SERVIR GLOBAL

CONNECTING SPACE TO VILLAGE

A Retrospective Report: 2014-2018

USAID FROM THE AMERICAN PEOPLE

NASA

RCMRD

ICIMOD

adpc

CILSS

Since its launch in 2005, SERVIR has grown into a global network of regional hubs that are supporting analysis and capacity building to connect satellite data to development challenges in Eastern and Southern Africa, West Africa, Hindu Kush Himalaya, and Lower Mekong regions.

Activities in
more than

45

countries

developed

70+

custom tools

partnered with

260

institutions

3,500+

individuals trained,
improving the capacity
to develop local
solutions.

Contents

SERVIR: Connecting Space to Village

A joint development initiative of the National Aeronautics and Space Administration (NASA) and the United States Agency for International Development (USAID), SERVIR works in partnership with leading regional organizations worldwide to help developing countries use information provided by Earth observing satellites and geospatial technologies. SERVIR creates tools, products, and services that empower decision makers to better address critical issues related to food security, water resources, natural disasters, land use, and weather variability.

Since its launch in 2005, SERVIR has grown into a global network of four active hubs that are improving awareness, increasing access to information, and supporting analysis to help people across Africa and Asia to better manage today's complex development and environment challenges. With activities in more than 45 countries and counting, SERVIR has already developed over 70 custom tools, collaborated with 260 institutions, and trained more than 3,500 individuals, improving the capacity to develop local solutions.

In Bangladesh, the government's Flood Forecasting and Warning Center is generating earlier forecasts to predict river flooding, thanks to river level data collected by satellite. In Eastern and Southern Africa, analysts now have access to satellite-based land cover maps that increase the accuracy of agriculture and conservation monitoring. And in Southeast Asia's Lower Mekong region, scientists and development practitioners now wield the power of Google Earth Engine to process big data in seconds instead of months, enhancing environmental management and sustainable development planning. These are a few examples of the many activities around the world supported by SERVIR.

Through the combined efforts of the four regional hubs, and with technical support from USAID, NASA, and U.S.-based science collaborators, SERVIR is at the forefront of demonstrating the value of using Earth observations and geospatial data, products, and tools to advance international development through science and technology.

View of satellite-based vegetation condition map of the Lower Mekong region.

SERVIR Service Areas

SERVIR activities are spread across four thematic service areas:

Agriculture and Food Security – the food security thematic service area includes agriculture, rangeland management and pastoralism, and fisheries and aquaculture, particularly through the lens of adaptation to increasing environmental extremes. Key topics include linking agricultural productivity assessments, crop yield models, and use of climate scenarios for assessing the impacts.

Land Cover – the land cover, land use change and ecosystems thematic service area focuses on sustainable landscapes through natural capital accounting and ecosystem services. Ecosystem services are critically dependent on natural capital such as forests, the quality of soils, organic and nutrient contents, topography, rainfall, and land cover among other factors.

Water and Disasters – the water resources and hydroclimatic disasters thematic service area includes water quantity (including groundwater), sediment transport, water quality, and water-related disasters. It involves improved estimation and predictability of water resources for integrated water management. Key topics also include estimations of water allocations, the food-water-energy nexus, and disaster investigations including floods, droughts, and rainfall-induced landslides.

Weather and Climate – the weather and climate thematic service area spans a continuum of time scales, ranging from short-term prediction of weather, through seasonal forecasts, to interannual climate scenarios. Integration of these data sets in applications brings the latest science to support the needs of SERVIR hubs and their end users.

Network of Hubs

SERVIR brings together a variety of specialists from diverse backgrounds to create a unique team for addressing complex environmental issues and providing solutions to local decision makers and stakeholders around the globe. The heart of this team is SERVIR's global network of four leading regional knowledge centers, or hubs—the Regional Centre for Mapping of Resources for Development (RCMRD) in Nairobi, Kenya; the International Centre for Integrated Mountain Development (ICIMOD) in Kathmandu, Nepal; the Asian Disaster Preparedness Center (ADPC) in Bangkok, Thailand; and the Agrometeorology, Hydrology and Meteorology (AGRHYMET)* Regional Center in Niamey, Niger—as well as hub consortium members and other partners dedicated to building resilience through the integration of Earth observations and geospatial technologies. In addition to the hubs, the SERVIR team includes the SERVIR Science Coordination Office, NASA headquarters and centers in the United States, USAID headquarters and missions around the world, and universities and other institutions across the globe.

Building and relying upon this growing network of partners is fundamental to SERVIR. Beyond the sponsorship and active participation of NASA and USAID, SERVIR collaborates with a number of other U.S. government agencies and projects as well as government agencies in SERVIR regions. SERVIR also engages in joint research with universities and non-governmental organizations, and promotes capacity building with these expert groups.

*a subsidiary of the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS), and its consortium partners.

SERVIR is at the forefront of demonstrating the value of using science and technology, including geospatial data products and tools, to advance international development.

Integrating precipitation data into river monitoring networks is especially critical in monsoon-affected regions for timely early warnings. Dohar, Bangladesh on August 5, 2016.

SERVIR: By the Numbers

Results Around the Globe

45+
Countries directly served by SERVIR products, applications, or trainings.
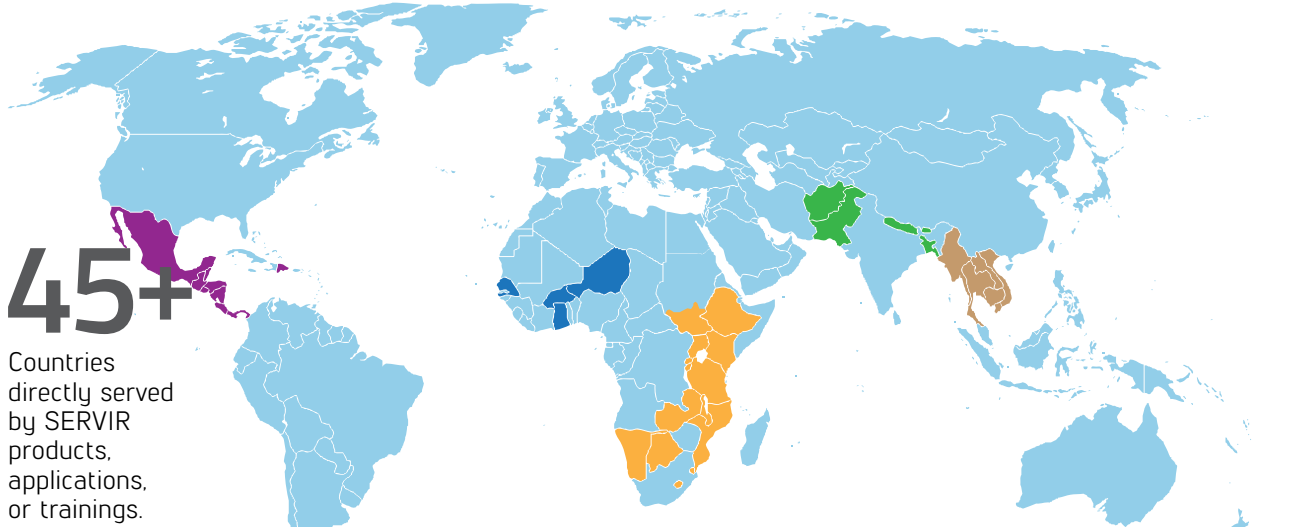
Training and Information Sharing

3,500+
People trained to use tools and information.

260
Institutions worldwide with improved capacity to address development and environmental issues.

400+
Decision makers and scientists participating in technical exchanges.

Products, Tools, and Applied Research

73
Climate risk and environmental decision–support products developed.

1.5M
Maps produced interactively on the SERVIR web portal (2015).

Connecting More Science

27
Satellites and sensors used by SERVIR.

27
Collaborative applied research activities linking U.S. scientists with SERVIR partners.

The Current SERVIR Hub Network

SERVIR-Science
Coordination Office
NASA/MSFC

USAID Washington
NASA Headquarters

SERVIR-Hindu Kush Himalaya
ICIMOD

SERVIR-Mekong
ADPC

SERVIR-West Africa
CILSS/AGRHYMET

SERVIR-Eastern and
Southern Africa
RCMRD

SERVIR-Amazonia
(planned 2018)

