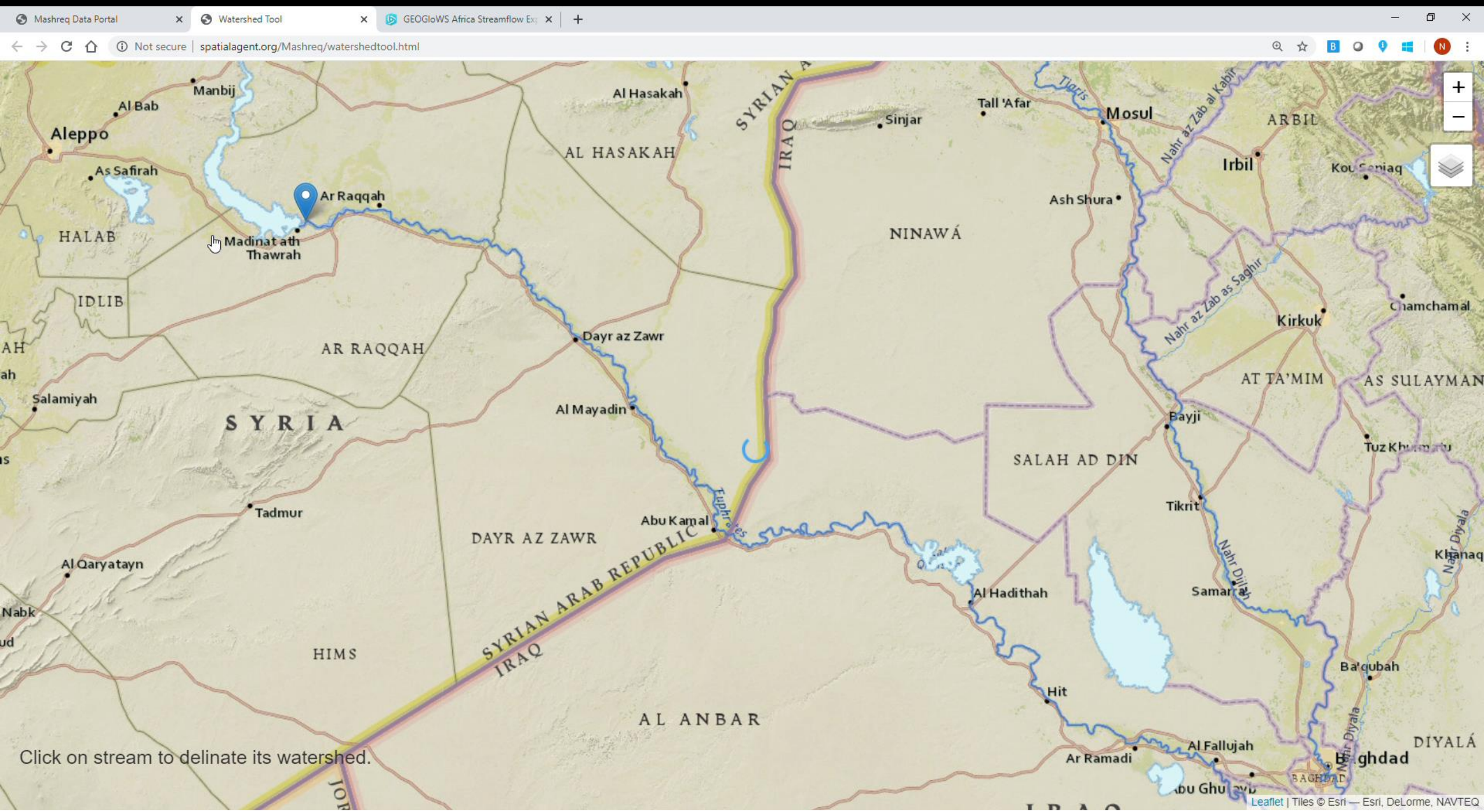
ACLED Conflict Data

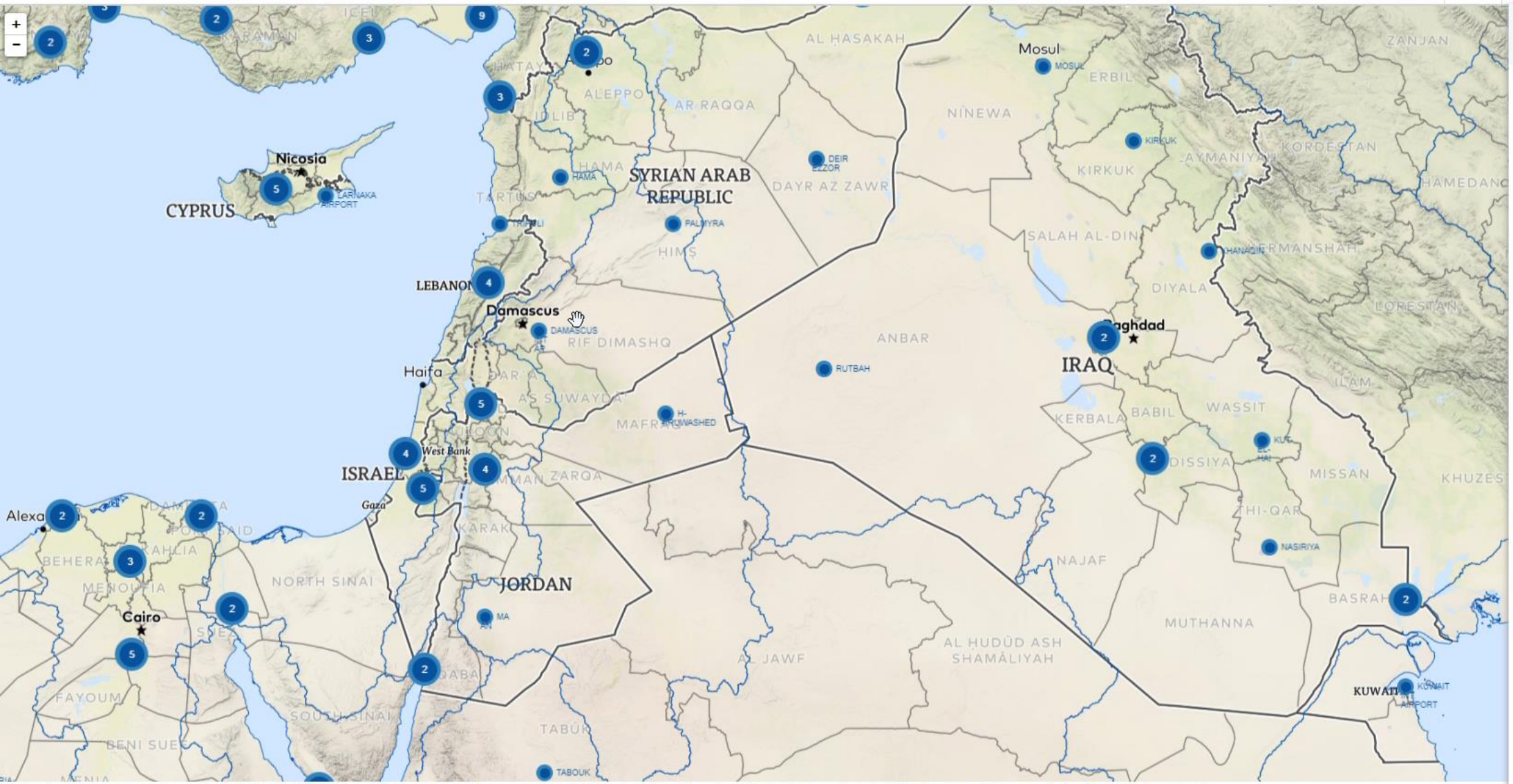


GRACE Groundwater

Cities




Mashreq Data Portal
Watershed Tool
GEOGloWS Africa Streamflow Ex
Not secure
spatialagent.org/Mashreq/watershedtool.html
Manbij
Al Bab
Aleppo
As Safirah
Ar Raqqah
Madinat ath Thawrah
HALAB
IDLIB
AR RAQQAH
Salamiyah
SYRIA
Tadmur
Al Qaryatayn
HIMS
Al Hasakah
AL HASAKAH
Dayr az Zawr
Al Mayadin
Abu Kamal
DAYR AZ ZAWR
SYRIAN ARAB REPUBLIC
IRAQ
Euphrates
Sinjar
Tall 'Afar
Mosul
Tigris
Nahr az Zab al Kabir
ARBIL
Irbil
Ash Shura
NINAWÁ
Nahr az Zab as Saghir
Kirkuk
AT TA'IM
AS SULAYMAN
Bayji
SALAH AD DIN
Tikrit
Nahr Diyala
Al Hadithah
Hit
AL ANBAR
Ar Ramadi
Al Fallujah
BAGHDAD
DIYALÁ
Ba'qubah
Khanaq
Click on stream to delinate its watershed.
Leaflet | Tiles © Esri — Esri, DeLorme, NAVTEQ



Disclaimer: Country borders or names do not necessarily reflect the World Bank Group's official position. This map is for illustrative purposes and does not imply the expression of any opinion on the part of the World Bank, concerning the legal status of any country or territory or concerning the delimitation of frontiers or boundaries.

