Monitoring Forest Dynamics in Rwanda:

Using NASA Earth Observations to Monitor Long-Term Deforestation

and Reforestation Dynamics for Natural Resource Management

by

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Introduction:

SHOT – Forest pan

ADITI (VOICE OVER)
The Gishwati Reserve in northwestern
Rwanda, a montane rainforest

SHOT – Study Area

in the Albertine Ridge of Eastern Africa was

SHOT – Forest Pan

once a haven of rich biodiversity. In the past thirty
years, Gishwati has become a region

SHOT – Erosion

plagued by irreversible soil erosion, illegal poaching
activities, and social upheaval,

SHOT – Eucalyptus

leaving the rolling hills of the Gishwati
Forest devastated by change. The

SHOT – Deforestation

deforestation of the Gishwati is not just an
environmental problem. The survival of the communities
surrounding Gishwati is intimately tied

SHOT – People Farming

to the forests. Forests replenish the soils that
produce their food, their fuel, and the foundations
of their homes. The Gishwati Forest spanned an impressive

SHOT – Landsat 2 image of Gishwati

280 square kilometers in 1986

SHOT – Landsat 5 image of the Gishwati

Ten years later, only 6km remained.

SHOT – Misty Forest

What happened in that time? How can we better understand

SHOT - Forest panning

the destruction of this forest? And how can we help
reconstruct it?
…there is a "forest of hope"…

Policies:

SHOT – Subsistence Farming

TALIA (VOICE OVER)

Thanks to recent efforts, the formidable
task of Gishwati's reforestation is underway.

SHOT - Small Committee and Senate

Progressive environmental policies are emerging
at the forefront the national agenda in the past decade.

SHOT – Policy Initiatives list

Initiatives such as Vision 2020, the Economic
Development and Poverty Reduction Strategy,
and the National Forestry Policy are demonstrating
the importance of this issue on a national scale.

SHOT – Agriculture

Despite the many initiatives and apparent progress,
current estimates of forest cover as a

SHOT – Bare Mountain Landscape

percentage of Rwanda's total area are inconsistent.
We need a better way to monitor the
environmental changes: and that's where we come in.

Project Focus:

SHOT – Deforested Misty Region

FAITH (VOICE OVER)

The lack of research done in the area helped us
define the focus of our work: we wanted to
determine the exact extent of the forest over time,

SHOT – Deforested Mountain

analyze the successes of past initiatives and
find a way to assist research efforts in
the future. DEVELOP partnered with the

SHOT – Still of Rwandan students with Embassy Officials at HQ

Rwandan Embassy to assemble a
team with Rwandan students in order to

SHOT – Charles Bolden with Joshua Abe

provide further insight on
the country's environmental state.

SHOT – Mike Ruiz with Embassy officials

We used NASA Earth Observing Systems, or

SHOT – Flyover on International Space Station

NASA EOS. EOS provides long-term observations of the earth's surface.

SHOT – Landsat, MODIS, and AHVRR

With the information found from EOS, we were able to add a particularly innovative component into our project.

Dr. Ross:

SHOT – Pan – Team in a meeting with Dr. Ross

ANDREW (VOICE OVER)

We have had the privilege of working with a science advisor, Dr. Kenton Ross. Through several meetings, he has provided us with understanding of prevalent concepts and innovative ideas that shaped our methodology.

NDVI:

SHOT – Medium Shot – In an interview

DR. ROSS

The Normalized Difference Vegetation Index is a numerical recipe for teasing out information regarding plant vigor. It uses red light to monitor the process of photosynthesis and it uses near infrared light to take a look at plant structure even down at the cellular level.

Methodology:

SHOT – Flash video created by Kevin

KEVIN (VOICE OVER)

This project posed a challenging remote sensing question because cloud cover, which blankets Rwanda for much of the year, made it very difficult to get reliable data. To work around the clouds, we used MODIS NDVI tiles from 2000 to present day, and calculated the maximum NDVI value for each pixel on an annual basis. Because clouds are colder than the Earth's surface, utilizing the max NDVI value affectively eliminates contamination due to cloud cover. We then applied this methodology to an NDVI dataset derived from the AVHRR sensor, which dates back to the early 1980s to better understand the historical context of Gishwati. Our first priority in developing this methodology was to create a monitoring tool that could be used by our end-users, assuming they had little to no experience in remote sensing. We scripted everything using Python, creating a tool that is transferrable to other studies, but is especially applicable in the tropics because of persistent cloud cover.

Results:

SHOT – Forest panning

QUINTEN (VOICE OVER)

These analysis tools have allowed us to compile a history of forest cover

SHOT – Agriculture in a field

dynamics in the Gishwati. The mean NDVI

SHOT – Image of Mean NDVI graph

pixel value across the Gishwati according to
AVHRR data noticeably declined across later
part of the 20th century. A particularly sharp decrease
in vegetation can be seen right around the peak of conflict in 1994.

SHOT – MODIS NDVI from 2001-2005 and 2006-2011

However, MODIS NDVI maps show that the
remnant forest is clearly strengthening.
Clearly, the modern conservation efforts are
having significant impact on the fragile Gishwati Forest.

Conclusion:

SHOT – Tea Plantations

ADITI (VOICE OVER)

Empowered with our innovative monitoring tools, NGOs, students,

SHOT – Agriculture

professionals, and governments alike possess
the information to rebuild Rwanda's degraded forests

SHOT – Forest Panning

in a sustainable and effective manner. The ability
to monitor the rehabilitation of the Gishwati
Reserve and other threatened
forests around the globe instills in us the

SHOT – Dancing Rwandans

importance of remote sensing technology
for our modern society. The efforts of the
Rwanda Ecological Forecasting Team have lent
invaluable knowledge and renewed
hope for the future of our environment.