SERVIR Focus Countries

Additional Countries Reached
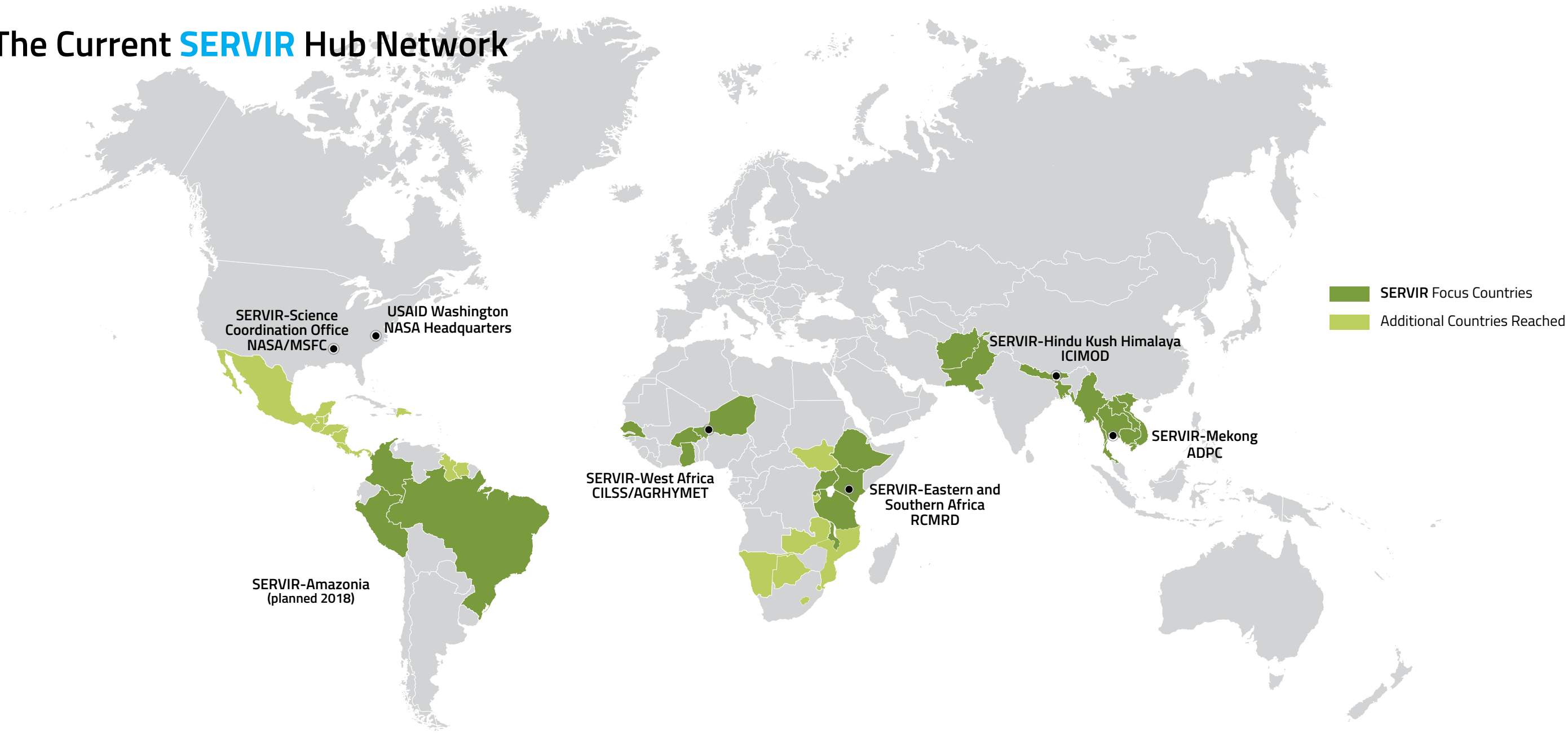
SERVIR: Regional Hubs and Networks

SERVIR – Eastern and Southern Africa

In 2008, NASA and USAID partnered with the Regional Centre for Mapping of Resources for Development (RCMRD) based in Nairobi, Kenya to establish SERVIR's Eastern and Southern Africa hub.

Founded in 1975, RCMRD is a leading intergovernmental African organization that currently has 20 Contracting Member States in the Eastern and Southern Africa regions. RCMRD's aim is to promote sustainable development through the generation, application, and dissemination of Geo-Information and related IT products and services in the Member States and beyond. SERVIR – Eastern and Southern Africa builds upon RCMRD's existing strengths and augments their data management and training capability. Efforts complement RCMRD's core mission and provide a springboard for the development of applications customized for Member States.

Primary Services
• Drought monitoring and assessments
• Frost forecasting
• Streamflow and flood forecasting
• Land cover mapping
• Vulnerability assessment
• Crop area estimation

Nairobi, Kenya (RCMRD HQ)

Learn more at: http://servir.rcmrd.org/
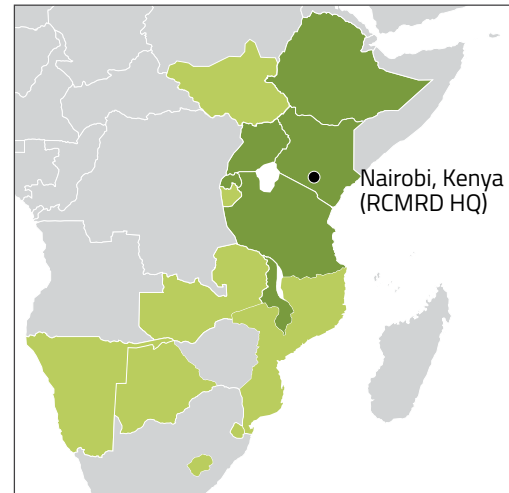
SERVIR – Hindu Kush Himalaya

SERVIR – Hindu Kush Himalaya was established in 2010 at the International Centre for Integrated Mountain Development (ICIMOD) in Kathmandu, Nepal. Founded in 1983, ICIMOD is a regional intergovernmental learning and knowledge sharing center serving the eight regional member countries of the Hindu Kush Himalayas.

With the increasing influence of globalization and climate change on the stability of fragile mountain ecosystems and the livelihoods of mountain people, ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues. SERVIR – Hindu Kush Himalaya strengthens ICIMOD's capabilities as an established regional resource center on geospatial information and Earth observation applications for the countries in this region. Stakeholders range from decision makers at the regional level addressing trans-boundary issues, to national governments, scientists, students, the general public, and development practitioners working in the region.

Primary Services
• Crop area estimation
• Drought monitoring and assessments
• Land cover mapping, forest monitoring, and biomass estimation
• Fire hotspot monitoring

Kathmandu, Nepal (ICIMOD HQ)

Learn more at: http://servir.icimod.org/
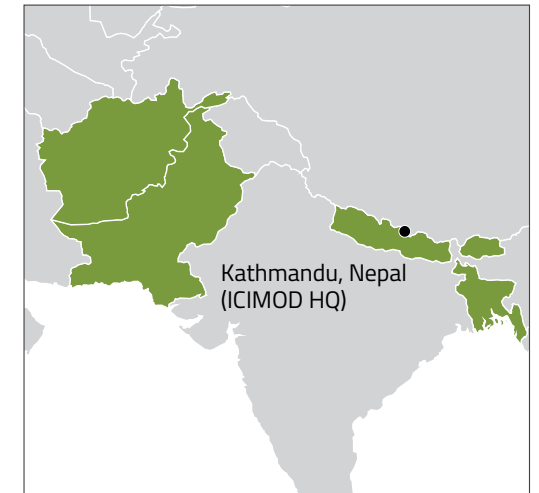
SERVIR – Mekong

In 2015, USAID and NASA continued the network's expansion with the launch of SERVIR – Mekong, implemented by the Asian Disaster Preparedness Center (ADPC) and its consortium partners—Spatial Informatics Group (SIG); Stockholm Environment Institute (SEI); and Deltares. ADPC is a leading regional resource center on disaster risk reduction and climate change adaptation in Asia.

Since its establishment in 1986, ADPC has developed strong partnerships with national governments in the region, and with support from its development partners provides more than 20 countries with technical services and capacity building to bolster resilience against natural hazards in one of the most disaster-prone regions of the world. SERVIR – Mekong promotes the use of publicly available satellite imagery and related geospatial decision-support tools/ products to help key stakeholders and decision makers in Burma (Myanmar), Cambodia, Lao PDR, Thailand, and Vietnam better predict and manage floods and other natural disasters, improve agricultural risk management, manage land-use more sustainably, and help governments and communities increase resilience to the negative effects of climate change.

Bangkok, Thailand
(ADPC HQ)

Primary Services
• Reservoir mapping
• Virtual rain and stream gauge
• Land cover monitoring
• Drought and crop yield information system

and its consortium partners

Learn more at: https://servir.adpc.net/

SERVIR – West Africa

In 2016, USAID and NASA welcomed SERVIR's newest hub to the network with the launch of SERVIR - West Africa, implemented by the Agriculture, Hydrology and Meteorology (AGRHYMET) Regional Center, a subsidiary of the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS), and its consortium partners,* with support from Tetra Tech, Inc.

Created in 1974, AGRHYMET is a specialized agency of the Permanent Inter-State Committee against Drought in the Sahel (CILSS) serving 13 member countries in West Africa. This hub promotes the use of publicly available satellite imagery and related geospatial decision-support tools/products to help key stakeholders and decision makers, especially in Burkina Faso, Ghana, Niger, and Senegal, make more informed decisions in SERVIR's four thematic areas.

Niamey, Niger
(CILSS/AGHRYMET HQ)

Primary Services
• Surface water body mapping
• Ground water monitoring and modeling
• Charcoal production monitoring
• Locust infestation monitoring

and its consortium partners

Learn more at: http://www.agrhymet.ne/eng/

*Centre de Suivi Ecologique (CSE), based in Senegal; Centre for Remote Sensing and Geographic Information Services (CERSGIS), based in Ghana; Regional Centre for Training in Aerospace Surveys (RECTAS), based in Nigeria, (now known as AFRIGIST – African Regional Institute for Geospatial Information Science and Technology); International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), based in Mali; and, African Centre of Meteorological Application for Development (ACMAD), based in Niger.

Grants and Small-Scale Applications

As demand grows for geospatial tools and services, SERVIR connects with a broad range of institutions through its small grants program.

Small grants encourage innovation by building partnerships with a wide range of organizations that are using Earth observations to solve national, regional, and local development challenges. Grantee institutions include non-governmental organizations, universities, and local government entities in SERVIR's regions.

To increase public access to information, products and services developed through the small grants program are integrated into SERVIR's product catalog, and data layers generated by grantees are integrated into SERVIR's data catalogue. SERVIR has implemented competitively awarded grants through three of its regional hubs to date and anticipates that all of its hubs will support the work of local and regional organizations through future grants programs.