Search List

Hydrosheds (rivers)

The World Hydro Reference Overlay Map service is designed to be used as a base map by scientists, professionals, and researchers in the fields of Hydrology, Geography, Climate, Soils, and other natural sciences. more

Source/Copyright: WWF, USGS, EPA, ESRI

LEGEND

TRANSPARENCY 100

Climate Stations

Select Sublayer

Precipitation Stations

The KNMI Climate Explorer is a web application to analysis climate data statistically. more

Source/Copyright: KNMI

LEGEND

TRANSPARENCY 100

Major Basins

This dataset was obtained by delineating drainage basin boundaries from hydrologically corrected elevation data (HydroSHEDS and Hydro1K). more

Source/Copyright: FAO

LEGEND

MASHREQ WATER RESOURCES PORTAL

All | Environmental | Social | Economic | Climate | Water | Disasters

GEOGLOWS Streamflow Forecast

Climate Stations

Climate Change Knowledge Portal

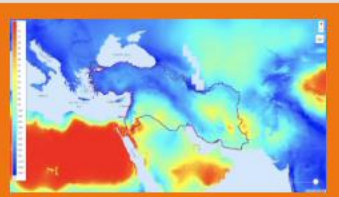
Climate Engine

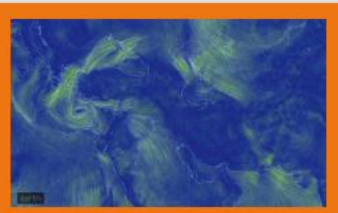
MODIS Flood Explorer

Satellite Temperature

Soil Moisture

Satellite Precipitation (NASA GPM)


Average Annual Precipitation

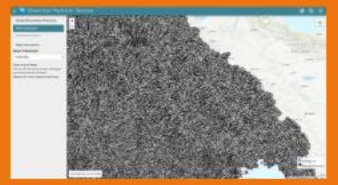

Earth Wind Map

Landsat Imagery

MODIS Layers

ESRI Water Balance

Himawari


SERVIR Streamflow Prediction Services

Select Language

GEOGloWS Africa Streamflow Explorer
version 1.0.6
Find address or place
UNITED STATES
MEXICO
APPALACHIAN MTNS
Atlantic Ocean
Caribbean Sea
FRANCE
SPAIN
ITALY
GREECE
TURKEY
UKRAINE
KAZAKHSTAN
MONGOLIA
GOBI DESERT
IRAN
JAPAN
CHINA
INDIA
ALGERIA
LIBYA
EGYPT
SAUDI ARABIA
S A H A R A
MALI
NIGER
CHAD
SUDAN
NIGERIA
ETHIOPIA
Arabian Sea
Pacific Ocean
COLOMBIA
PERU
BRAZIL
BOLIVIA
ANGOLA
ZAMBIA
NAMIBIA
TANZANIA
INDONESIA
Indian Ocean
AUSTRALIA
Coral Sea
SOUTH AFRICA
ARGENTINA
Tasman Sea
600mi
61.486 17.072 Degrees
Esri, HERE, Garmin, FAO, NOAA | Source: GEOGLOWS, BYU, ESRI
esri

Disrupt or Be Disrupted!

harsh@worldbank.org