15
Countries

35
Grants and
small-scale applications

Grant Impact in Focus: Supporting Banana Farming in Nepal

The banana is a high-value agricultural product, and although there is great potential for banana production in Nepal, there are few commercial banana plantations and current productivity is low. Demand for bananas in Nepal currently exceeds total national production.

The SERVIR small grant project "Spatial Modeling of Climate Change Impacts on Two Major Cash Crops in Nepal" implemented by HELVETAS Swiss Intercooperation in collaboration with the Centre for Mountain Ecosystem Studies at the Kunming Institute of Botany, projected the impacts of bioclimatic conditions on the banana crop.

The project incorporated field work including farmer surveys, mapping of current banana plantations, and suitability modelling using bioclimatic, environmental stratification, land use, and geographical data. In total, 105 banana farmers in two districts were interviewed for the project.

The results of the project were discussed with Nepal's Ministry of Agricultural Development, Ministry of Forests and Soil Conservation, research institutes, non-governmental organizations, and farmers' representatives in March 2015. Out of this discussion, a strategy for developing a banana-based agroforestry system, particularly with coffee, was proposed as an option for sustainable agriculture in banana- and coffee-suitable zones identified by the project.

The final research outputs are available on the geoportal of the World Agroforestry Centre GeoScience Lab (http://landscapeportal.org/). This site is user friendly, and maps can be prepared according to user needs utilizing the project's research results.

SERVIR – Eastern and Southern Africa Grants and Small–Scale Applications

Country/Region	Organization	Project
Botswana	Botswana International University of Science and Technology (BIUST)	Monitoring Land Degradation in the Central District of Botswana: A three-tier land degradation index mapping approach
Ethiopia	Center for Environmental Science, College of Natural Sciences, Addis Ababa University	Allometric Equation for Biomass Estimation of 30 Indigenous Tree Species in Southern and Eastern Ethiopian Forests: Nexus for Climate Change Mitigation and Adaptation
Kenya	Dedan Kimathi University of Technology (DeKUT)	A Pilot Implementation of the Land Administration Domain Model for Kenya
Kenya	Jaramogi Oginga Odinga University of Science and Technology (JOOUST)	Resilience to Climate Change through Building Capacities in Spatial Data Infrastructure (SDI) for Uptake by Selected Country Governments in Lake Victoria Region in Kenya
Kenya	Kenya Meteorological Department	Enhancing Weather Forecast Modeling Capabilities in Kenya Meteorological Services by Use of NASA-SPoRT/SERVIR Data
Kenya	County of Wajir	Web-Based GIS Water Resource Management System for the County Government of Wajir
Kenya	Jaramogi Oginga Odinga University of Science and Technology (JOOUST)	Development of Decision-Support System for Sustainable Participatory Sub-catchment Water Resources Management in the Face of Deteriorating Climatic Conditions
Namibia	Namibia Geographical Information Technologies (NGIT)	Development of a Geographical Information System-based Support Tool for Integrated Water Resources Management in Zambezi Catchment Area within the Zambezi Region
Rwanda	University of Rwanda	Integrated Flood Modelling for Flood Hazard Assessment in Kigali City
Seychelles	Nature Seychelles	Implementing the First Stage of an Indian Ocean Global Warming Observatory Based in Seychelles
Tanzania	Ardhi University	Spatial Temporal Assessment of Mangrove Forest as a Strategy to Mitigate Impacts of Coastal Hazards: The Case of Mafia Island
Uganda	ESIPPS International Limited	Geo-Mapping for Hay-Making in Climate Stressed Rangelands (Geo4HCR)
Uganda	Mountbatten / Fruits of Thought	Training Policy Makers in Data Collection and Mapping of Vulnerable Areas in Kampala, Uganda, to Carry out Risk Analyses to Mitigate Climate Change Risks
Uganda and Tanzania	Department of Geomatics and Land Management, Makerere University	Operational Monitoring of Water Quality on Lake Victoria Using Satellite Imagery

SERVIR – Hindu Kush Himalaya Grants and Small-Scale Applications

Country/Region	Organization	Project
Bangladesh	Bangladesh University of Engineering and Technology – Japan Institute of Disaster Prevention and Urban Society (BUET–JIDPUS)	Developing Dynamic Web-GIS based Early Warning System for the Communities at Landslide Risks in Chittagong Metropolitan Area
Bangladesh	Center for Environmental and Geographic Information Services (CEGIS)	Development of Geospatial Database and Information System for Panchhari Upazilla to Identify Potential Water Harvesting Storages and Climate Change Impact on Water Availabilities
Bangladesh	Institute of Water Modeling (IWM)	Strengthening the Capacity of Satellite-Based Flood Forecasting Using Near Real Time Jason-2 Satellite Altimeter Data
Bangladesh	Institute of Water Modeling (IWM)	Implementation of JASON-2 Satellite Altimetry-Based Flood Forecasting System at Flood Forecasting and Warning Center of Bangladesh Government
India	South Asian Forum for Environment (SAFE)	Geospatial-scenario Planning Framework for Assessing Risks and Impacts of Forest Fire in Eastern Himalayas
India	The Energy and Resources Institute (TERI)	Building Community Resilience to Flood Hazards Using Geospatial Technology
Nepal	HELVETAS Swiss Intercooperation Nepal	Spatial Modeling of Climate Change Impacts on Two Major Cash Crops
Nepal	Institute of Forestry (IOF)	Geospatial Modelling for Fire Hazard Mapping and Management
Nepal	Kathmandu Living Lab	Engaging and Empowering Citizens to Collect Agricultural and Environmental Information
Nepal	Kathmandu University	Interactive web and mobile app using open-source data and open-source software for creating disaster and emergency response system
Nepal	Kathmandu University	Estimation of Above Ground Forest Biomass and Carbon Stock Using UAV Images
Nepal	Nepal Department of Forests	Community-Based Forest Fire Information System
Pakistan	Karakoram International University, Mountain Agricultural Research Centre (MARC)	Assessing Grazing Intensity and Rangeland Health to Support Decision-Making for Rangeland Management in Gilgit-Baltistan
HKH Region and Pakistan	Institute of Space Technology (IST)	Using Spaceborne Synthetic Aperture Radar (SAR) in synergy with other methods for Forest Above Ground Biomass Assessment in the Hindu Kush-Himalayan (HKH) region and Pakistan

SERVIR – Mekong Grants

Country/Region	Organization	Project
Cambodia	The Asia Foundation	Production of a New Cambodian National Atlas on Gender and Climate
Cambodia	Open Development Cambodia	The Use of Google Earth Engine to Play a Role in Gender Equality and Education in Flood-Prone Areas
Thailand	Asian Institute of Technology	Spatio-Temporal Analysis on Urban Development and Scenario-Based Flood Risk Assessment in Bangkok Metropolitan Region
Thailand	Chulalongkorn University	Assessing Impacts of Rubber Prices on Land Use Change in the Eastern Region of Thailand
Vietnam	Institute for Water & Environment	Application of Satellite Data to Strengthen the Capacity of Reservoir Operation and Management for Increasing Resilience to Drought and Ensuring Water and Food Security for Ninh Thuan Province
Vietnam	International Union for Conservation of Nature	Mangrove Identification and Evaluation in Integrated Aquaculture-Forestry Ecosystems
Vietnam	Center for Environment & Community Assets Development	Gender-Sensitive GIS Mapping of Livelihoods and Vulnerability of Thai Ethnic Minority Group to Land Dispossession in Northwest Vietnam

Investigators from SERVIR - Mekong grantee Chulalongkorn University interview rubber farmers in Thailand to gather socioeconomic data as they assess the impact of rubber prices on land use change.

SERVIR: Collaborating Researchers

Role of Collaborating Researchers

Through SERVIR, NASA's Earth Science Division's Applied Sciences Program advances the use of space-based observations to inform policy and decision makers as they adapt to the impacts of global change and plan for a sustainable future. NASA brings innovative and appropriate applied science to meet SERVIR user needs through the Applied Sciences Team (AST) as collaborating scientists.

Eleven proposals were competitively selected for four-year efforts to collaborate with hubs on SERVIR applied research activities in 2011. Through a second solicitation, 16 new proposals were selected for three-year efforts beginning in 2016.

Through these activities, U.S.-based researchers are working with hubs on projects in Eastern and Southern Africa, West Africa, the Hindu Kush Himalaya region, and the Lower Mekong region of Southeast Asia. U.S.-based researchers help to bring the latest in Earth observation and geospatial technologies to bear on regional issues related to agriculture and food security, water resources and hydroclimatic disasters, land cover and land use change and ecosystems, and weather and climate. Developed in collaboration with the SERVIR hubs, these projects are also designed to build regional capacity for using cutting edge tools and data.

A complete list of past and current projects can be found here: www.servirglobal.net/SERVIR-AST

SERVIR is a NASA-USAID venture that fosters applications of Earth observations to help developing countries assess environmental conditions to improve their planning, decisions, and actions.

NASA-funded collaborating researchers are working with hub team members on projects in SERVIR regions: Eastern and Southern Africa, West Africa, the Hindu Kush Himalaya region, and the Lower Mekong region of Southeast Asia.

SERVIR Science Collaboration Activities in Focus

Highlights of Applied Sciences Team Projects

Principal Investigator: Sean Healey, U.S. Forest Service, Rocky Mountain Research Station

Hub Collaborators: Phoebe Oduor, RCMRD/SERVIR – Eastern and Southern Africa; Edward Ouko, RCMRD/SERVIR – Eastern and Southern Africa

Thematic Service Area: Land Cover

This project uses cloud computing and the Landsat archive to deliver historical and continuously updated 30-meter maps of land cover across Kenya, Malawi, Ethiopia, Zambia, Tanzania, Rwanda, and Uganda to monitor the impacts of human activities on forest and water resources of the region.

Principal Investigator: Hyongki Lee, University of Houston

Hub Collaborators: Senaka Basnayake, ADPC/SERVIR – Mekong; Susantha Jayasinghe, ADPC/SERVIR – Mekong

Thematic Service Area: Water and Disasters

This project develops a comprehensive, satellite data-based system that can routinely map, provide early warning of, and enable decision-making to reduce risks of seasonal floods and droughts in low-lying deltas of Southeast Asia.

Principal Investigator: Patrick Gatlin, NASA Marshall Space Flight Center

Hub Collaborator: Bhupesh Adhikary, ICIMOD/SERVIR – Hindu Kush Himalaya

Thematic Service Area: Weather and Climate

This project integrates NASA Earth Observing System information to facilitate daily assessments of the hazards posed by thunderstorms to improve weather forecasting and early warning services in the Hindu Kush Himalayan region.

Principal Investigator: Niall Hanan, New Mexico State University

Hub Collaborator: Amadou Dieye, Centre de Suivi Ecologique (CSE)/SERVIR – West Africa

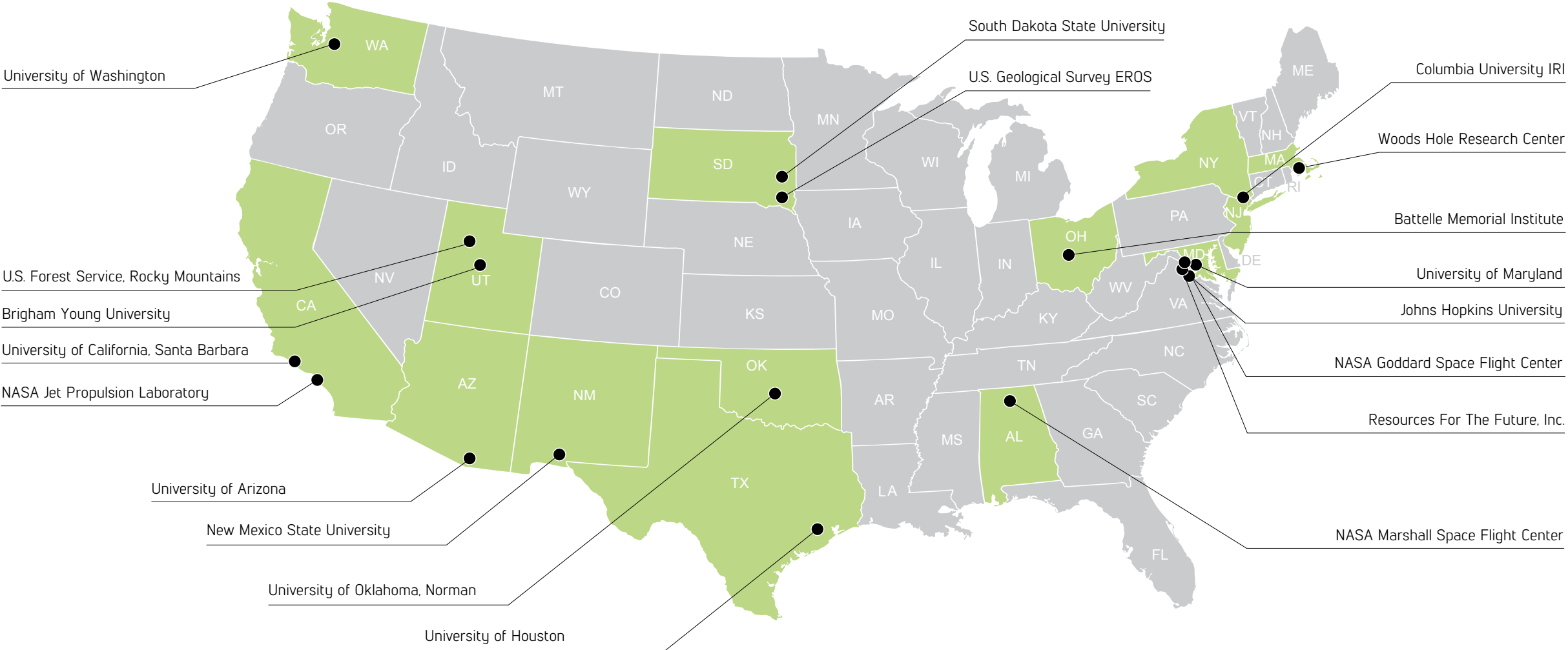**Thematic Service Area:** Agriculture and Food Security

This project develops remote sensing-based applications relevant to rangeland vegetation structure and forage production in order to improve the wellbeing and resilience of pastoralist and agropastoralist communities in West Africa.

SERVIR Applied Sciences Team member Catherine Nakalembe (right) instructs a Village Knowledge Extension Agent in electronic field data collection in Iringa, Tanzania.

Research Institutions Collaborating with SERVIR Across the United States

University of Washington

South Dakota State University

U.S. Geological Survey EROS

Columbia University IRI

Woods Hole Research Center

U.S. Forest Service, Rocky Mountains

Brigham Young University

Battelle Memorial Institute

University of California, Santa Barbara

University of Maryland

NASA Jet Propulsion Laboratory

Johns Hopkins University

NASA Goddard Space Flight Center

University of Arizona

Resources For The Future, Inc.

New Mexico State University

NASA Marshall Space Flight Center

University of Oklahoma, Norman

University of Houston

SERVIR: Success Stories

Targeting the Hungry During Crop Crisis

Two-thirds of the people in Nepal depend on agriculture for their livelihoods. However, with uncertainties in weather patterns and water availability, reliable crop production across the country poses a serious challenge.

The impact of crop failure on food security is a very real concern. During a prolonged drought in spring 2016, for example, remote districts of western Nepal experienced their worst drought in 40 years.

To identify the areas affected most by the drought, the United Nations' World Food Program (WFP) used NASA Earth observation satellite data and analyses provided by SERVIR – Hindu Kush Himalaya. These products helped WFP to target the distribution of $1M worth of food aid to the areas most in need.

WFP and Nepal's Ministry of Agricultural Development jointly produce periodic Food Security Bulletins profiling the current and forecasted situation for food security—and food shortages—in Nepal by district.

The data and products provided by SERVIR – Hindu Kush Himalaya and ICIMOD inform the assessments in these bulletins.

"The SERVIR products have enabled the integration of crop yield forecasting and analyses to understand the drought onset and severity patterns across the country. These products are also used for evidence-based communications to inform the highest level governmental decision makers in Nepal on the issue."

Kurt Burja, Head of WFP's Vulnerability Assessment and Mapping unit in Nepal
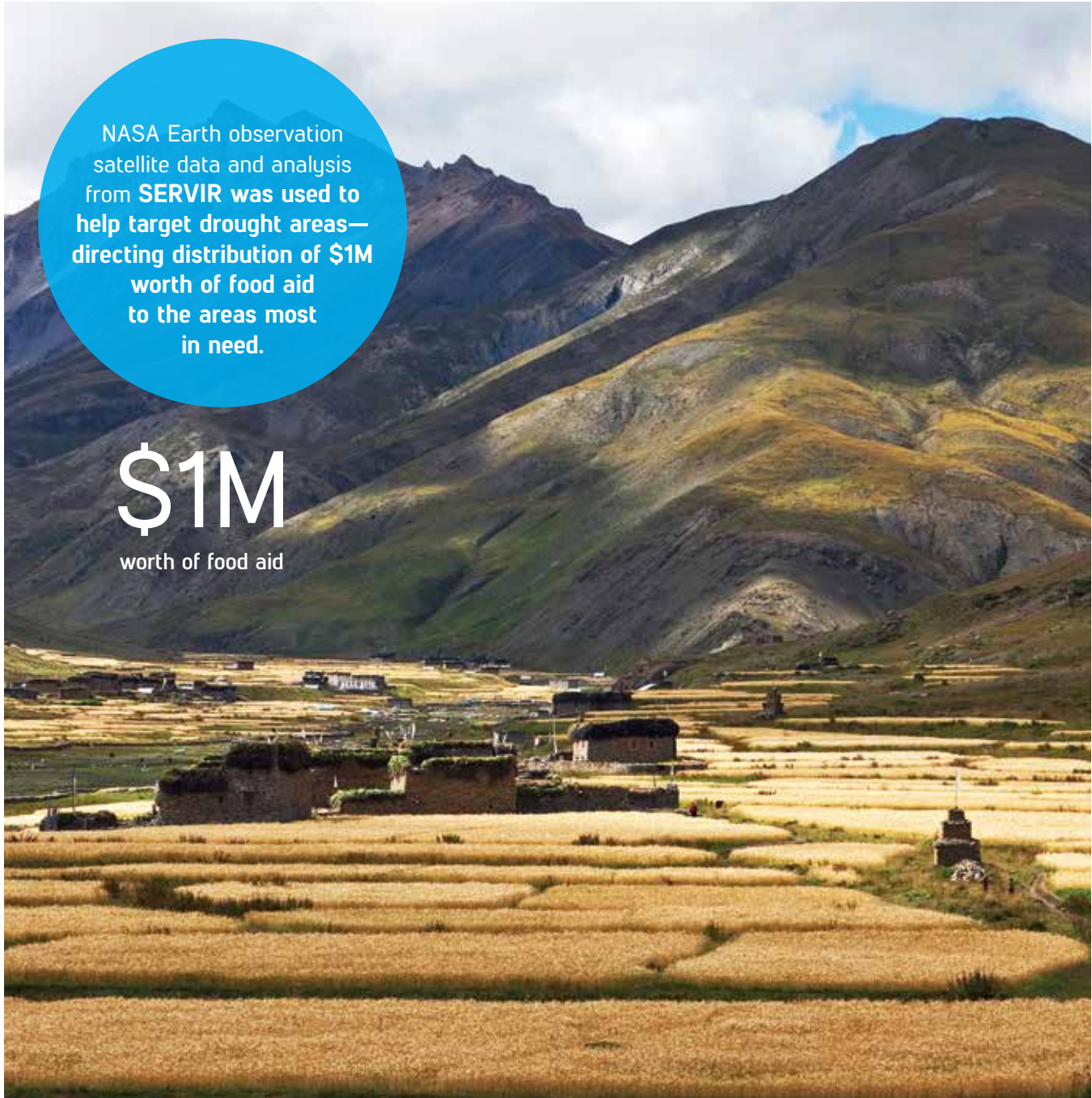
NASA Earth observation satellite data and analysis from **SERVIR was used to help target drought areas—directing distribution of $1M worth of food aid to the areas most in need.**

$1M
worth of food aid

Saving Valuable Crops in Kenya

Kenya is the third largest tea exporter in the world, producing 10 percent of the world's black tea. The tea industry provides a living for about 4 million Kenyans, or about 10 percent of the total population.

Sixty percent of Kenya's tea comes from 600,000+ smallholder tea farmers across the country. During January, February, and March, these farmers face a subtle but pervasive adversary: frost. The delicate icy coating can cause millions of dollars in damage to tea crops. In 2012, for example, a severe frost caused almost 30 percent tea crop loss in the Nandi area of Kenya.

To improve their crop yields—and protect their livelihoods—farmers need information about where and when frost is likely to occur. SERVIR – Eastern and Southern Africa developed an automated, near real-time frost mapping system that identifies and maps frost-impacted areas by analyzing nighttime land surface temperature datasets from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS). Insurance companies in the region use the maps to cover frost damages and adjudicate claims so farmers are reimbursed for losses.

The SERVIR team has upgraded the system to predict the probability of frost so farmers can take preventive measures to avoid crop loss. The frost forecasting system produces and sends to stakeholders daily frost maps showing where frost is likely to occur in the next 24 hours. The system's forecasts are based on Weather Research and Forecasting model runs, which use a SERVIR-developed frost prediction algorithm that factors in dew point, temperature, and wind speed.

According to an external evaluation group that studied the potential impact of the system, the average smallholder tea farmer could avoid $83 in annual crop losses by using it. To a smallholder farming household, this equates to 25 days of household food spending, 60 days of health spending, or a full year of school tuition for one child.

The SERVIR team also developed a phone app and online reporting system for farmers' use to report frost events and record information such as precise location, date, extent, and severity of frost. These reports help validate the frost prediction algorithm. The team is also gathering feedback from stakeholders about their needs, how the system is working, and whether the information they receive from it is understandable, useful, and provided in a user-friendly format to make future improvements.

"The frost maps are excellent tools. These will give us a much stronger basis to conduct our assessments and will boost development of frost insurances. With forecast and/or real-time reports, we will be able to alleviate this problem and make our farmers smile."

James Kiguru, Accounts Manager and Agronomist, AON Risk Solutions

Sixty percent of Kenya's tea comes from 600,000+ smallholder tea farmers across the country. During January, February, and March, these farmers face a subtle but pervasive adversary: frost.

SERVIR – Eastern and Southern Africa developed an automated, near real-time frost mapping system that identifies and maps frost-impacted areas by analyzing nighttime land surface temperature datasets from the MODIS sensor onboard NASA's Aqua satellite.

Satellite Data Saving Great Apes

Many protected areas across Africa are fragmented by farms, villages, and cities. Planning new infrastructure and agricultural expansion while maintaining intact protected areas requires careful analysis.

Deforestation and habitat fragmentation in the tropics represent major threats to biodiversity and major sources of carbon emissions. The tropics support the greatest diversity of living organisms on Earth and identifying connective corridors with the highest carbon concentrations helps to optimize biodiversity and conservation objectives.

To better address these challenges, SERVIR is helping to identify areas where reforestation can preserve critical habitat for apes. The project team used NASA satellite derived high-resolution datasets of forest carbon to map corridors of the richest biomass between protected areas in the tropics. Their analysis revealed 16,257 global corridors covering 3.4 million square kilometers and containing 51 gigatons of carbon. The United Nations' Great Apes Survival Project (GRASP) is using these maps to identify biological corridors that could both serve as forest protection areas and improve connectivity for ape populations.

The SERVIR project team is supporting the creation of forest corridors in the Murchison-Semliki Landscape in Uganda to conserve eastern chimpanzee populations.

The connectivity maps produced by SERVIR are freely available online, and feed a growing demand for accurate data in support of conservation planning throughout West and East Africa.

> "The carbon tool helps to identify areas where Reducing carbon Emissions resulting from Deforestation and forest Degradation (REDD+) investments could potentially generate biodiversity benefits, in our case for great apes. We looked at corridors which could potentially link great ape habitats, and where REDD+ could provide the necessary seed funding to protect these areas."
>
> GRASP Program Manager *Johannes Refisch*

Analysis revealed 16,257 global corridors covering...

3.4 million square kilometers and containing 51 gigatons of carbon.

"You cannot protect apes in Africa or Asia without also protecting the forests in which they live, and this project does an excellent job of emphasizing the overlap."

GRASP Coordinator *Doug Cress*

Bringing the Power of Google to the Mekong Region

Landscapes on Earth are changing at unprecedented rates. In the Lower Mekong region, officials have struggled to manage landscape changes partly because they lack sufficient access to geospatial technology and data to monitor land cover changes and guide land use decisions.

Through SERVIR - Mekong, ADPC and Google Earth Engine (GEE) are changing this reality and bringing the power of cloud computing to practitioners—dramatically improving their geospatial capabilities via a series of GEE train-the-trainer workshops. Trainings across the region deliver skills that will directly benefit environmental management and sustainable development planning.

GEE provides access to millions of gigabytes of Earth observation satellite imagery and a powerful cloud-based tool that can streamline land cover monitoring. Work that used to take months can now be done in seconds. Financial resources that would have been spent on large servers and high-computing processors can instead be reallocated for other strategic purposes.

Several training courses have been completed, with over 130 practitioners trained across the region and more trainings on the way. Just like SERVIR's motto, 'connecting space to village,' Google Earth Engine brings remote sensing capability to anyone with an internet connection and helps to build capacities to answer environment and development questions.

SERVIR - Mekong is leveraging the power of GEE to develop the Regional Land Cover Monitoring System, whose purpose is to produce high-quality regional land cover maps and identify land cover changes in the Lower Mekong region.

Land cover of the Lower Mekong region.

"Now that I have been introduced to Google Earth Engine I can see that it is much easier and faster to use than the platform I currently have. My thesis is related to forest mapping for the Mekong region, and when I return to my university I plan to change my analysis tool to Earth Engine."

Nguyen Thien Hoa, PhD student and researcher at Can Tho University, Vietnam

Guiding Flood Protection in Kenya

Like many rivers across the world, the Nzoia River in western Kenya overtops its banks with seasonal flooding. The river often bursts through the dikes, flooding the low-lying land around it.

When floods occur, thousands of people become marooned or evacuated from the banks of the swollen river, according to the United Nations Office for the Coordination of Humanitarian Affairs.
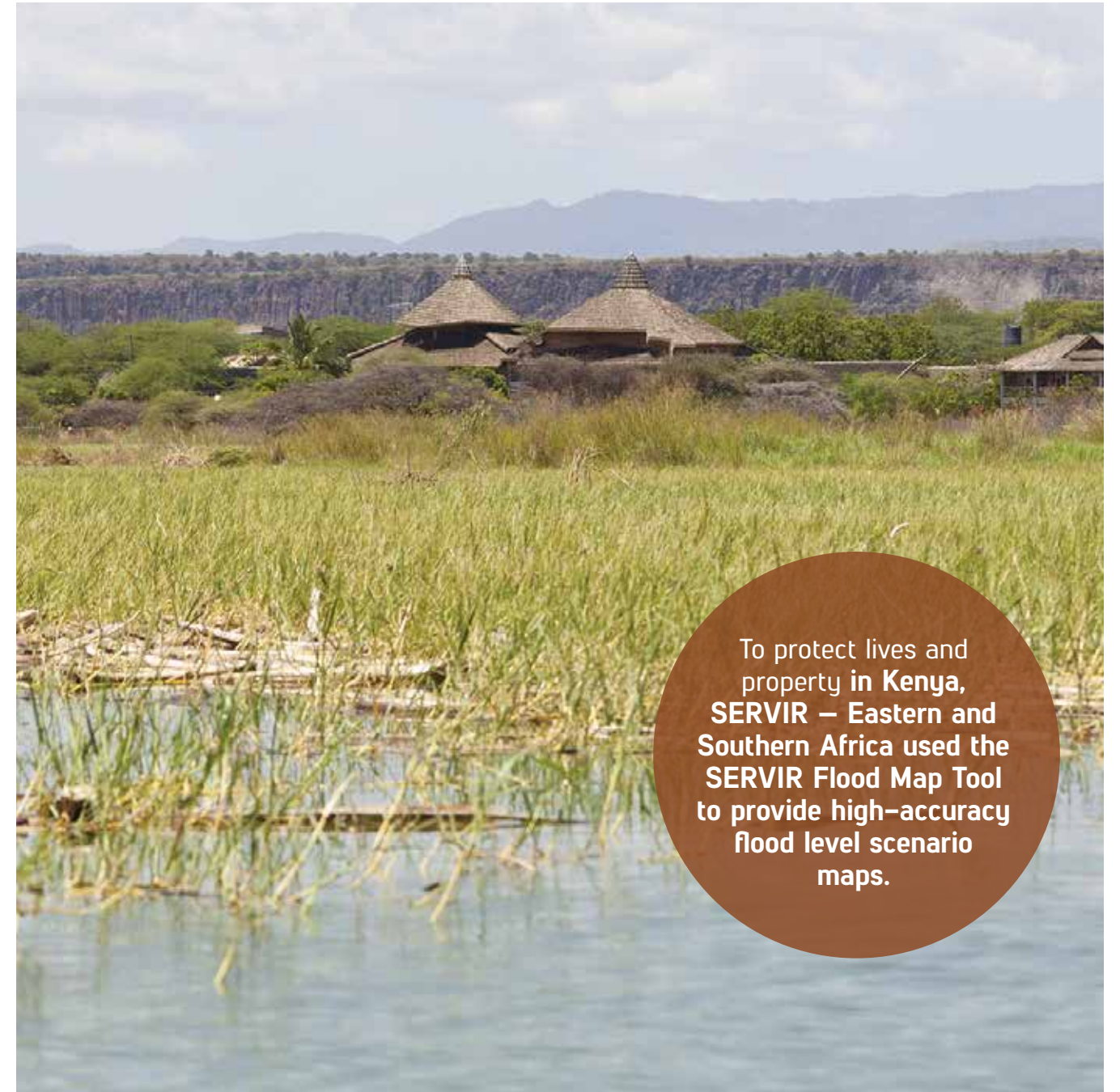
To protect lives and property in Kenya, SERVIR - Eastern and Southern Africa and RCMRD used the SERVIR Flood Map Tool to provide high-accuracy flood level scenario maps to the World Bank to guide their flood protection dike repairs.

The tool incorporates high-resolution elevation data from both NASA and commercial satellites to create a rating curve showing the relationship between streamflow and water elevation above the streambed. Based on this information, the World Bank's Water Security and Resilience Project provided financial assistance to design and implement repairs to the dikes where they were needed most, helping vulnerable populations better withstand future flooding.

"We used the [SERVIR] maps for watershed modeling to help guide repair and construction of flood prevention dikes in western Kenya."

Peter Muiruri, Technical Manager and Lead Engineer for the World Bank's Water Security and Resilience Project

To protect lives and property **in Kenya, SERVIR — Eastern and Southern Africa used the SERVIR Flood Map Tool to provide high-accuracy flood level scenario maps.**

Improving Flood Forecasting in Bangladesh

Bangladesh is home to over 160 million people. This densely populated country—barely larger than the state of New York—sits in the "sink" of the second largest river basin in the world, the Ganges–Brahmaputra–Meghna river basin.

These three rivers originate thousands of miles away in India, Nepal, China, and Bhutan and pass through Bangladesh to then drain into the Bay of Bengal. With heavy rains and snow melt from the Himalayas and rising sea levels, the rivers can swell to 20 times their normal widths. In some years, 75 percent of the country may be under floodwaters.

SERVIR and ICIMOD helped the Government of Bangladesh increase flood warning lead time from three to five days, to as many as eight days. For years, the Bangladesh Flood Forecasting and Warning Center (FFWC) has used ground-based stations to monitor river flow volume. However, with more than 90 percent of the drainage flows generated beyond Bangladesh's borders and lack of data sharing by upstream countries, it has been impossible to accurately predict the volume of water headed for Bangladesh. Based on available ground station data, the FFWC has only been able to issue flood forecasts up to five days in advance.

SERVIR trained FFWC personnel to use data from NASA's Jason-2 satellite, unconstrained by the "ground rules" of political boundaries, to track levels of the Ganges and Brahmaputra Rivers in the neighboring countries upstream of Bangladesh and produce daily eight-day flood forecasts of water levels for several water stations. FFWC can now compare satellite-informed early warnings with their existing operational system.

"The flood information helps almost 100 million people in our country."

A. Hossain of FFWC
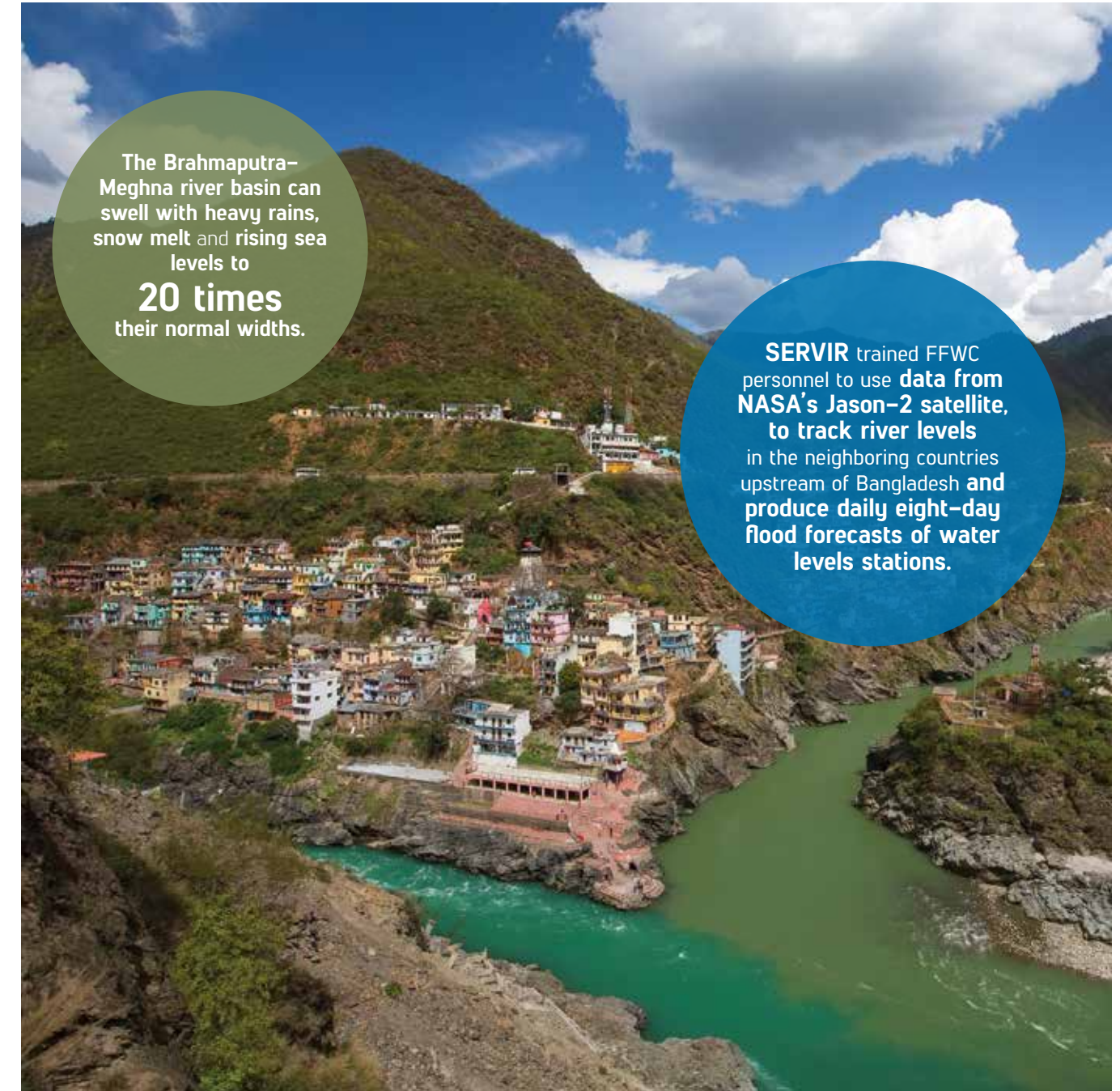
The Brahmaputra–Meghna river basin can swell with heavy rains, snow melt and rising sea levels to **20 times** their normal widths.

SERVIR trained FFWC personnel to use **data from NASA's Jason-2 satellite, to track river levels** in the neighboring countries upstream of Bangladesh **and produce daily eight-day flood forecasts of water levels stations.**

Protecting Farmers' Livelihoods Using Satellite Imagery

More than half of Kenya's nearly 50 million citizens work in the agricultural sector, underscoring the important role farming plays in Kenya's economy and individuals' livelihoods.

Despite the importance of agriculture, up until recently the Government of Kenya had been using outdated cropland maps (from 2000-2001) to conduct food security assessments. To help address this problem, in 2017, SERVIR – Eastern and Southern Africa and the Regional Center for Mapping of Resources for Development (RCMRD) worked with the Kenyan State Department of Agriculture to release updated cropland maps that were co-developed with USAID's Famine Early Warning Systems Network (FEWS NET) — a leading provider of early warning and analysis on food insecurity.

The completed cropland maps (or crop masks) provide information on the locations of the major and minor crops being grown, and if rain-fed or irrigation systems are being used. This information allows for rapid identification of changes in crop development, helping the Government of Kenya better plan where to deliver village-level food assistance during droughts, flooding, and other food security crises.

In addition, Kenya's State Department of Agriculture plans to use these crop masks in their recently established crop insurance program that provides payouts to farmers during incidences of crop failure. To support this initiative, SERVIR – Eastern and Southern Africa assisted the government in developing a methodology for determining harvest yield trends on a local level. This approach was successfully applied in Nakuru County and provided a significant cost savings – a reduction from US$10,000 to 3,000 (or 70%) – as the government can now make detailed assessments with updated satellite maps rather than counting individual farmers on the ground. The successful use of these crop masks has created a new demand to expand this methodology to 20 additional counties where the crop insurance program operates.

To ensure the long-term availability of updated crop masks, several technical training sessions have been offered to equip key stakeholders in the agricultural sector with the necessary skills for developing updated maps and computing image changes from different periods. After attending one of these sessions, Antony Ndubi, RCMRD's Remote Sensing Expert, observed that, "Participants can now use the technical knowledge gained and apply it directly to their agricultural field work."

The Government of Kenya continues to view agriculture as a priority for national economic development. More accurate, timely, and cost-effective crop masks will help the government meet this objective by improving food security assessments to better protect vulnerable communities and to ensure a strong agricultural sector.

SERVIR – Eastern and Southern Africa assisted the government in developing a methodology for determining harvest yield trends on a local level.

This approach was successfully applied in Nakuru County and provided a significant cost savings – a reduction from

$10,000 to $3,000

– as the government can now make detailed assessments with updated satellite maps rather than counting individual farmers on the ground.

Streamlining Access to Data for Food and Water Issues

In SERVIR hub regions, where long-term ground observations of rainfall are sparse, there is a critical need for satellite and model-derived rainfall data for predicting droughts, estimating crop yields, and more.

Decision makers need a way to accurately assess how severe a drought will be, how it compares to past droughts, and its potential effect on crop yields. It is important to place an evolving drier-than-normal season into historical context in order to analyze the severity of rainfall deficits. Until now, such analyses used rainfall data from ground observations at specific locations. However, that data fails to show the region-wide variability that reveals comprehensive rainfall patterns. To complicate matters further, internet connectivity challenges in developing countries make accessing large volumes of satellite imagery problematic.

Several high-quality global datasets exist that can help with these challenges, but analyzing these datasets, especially in areas with limited internet accessibility, is often impossible. SERVIR developed a tool called ClimateSERV that allows development practitioners, scientists, researchers, and government decision makers to easily analyze, visualize, and download historical rainfall data, vegetation condition data, and seasonal forecasts (180 days) of rainfall and temperature to improve understanding of conditions, and inform decision-making related to agriculture and water availability.

ClimateSERV gives anyone the ability to assess and monitor large-scale rainfall patterns and to analyze how those patterns may be affected by climate variability, determining the likelihood of drought, and tracking crop conditions.

SERVIR developed a tool called ClimateSERV that allows development practitioners, scientists, researchers, and government decision makers to visualize and download historical rainfall data, vegetation condition data, and 180-day forecasts of rainfall and temperature to quickly understand conditions related to agriculture and water availability.
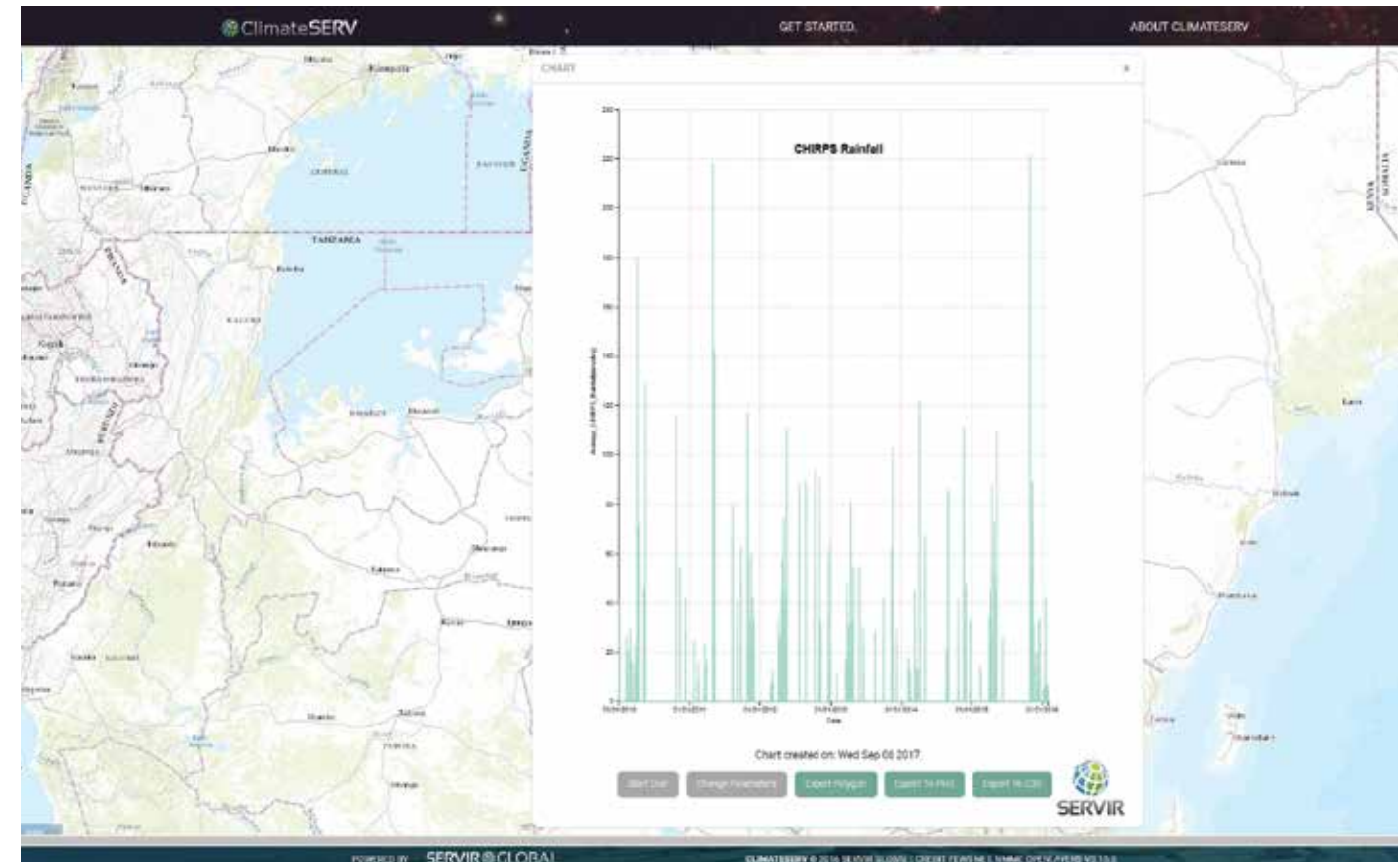
Satellites and Sensors

SERVIR Uses Data from 27 Satellites and Sensors

Satellites/Sensors	Application
ALOS (Japan) (PALSAR data)*	Vegetation structure
AltiKa (France, India)	Water and sea surface height
AMSR–E on Aqua* (NASA)	Soil moisture
Sentinel–1 and –2 (Europe)	Disaster response, vegetation
Terra–ASTER (NASA)	Vegetation properties, surface temperature and elevation
Digital Globe constellation** (USA)	High-resolution visible imagery
EO–1 30–m multi-spectral* (NASA)	Disaster response, vegetation change
GOES–16 (NOAA/NASA)	Atmosphere composition, cloud formation, air mass characteristics
GPM (NASA/Japan)	Precipitation
GRACE* (NASA/Germany)	Groundwater
ICESat (GLAS)* (NASA)	Land topography
Jason–2 and –3 (NASA/NOAA/France/Europe)	Water and sea surface height
LANDSAT 5*, 7, and 8 (NASA/USGS)	Vegetation properties, agriculture and land cover changes
Meteosat (Europe)	Atmospheric composition, cloud formation, air mass characteristics
QuikSCAT* (NASA)	Vegetation structure
Radarsat–2 (Canada)	Vegetation, surface water
SMOS (Europe)	Soil moisture and ocean salinity
SRTM (NASA)	Land topography
Terra and Aqua–MODIS	Land surface temp
TRMM* (NASA/Japan)	Precipitation
SMAP (NASA)	Soil moisture
VIIRS on Suomi–NPP (NASA/NOAA/DoD)	Land surface temperatures, vegetation, water resources, fire, light at night

* Satellite/sensor no longer producing data
** 5 Commercial Satellites in use through a unique data collection tasking agreement
Note: U.S.-affliated satellites and sensors are bolded

More information about these satellites and sensors can be found here: http://www.eohandbook.com/

Examples of SERVIR Tools Developed with NASA Satellites and Sensors

Using GPM to Simulate Floods

Tool: Flood Simulator for African Basins

Description: This application combines real-time satellite rainfall data with a hydrologic model with digital elevation maps and sends users an email alert with real-time and short-term forecast flood inundation maps of select stream-gauge locations.

Hub: SERVIR-Eastern and Southern Africa

Global Precipitation Measurement (GPM)
(NASA/Japan)

Using JASON–2 and –3 to Measure River Levels

Tool: Satellite-Based Visualization System for Water Resources in the Hindu Kush Himalayan Region

Description: This project progressively develops, calibrates, and validates a prototype satellite-based flood forecasting and visualization system for the Ganges, Indus, and Brahmaputra Rivers.

Hub: SERVIR–Hindu Kush Himalaya

Jason–2 and –3
(NASA/NOAA/France/Europe)

Using Landsat for Land Cover Monitoring

Tool: Regional Land Cover Monitoring System–Lower Mekong Region

Description: This system produces Landsat-based, high-quality regional land cover maps and identifies annual land cover changes for 2000–2015 in the Lower Mekong region.

Hub: SERVIR–Mekong

LANDSAT 5*, 7, and 8
(NASA/USGS)

Collaborations and Private Sector Partnerships

As the SERVIR network grows, developing new partnerships that tap into the expertise, resources, and innovations of a diverse array of organizations across the public, private, and nonprofit sectors will be critical to sustaining and strengthening our ability to bring cutting-edge solutions to our hub regions' development challenges. Below are a few highlights of SERVIR's key partnerships.

Google Earth Engine (GEE) curriculum training in Kathmandu, May 2017.

SilvaCarbon

Drawing on the strengths of multiple U.S. agencies and a global network of partners, the SilvaCarbon Program provides targeted technical assistance to build country capacities for measuring, monitoring, and managing forest and terrestrial carbon. SERVIR is collaborating with SilvaCarbon to strengthen the capacity of hubs on forest mapping and monitoring, including biomass estimation, by capitalizing on currently underutilized Earth observation resources, such as Synthetic Aperture Radar (SAR) datasets, (a type of radar that can "see" through clouds to gather data) in developing new products.

In addition, SERVIR is partnering with the U.S. Forest Service, Spatial Informatics Group, and the Food and Agriculture Organization (FAO) of the United Nations to jointly develop a free-and-open online version of Collect Earth (a tool that enables data collection through Google Earth Engine). Called

Collect Earth Online, it includes new features, capabilities, and functionality to collect ground validation data for improved land cover analysis. This new global tool, leveraging the SERVIR network, will assist Silva Carbon and the Global Forests Observation Initiative by adding value to existing platforms and supporting countries in reducing emissions from land use and land use change.

Esri

In 2016, through USAID, SERVIR and Esri – an international supplier of geographic information system software – entered into a partnership to provide hubs with lower-cost access to a wide range of Esri products and services, including software, educational resources, and technical support.

SERVIR hubs develop many of their products and tools through GIS processes and applications to meet the needs of their regional end users.

To be effective, these tools must be affordable, reliable and supported by a committed development and support staff. The hubs also need access to educational and reference materials that guide them on how to build solutions—or even help them discover previously built solutions that solve a similar problem. Finally, they need to collaborate with a broad community of peers that are using similar tools to solve problems. Through this partnership, SERVIR benefits from the latest geospatial software and practices.

Google Earth Engine

Tracking the Earth's rapidly changing landscapes efficiently and accurately is critical to protecting lives and livelihoods. Satellite technology provides a unique vantage point for observing our land, rivers, atmosphere, and many other elements of the environment. For decades, access to this technology for effective

decision-making has been a strenuous endeavor for scientists and development practitioners across the globe, requiring high processing computers, access to troves of images, and technical expertise in advanced algorithm development, all of which require significant financial and technical resources.

Now, through a unique partnership with Google, SERVIR - Mekong is changing this reality for scientists and development practitioners across the Lower Mekong region by leveraging Google's cloud-based, high computing

platform called Google Earth Engine (GEE). In partnership with the University of San Francisco, U.S. Forest Service, and SilvaCarbon, SERVIR - Mekong developed, tested, and delivered a GEE curriculum that served as the backbone for a regional training event for 38 scientists in Bangkok in July 2016. With three introductory courses completed, more than 100 scientists have been trained across the region, with a train-the-trainers approach aimed at promoting sustainability and continued capacity building.

At the SERVIR hubs, the curriculum has been reused and customized for additional national and regional level trainings in South and Southeast Asia, Eastern and Southern Africa, and West Africa. These trainings are empowering scientists with state-of-the-art skills that directly guide decision makers in their environmental management and sustainable development planning.

Global Exchanges

SERVIR's greatest asset is its people. Together, SERVIR's experts create a collaborative global network focused on some of the world's greatest challenges. Each year, the SERVIR network convenes multiple face-to-face exchanges. These exchanges play a pivotal role in strengthening the SERVIR community of practice by providing a venue for participants to share new ideas, methods, and lessons that can be implemented upon returning home.

Furthermore, exchanges help to create professional and personal contacts across the network so that all SERVIR members can see themselves as part of a larger global community. Exchanges are organized throughout the year covering a wide range of topics—from highly technical science-related themes to program management themes—based on the changing needs of the network.

SERVIR Annual Global Exchange (SAGE)

The SERVIR Annual Global Exchange (SAGE) is the program's premier event, drawing approximately 100 participants from around the globe representing SERVIR hubs; the SERVIR Science Coordination Office in Huntsville, Alabama; NASA HQ and USAID HQ in Washington, D.C.; and collaborating U.S.-based researchers, with members from across the United States. SAGE is designed to catalyze strong working relationships across the global network, support collaboration around work plans based on strong science, facilitate collective learning and exchange about improving program management, and foster practical approaches to ensuring the

Anastasia Wahome (Eastern and Southern Africa hub) provides comments during a session on best practices, SAGE, October 2016 in Pokhara, Nepal.

impact and sustainability of all SERVIR services and applications.

During this week-long gathering, attendees have the opportunity to share best practices and discuss current Earth observation-related technical innovations, as well as best practices for service design and delivery. To date, there have been three SERVIR annual global exchanges.

Geospatial Information Technology (GIT) Exchange

Organized through NASA's SERVIR Science Coordination Office, the week-long Geospatial Information Technology (GIT) exchange gathers representatives from the SERVIR hubs, NASA, USAID and experts from leading technology companies in the geospatial information field. The annual exchange is primarily a venue for sharing information and knowledge among the SERVIR network on Geospatial Information Technologies, and to promote collaboration in GIT matters across the network.

Past exchanges have featured presentations from technology companies such as Amazon, Digital Globe, Docker, Esri, Google, Hexagon Geospatial, Radiant, and Trimble about their recent innovations, which are extremely valuable for streamlining GIT operations and/or providing value added services. SERVIR partners with such organizations to raise awareness of new technologies, strengthen hub technical expertise,

GIT Exchange attendees gather for a group photo in Google's Android statue garden, March 2017

increase access to data, high-resolution imagery, and software, and provide additional training opportunities. During the exchanges, these experts make themselves available for face-to-face breakout sessions, interacting directly with SERVIR hub team members for more in-depth and meaningful conversations.

Conclusion

Moving forward, SERVIR will continue to build on the significant achievements of the past decade by increasing the use and impact of SERVIR tools and services, creating new connections across the network through training and workshops, forging new cooperative agreements with strategic partners, and focusing on sustainability at multiple levels.

The SERVIR network will expand its geographic reach in 2018 with the launch of a new hub in South America covering the Amazonia region. This exciting development will not only bring SERVIR tools and services to countries previously unserved by the program, but also tap into new regional knowledge that will benefit the entire network.

SERVIR's overarching goal is to improve environmental management and resilience in developing countries through the increased use of Earth observation information and geospatial technologies in decision-making. Four strategic goals guide the project through 2020:

Reach more users with demand-driven products and services:
Since its inception, SERVIR has reached thousands of users in 62 countries with more than 73 products, tools and services. There is now an excellent opportunity to reach even greater numbers through scaling-up existing products to reach more end users, and increasing awareness of SERVIR services among broader audiences through improved communications and outreach.

Connect more innovative and appropriate science to SERVIR:
SERVIR will apply new satellite data sources as they become available and engage with a greater variety of science and technology partners in the regions to take advantage of complementary research and analysis. This will be done through stronger linkages with regional programs, NASA-supported scientists and centers, plus providing access to a wider availability of free and open global data for the development of new products and services.

Expand SERVIR networks through new strategic partnerships:
While seeking to deepen existing partnerships, SERVIR will also pursue new strategic partnerships, particularly with non-governmental organizations, private sector, academia and scientific institutions. These connections will help complement, expand, and sustain SERVIR's reach and impact.

Improve sustainability of SERVIR at multiple levels:
Strengthening the sustainability of the SERVIR global network will be achieved through more active engagement with USAID Missions and global, regional, and bilateral programs to strengthen awareness and diversify support for the program. Hub-to-hub and global network exchanges will also be increased to sustain network relationships and facilitate knowledge and tool transfers to other regions with similar needs. Improving sustainability will also bring focus to the hubs' capacity needs, including science and technology, infrastructure, communication and learning, and management and financial resources.

With new tools in development, innovative partnerships, cutting-edge science and an expanding network of hubs, SERVIR looks forward to increasing the use of Earth observing data to help more people in developing countries adapt to a changing environment by *connecting space to village.*

With new tools in development, innovative partnerships, cutting-edge science, and an expanding network of hubs, SERVIR looks forward to increasing the use of Earth observing data to help more people in developing countries adapt to a changing environment by *connecting space to village.*

An employee of the DL Koisagat Tea Company waits to weigh freshly picked bags of tea leaf at a tea collection station in Nandi Hills, Kenya.

Contact Us

SERVIR Global
info@servirglobal.net
www.servirglobal.net

SERVIR – Eastern and Southern Africa
Regional Centre for Mapping of Resources for
Development (RCMRD)
P.O. Box 632-00618
Nairobi
Kenya
http://servir.rcmrd.org

SERVIR – Hindu Kush Himalaya
International Centre for Integrated Mountain
Development (ICIMOD)
G.P.O. Box 3226
Khumaltar, Lalitpur
Kathmandu
Nepal
http://servir.icimod.org

SERVIR – Mekong
Asian Disaster Preparedness Center (ADPC)
Head Office
SM Tower, 24th Floor, 979/69 Paholyothin Road,
Samsen Nai Phayathai
Bangkok 10400
Thailand
https://servir.adpc.net

SERVIR – West Africa
AGRHYMET Regional Centre
P.O. Box 11011
Niamey
Niger
http://www.agrhymet.ne/eng

SERVIR GLOBAL

CONNECTING SPACE TO VILLAGE

www.servirglobal.net

facebook.com/SERVIRGlobal   @SERVIRGlobal